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SUMMARY

The use of cone beam computed tomography in endodontics

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ABSTRACT
Since the adequacy of radiography for dental use, it has been the most widely used imaging test in endodontics. Useful in all stages of treatment, this imaging test allows us to evaluate the tooth and important adjacent anatomical structures. Because it is a two-dimensional examination of three-dimensional structures, it has considerable limitations, such as distortions, noise, and artifact projections. Cone Beam Computed Tomography has the advantage of being a high-resolution three-dimensional examination and allows the evaluation of structures in various planes without overlapping or distortions.

Keywords: Endodontics, Cone Beam Computed Tomography, Volumetric Tomography, Periapical Radiography.

1 INTRODUCTION

1.1 HISTORY OF CBCT IN ENDODONTICS

In 1899 Kells revolutionized dentistry and especially endodontics, after in an experiment he was able to detect a conductive wire inside a canal through a radiogram, allowing the endodontic working length to be established. (LANGLAND, LANGLAIS, 1995). Since then, radiography has been a fundamental tool in endodontics. (SCARFE et al. 2009). Even today, this type of imaging remains the main imaging base in this specialty.). However, in recent decades, modern medical imaging techniques have also been used in several areas of dentistry. (DURACK, PATEL, 2012).

Since the first efforts by pioneers trying to apply conventional computed tomography and microtomography in endodontics, the introduction of Cone Beam Computed Tomography (CBCT) in

1996 resulted in the first three-dimensional imaging tool for endodontic purposes. (FARMAN, LEVATO, SCARFE, 2007) After the approval in 2000 by the Food and Drugs Administration (FDA), dentists were able to use the advantages of 3D CBCT in relation to conventional radiography, which can be considered a revolution in dentoalveolar imaging, with a radiation dose similar to conventional intraoral imaging methods, including whole-mouth and panoramic radiographs. (TYNDALL, RATHORE, 2008, LUDLOW et al., 2006)

The use of Cone Beam Computed Tomography in dentistry has increased exponentially since its introduction. CT scanners have become smaller and cheaper. CT units allow you to adjust scan settings, such as Field of View (FOV) adjustment, Voxel size (resolution), and scan time. In the software, it is possible to work with the scanned images in multi-planes, allowing the dentist to evaluate areas of interest for dentoalveolar alterations, root fractures, tumors, prosthetic evaluation, orthodontic-orthognathic planning and implant planning. (ABRAMOVITCH K, RICE D, 2014).

1.2 STUDIES ON THE USE OF CBCT IN ENDODONTICS

The X-ray examination is useful in all phases of endodontics, from the diagnosis of odontogenic and non-dental pathologies, to the treatment of the Root Canal System (SCR) in infected teeth, during chemical mechanical preparation, filling and preservation of the tooth. (SCARFE et al., 2009). Periapical radiographs during endodontic procedures are the most commonly used imaging methods. They provide useful information on the presence and location of periradicular lesions, canal anatomy, and proximity to important adjacent structures. Even with all these uses, radiographs have limitations, such as the overlapping of structures (because it is a two-dimensional examination) and results in the compression of three-dimensional structures, geometric distortions (elongation and shortening) and anatomical noise. (PATEL et al., 2009).

When a 3D scan is required, CBCT is considered the gold standard. (FARMAN, 2006). Although it originates from conventional medical CT, it differs in many aspects that make it even more suitable for dental use. (DURACK, PATEL, 2012). In the late 1990s, two independent groups of Italians and Japanese developed a new tomographic scanner known as the volumetric digital tomograph, specifically for dental and maxillofacial use. Offering a lower dose of radiation, this three-dimensional examination has been implemented in oral and maxillofacial surgeries, implant dentistry, endodontics, orthodontics, periodontics, and temporomandibular dysfunction. (PATEL et al., 2007).

CBCT has a conical X-ray beam that captures a cylindrical or spherical volume of data, described as a field of view. A volume of 3D data is acquired in a single shot of the scan, using a direct and simple connection of the radiation emitter and the sensor that rotates 180º-360º around the patient's head. (PATEL et al., 2007). During the examination, hundreds of planar projections are obtained from the field of view (FOV). In this way, this exam presents accuracy and immediate 3D images. Only one

rotating sensor sequence is required to acquire sufficient data for image reconstruction, since the exposure encompasses the entire FOV. (FARMAN, 2007). Each image projection consists of up to 512^2 pixels. The 3D reconstructed data will include 512^3 pixels, or voxels. (DURACK, PATEL, 2012). You can increase the number of pixels per image projection from 512^2 to 1024^2, which also increases the resolution. However, this generates a two- or three-fold increase in radiation. (SCARFE, FARMAN, 2008). CBCT uses simpler and cheaper hardware than conventional CT scanners. (COTTON et al., 2007). This has resulted in an increase in use in dental practice. (ARNHEITER, SCARFE, FARMAN, 2006). In this way, it is an exam that allows to significantly change the diagnosis and management of endodontic problems, since the dentist can easily work in the software to evaluate the areas of interest in any plan. (PATEL, 2009).

Cone beam CT scans are typically classified by volume and field of view (FOV) dimensions. This will be chosen appropriately based on the patient's pathology and region of interest to be examined. According to the availability or height of the volume to be scanned, the size of these can be classified into: Small field (< 5cm), Single arch (FOV 5-7cm), Interarch (7-10cm), Maxillofacial (10-15cm) and Craniofacial (> 15cm). (SCARFE et al., 2009). In general, the smaller the scanned volume, the higher the resolution. Ideally, in endodontics, the resolution should not exceed the mean width of the periodontal ligament (200 µm), considering that the most recent signs of periapical alterations are discontinuity of the lamina dura and splurge of the periodontal ligament. (TYNDALL, RATHORE, 2008). However, more modern CT scanners with 76 µm voxels have higher resolution and allow a better diagnosis of cracks, fractures and root canal localization, and generate a lower radiation dose. (DURACK, PATEL, 2012).

Considering the radiation emitted by cone beam CT scanners, the exposure is converted to an effective dose that is measured in Sieverts (Sv), for a meaningful comparison of radioactive risk. The Sv is a large unit, so in maxillofacial CT milliSieverts (MSv)[10-3] or microSieverts µSv[10-6] are used. The effective radiation dose for specific regions is measured and adjusted for the volume of tissues in the FOV. (SCARFE et al., 2009). For the posterior jaws, the scans generate 9.8 µSv, while for the posterior mandibulars, 38.3 µSv, and in the anterior region it generates 4. µSv. (OSER et al., 2017).

Cone beam tomography overcomes the limitations of conventional radiography by producing three-dimensional images that allow a better evaluation of the anatomy and spatial relationship of pathology and anatomical structures. (PATEL, KANAGASINGAM, MANNOCCI, 2010). The clinician can choose and view volumetric data in all orthogonal and non-orthogonal planes, so anatomical noise is easily eliminated. (SCARFE, FARMAN, 2008). The voxels of this examination, unlike conventional CT scans, are isotropic (they have the same physical properties in all directions), ensuring that the images produced are accurate, in any plane and free of distortions. (SCARFE, FARMAN, SUKOVIC, 2006).

In general, the main advantages of CBCT over conventional CBCT are the lower radiation dose and superior image quality over hard tissues. Since the X-ray beam is pulsatile, the patient is exposed to radiation for a short period of time (2 to 5 seconds) compared to the examination time of the panoramic X-ray, which is useful since the probability of the patient moving the head becomes lower. In addition, this type of examination is much cheaper than conventional CT. (PATEL, 2009). Perhaps the most advantageous feature of CBCT is that images can be reconstructed three-dimensionally in 3 orthogonal planes (axial, sagittal, and coronal). (SCARFE et al., 2009).

Regarding the limitations of CBCT, its spatial resolution and contrast resolution are lower than those of conventional analog or digital intraoral radiographs. (FARMAN, FARMAN, 2005). Radiographic artifacts are another problem. When the x-ray beam collides with a very high-density object, such as enamel or metal restorations, low-energy photons from the beam are absorbed by the structure. This produces two types of artifacts that can impair diagnostic imaging: distortion of metal structures, called rarefaction artifacts, and the presence of dark stripes and bands between two dense structures. (SCARFE, FARMAN, 2008).

Despite the few limitations of CBCT, it is extremely useful in endodontics, in more complex cases or cases in which conventional radiographic examination is limited, being extremely useful in the detection of apical periodontitis, planning for surgical endodontics, evaluation for endodontic retreatment in complex cases, evaluation of dento-alveolar trauma, diagnosis of different types of root resorption, evaluation of the anatomy and morphology of the canal, diagnosis of vertical root fractures, among others (SCARFE, FARMAN, SUKOVIC, 2006) and a more current use, is the planning of guided access for coronary opening and localization of atresial or partially calcified canals. After the cone beam tomographic examination, the images are examined, the canal is located, and an access direction to it is established. This information is sent to another software that plans a surgical access guide, which is made by a 3D printer. With the positioning of this guide in the mouth, a special milling cutter is used for the coronary opening and location of the root canal, allowing the endodontic treatment itself to be performed. (KRASTL et al., 2016).

In a study conducted by MICHETTI et al., (2010), to evaluate the accuracy of CBCT, in which the examinations of extracted teeth were reconstituted in 2 dimensions, it was concluded that this examination was very reliable and accurate when compared to the analysis under an optical microscope of the histological sections of the same teeth.

In a study conducted by USTUN et al.,(2016), 73 single-rooted teeth underwent a CBCT examination and subsequently underwent root canal treatment. The images of the examination were evaluated and the teeth in question were measured by means of tomography. During the endodontic procedure, odontometry was performed by two different electronic apical locators (Propex Pixi –

Dentstply and Raypex 6-VDW) and it was concluded that the measurements obtained by the CT scans were as accurate as those performed by the locators.

4 The definitive diagnosis of vertical root fractures in endodontically treated teeth is challenging. According to TAMSE et al. (1999), the clinical symptoms and radiographic signs are not completely pathognomonic, although PITTS, NATKIN, (1983), consider the double paths and fistulas in pouches on the opposite side of the root to be very characteristic of this type of complication. The prognosis of vertical root fractures is poor. In a study in which endodontically treated teeth were preserved for 5 years, root fracture was the adverse event in 32.1% and the treatment of choice was the extraction of the element. (CHEN, CHUEH, 2008).

BASSAM et al. (2009) conducted a study with the main objective of evaluating the accuracy of CBCT compared to digital periapical radiographs in the detection of vertical fractures in teeth with filled and unfilled roots. The second objective was to evaluate the influence of gutta percha on the detection of fractures through these examinations and periapical radiographs. According to the results, the tomographic scans were more accurate than the periapical ones in detecting vertical root fractures, but the presence of filling material inside the canal generated artifacts, impairing their diagnosis.

The proximity of the roots of the maxillary posterior teeth to the floor of the maxillary sinus may be associated with the development of chronic sinusitis. (MEHRA, MURAD, 2004). In a study conducted by LIMA et al.,(2017), 83 patients were selected and submitted to clinical examination to evaluate tooth mobility and pulp condition. In addition, a CT scan was performed to evaluate the presence of periapical lesion and bone loss and to measure the distance from the root apex to the cortical maxillary sinus. The results associated chronic sinusitis with patients with periodontal disease and/or endodontic infection near the maxillary sinus, demonstrating the usefulness of CBCT to aid in the diagnosis of chronic sinusitis of odontogenic origin.

External cervical resorption (CER) is difficult to diagnose and plan treatment even for specialists. Although its exact etiology remains unknown, it is believed to be associated with orthodontics, trauma, occlusal dysfunction, periodontal treatment, and endogenous whitening. (PATEL, KANAGASINGAM, PITT, 2009). This pathological change usually occurs asymptomatically and in 3 stages: initial, active resorption, and reparative stage. (MAVRIDOU et al., 2016). In a study conducted by GOODELL, MINES, KERSTEN, (2017), 30 teeth with WHtR were evaluated. All resorption teeth were diagnosed by CBCT scan, and 29 of the cases were detected by panoramic radiography. This only undiagnosed case was due to the lesion being located on the lingual surface of the tooth, overlapping the bone tissue. The authors concluded that both imaging studies were effective in diagnosing resorptive pathologies, however, because they presented more details, tomography allowed a better treatment plan, as it accurately showed the extent and location of the resorptions.

Radiographic examinations are essential in all stages of endodontic treatment. Along with the absence of signs and symptoms, success is also assessed by comparing baseline and follow-up radiographs. The evaluation of the appearance of periapical tissues on radiography is influenced by the overlapping of anatomical structures and the variable nature of the density and texture of the bone trabeculate. (GELFAND, SUNDERMAN, GOLDMAN, 1983). In a study in which 200 teeth were evaluated and submitted to cone beam tomography, periapical radiography and endodontically tested (through cold sensitivity tests and electrical tests), it was noted that the periodontal ligament (PL) was thicker in CBCT than in periapical radiography, because this is a more sensitive examination. The results also showed that on CT scanning, most of the vital teeth showed some degree of LP spacing. (POPE, SATHORN, PETERS, 2013).

One of the difficulties in identifying fractured instruments in filled canals using CBCT compared to periapical radiography is the production of artifacts in image reconstruction, due to the absorption of radiation due to the structural density of the metals. (NEVES et al., 2014). In a study conducted by ROSEN et al.,(2016) in which 60 teeth were divided into 2 groups (30 with fractured instruments and 30 without them), it was concluded that periapical radiography is more effective in detecting fractured instruments in the apical third of filled teeth than CBCT, as it does not generate artifacts.

One of the factors that influence the success of endodontic treatment is the anatomical knowledge of the root canal system. (BAISDEN, KULILD, WELLER, 1992). Due to the difficulty of conventional radiography methods to evaluate root canals, computed tomography has been very useful. In a study conducted by CAPUTO et al., (2016), in which 342 mandibular first molars were evaluated tomographically in order to analyze their anatomy. The results showed that 0.3% of the molars had 2 canals, 75.1% had 3 canals, 23.7% of the sample had 4 canals and 0.9% of the molars had 5 canals. It was concluded that this imaging test was very effective for the study of the morphology of the root canals.

The use of CBCT in endodontics has increased significantly and is now suggested by both the American Association of Endodontists and the American Academy of Oral and Maxillofacial Radiology as the test of choice for the treatment of complex morphological root canals, calcified root canals, apecectomy, resorptions, trauma, and non-surgical retreatments. (AMERICAN ASSOCIATION OF ENDODONTISTS, 2015).

Surgical endodontic treatment should be considered when other, more conservative treatments have not been successful. Endodontic surgery evolved into microsurgery. (KIM, KRATCHMAN, 2006). Before the surgical procedure, it is essential that the surgeon is familiar with the anatomical structures as well as their dimensions, thickness of the buccal and lingual bone, dimensions and inclinations of the roots and especially location of nerves and sinuses. Radiographic examination is

commonly used for surgical planning. CBCT is one of the diagnostic tools that can help to obtain accurate measurements of the surgical field, as it does not present distortions when compared to conventional radiographs. (SIMONTON, AZEVEDO, SCHINDLER, 2009). In a study conducted by LAVANASI et al. (2016), 155 cone beam CT scans were used to evaluate the measurements of 505 teeth and their adjacent areas. Through these examinations, it was possible to accurately measure the buccal and lingual bone width and the distance between the apices and the floor of the maxillary sinus. It was possible to conclude that this three-dimensional examination is a superior complementary tool in surgical endodontic planning than conventional radiographs.

Endodontic treatment failures result from incomplete debridement and filling because of the variable anatomical composition of the SCR, including apical branches and morphological variations. (SONG et al., 2011). In a study conducted by SOUSA et al., to evaluate the presence of lateral canals before and after endodontic treatment using CBCT, it was concluded that CBCT was not an effective and accurate test for the detection of lateral canals.

Many endodontic treatments fail in maxillary molars due to the forgetting of the second MV canal. (SHAH et al., 2014). The MV2 canal hole may be present in up to 95% of maxillary molars, but it is not always found. (KULILD, PETERS, 1990). Additional tools such as CBCT may be required to locate these channels. In a study conducted by STUDEBAKER et al., (2017), information, radiographs, and CT scans of 886 maxillary molars were evaluated. In 74.1% of the cases, MV2 was located during access. In 14.2% of cases, MV2 was located with the aid of drills and ultrasonic tips. In 11.7% of cases, these canals were located only with the aid of three-dimensional examination. The results showed that the CT scan was useful for the detection of these channels in many of the cases and that the MV2 channel occurred in 55.8% of the cases.

The central and lateral mandibular incisors usually have only 1 canal. VERTUCCI (1974) described the complex system of canals and identified 8 different configurations. He found that 70 percent of the central incisors and 75 percent of the mandibular lateral incisors had only one canal and one foramen. In a study conducted by SHEMESH et al., (2017), a total of 1472 central and 1508 lateral were evaluated by CBCT. The results showed that the incidence of more than 1 canal in the central and mandibular lateral incisors was approximately 40%. Once again, CBCT proved useful for diagnosing pulp morphology and for identifying extra canals and roots.

The success of endodontic treatment is variable. 60-100% of cases demonstrate cure during preservation. (NG et al., 2007). Therefore, when this preservation is performed through CBCT, a lower initial cure percentage is demonstrated, as this is a more sensitive examination when compared to conventional radiographs. (PATEL et al., 2012) In a study conducted by DAVIES et al., (2015), single periapical radiographs, periapical radiographs using the Clark technique, and CT scans of 100 teeth indicated for endodontic treatment were evaluated. The number of periapical lesions and roots

identified through CT scans was significantly higher than in periapical radiographic scans, demonstrating the superiority of three-dimensional scans in this aspect over two-dimensional scans.

1.3 IMPORTANT CONSIDERATIONS ABOUT CBCT IN ENDODONTICS

This chapter reports the beginning of the use of imaging exams in dentistry. Radiography, developed from 1893 onwards, continues to be the most widely used imaging test in endodontics. (LANGLAND, LANGLAIS, 1995). Because it is a two-dimensional test, it has many limitations. With the introduction of CBCT in 1996, many of these limitations in relation to conventional radiographs were overcome through a three-dimensional, high-resolution examination that allows the dentist to evaluate, through a software, the images obtained from the teeth and important adjacent structures, in multi-planes, without distortions and without anatomical noises. allowing the diagnosis of periradicular pathologies, localization and planning of guided access in calcified canals, detection of root fractures, planning for complex endodontic treatments. (SCARFE, FARMAN, SUKOVIC, 2006; KRASTL, 2016).

CBCT also has its limitations and disadvantages, such as availability, cost, exposure to ionizing radiation, and projection of artifacts onto the image (when in the presence of high-density objects). (SCARFE, FARMAN, 2008).

In the studies evaluated, cone beam computed tomography was useful for almost all purposes. MICHETTI et al. (2010) confirmed the accuracy of tomographic images compared to histological sections of teeth visualized under a microscope.

USTUN et al., (2016) demonstrated the same efficacy of CBCT in performing odontometry compared to apical locators.

BASSAM et al., (2009) concluded that CBCT was more effective in detecting vertical root fractures compared to conventional radiographs.

LIMA et al.,(2017) stated that CBCT is an effective test for the association of chronic sinusitis with odontogenic infections in teeth close to the maxillary sinus.

In several studies, it has been possible to prove the efficacy of CBCT for the evaluation of dental morphology and important adjacent structures. (POPE, SATHORN, PETERS, 2013); (CAPUTO et al., 2016); (LAVANASI et al., 2016); (STUDEBAKER et al., 2017); (SHEMESH et al., 2017); (DAVIES et al., 2015)

In a study conducted by GOODELL, MINES, KERSTEN, (2017), both CBCT and panoramic radiography were effective for the diagnosis of WHtR.

However, in a study conducted by ROSEN et al.,(2016), it was concluded that CBCT is not an effective test for the detection of fractured instruments in the cervical third of filled teeth, due to the characteristic of projecting artifacts.

In view of all the uses of CBCT, it has been shown to be extremely effective, even in more complex treatments. However, the higher effective dose of ionizing radiation compared to conventional two-dimensional radiographs is not justified in all cases.

2 FINAL THOUGHTS

Endodontics presents difficulties even for the most experienced specialists. Cone Beam Computed Tomography has proven to be an excellent complementary tool in many situations in aiding diagnosis and planning of more complex endodontic treatments. In developed countries, it is already widely used as a first choice in many cases. CBCT was not developed to replace conventional radiographic methods, but to complement them.

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Evaluation of the periapical condition of endodontically treated teeth by cone beam computed tomography

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ABSTRACT

Cone Beam Computed Tomography has become an important part of endodontic practice as it allows the visualization and manipulation of three-dimensional images. The present study aimed to evaluate the periapical condition of endodontically treated teeth through the analysis of computed tomography scans. This is a retrospective cross-sectional study in which 707 teeth were analyzed. The different dental groups, the presence of an intraradicular retainer, coronary restoration, root fracture, and root resorption, as well as the apical and lateral limits of the filling and the quality of the filling, were evaluated. The data were tabulated and then statistically treated through descriptive analyses and associations. The Kolmogorov-Smirnov and chi-square tests were used, and the significance level was 95% ($p \leq 0.05$). Of the total number of teeth analyzed, the maxillary incisors were the most prevalent (27.7%), followed by the maxillary premolars (18.8%) and the mandibular molars (15.1%). Significant associations were observed between the presence of alterations in the periapex and the apical limit ($p=0.001$), the lateral limit of the filling ($p=0.000$), the quality of the filling ($p=0.030$) and the presence of root resorption (0.000). It is concluded that unsatisfactory filling of root canals is a relevant factor for the presence of periapical diseases.

Keywords: Root Canal Filling, Cone Beam Computed Tomography, Endodontics, Periapical Periodontitis.

1 INTRODUCTION

Endodontic treatment aims to clean, disinfect and seal all root canals and their ramifications (Ørstavik, 1998) to prevent the formation of apical periodontitis or to create conditions for its reversal (Eriksen, 1991). Periapical radiolucency, characterized by bone resorption, is a consequence of inflammation around the root canal endings in response to a bacterial infection (Gomes et al., 2018), and is considered one of the criteria to determine the success of endodontic treatment (Alfouzan et al., 2016; Sarıyılmaz et al., 2016; Nascimento et al., 2018). Pulp and periapical diagnosis, residual pulp infection, apical limit of filling, complications during the procedure, and the presence and quality of the restoration are some of the factors that influence the success of endodontic treatment (Chugal et al., 2003). In addition, the filling of lateral canals (Yamaguchi et al., 2018), the presence of untreated canals (Hoen & Pink, 2002; Costa et al., 2019) and the homogeneity of the filling (Asgary et al., 2010) are some of the variables that are related to the success of the treatment performed.

Cone beam computed tomography (CBCT) has been widely used in the field of Endodontics for clinical planning, diagnosis of pathologies and follow-up of cases after procedures. The great advantage of this examination is that it allows the visualization of the oral cavity and its structures in a three-dimensional aspect instead of the two-dimensional aspect common to conventional radiographs (Beacham et al., 2018). In addition, it is a tool of great diagnostic value, especially in cases of failure of the endodontic treatment where there is a need to investigate possible causes. Due to its three-dimensional imaging configuration, it is easier to visualize root canal anatomy, identify root canals, and diagnose and manage root resorption (Patel et al., 2015).

Given the ability of CBCT to analyze the periapical condition and endodontic treatment, this study aimed to evaluate the periapical condition of endodontically treated teeth through the analysis of computed tomography scans.

2 MATERIAL AND METHODS

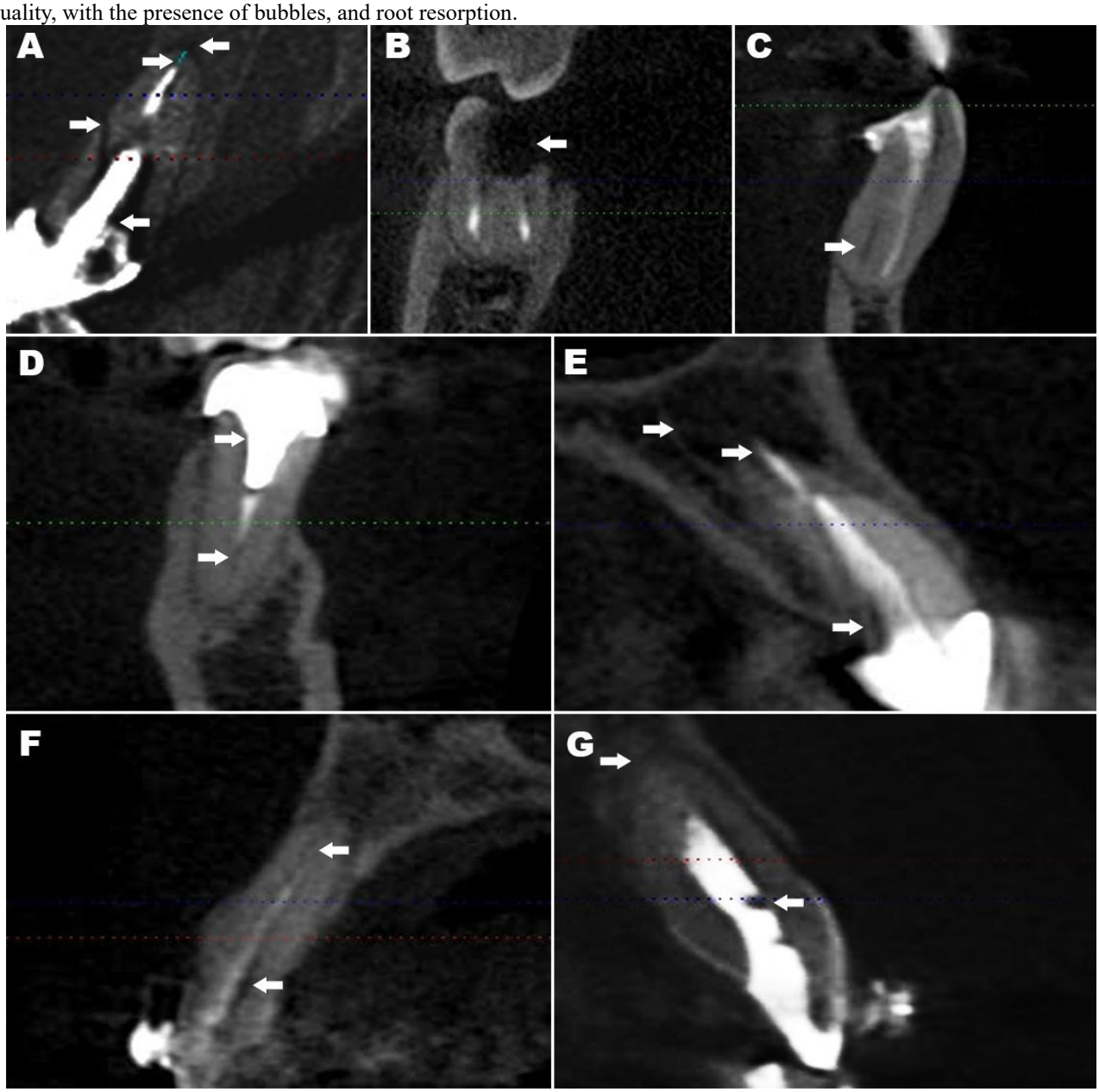
This retrospective cross-sectional study included the analysis of 707 teeth from CBCT exams filed at the Imaging Laboratory of the School of Dentistry of the Federal University of Paraná (LABIM-UFPR), dated from November 2014 to September 2018. The CT scans were performed to plan dental procedures, complementary diagnosis of dental and oral pathologies, implant placement, and surgical and endodontic treatments. The tomographic images were performed using the i-Cat (Imaging SciencesvInternational, Hatfield, PA) tomograph operated at 120kV and 7mA. All images were performed according to the protocol determined by the equipment manufacturer. The present study was approved by the Research Ethics Committee of the Health Sciences Sector of the Federal University of Paraná (Protocol no. 2,362,156).

Thei-CAT software (3.1.62, i-CAT Xoran Technologies, Ann Arbor, MI) was used for image analysis and a thickness of 0.25 mm was defined as standard for the observation of the CT scans. The images were analyzed in axial, sagittal and coronal sections. The contrast and brightness of the images have been adjusted with the aid of the software's image processing tool to ensure optimal viewing.

The inclusion criteria for the study were: CBCT images of endodontically treated permanent teeth with well-processed images, with no problems in the acquisition and visualization of the sections. The exclusion criteria established for the analysis of CT scans were: CT scans that contained artifacts that made it impossible to analyze the tooth.

The CT scans were analyzed by two trained examiners and previously calibrated (kappa 0.8). Information related to endodontic treatment, coronary restorations, periapical conditions, and root integrity was collected. The appropriate apical limit of filling was established as one at which the filling-apex distance was between 0 and 2 mm, and inadequate in case of subfillings greater than 2 mm (Sjögren et al., 1990; Farzaneh et al., 2004; Heling et al., 2001; İlgüy et al., 2013; Lee et al., 2012; Liang, Li, Wesselink, Wu 2011; Peak et al., 2001; Ridell et al., 2006; Smith, Setchell, Harty, 1993; Tani-Ishii, Teranaka, 2003), overfillings or untreated root canals. In the case of the lateral limit of filling, it was considered inadequate when it was greater or much lower than the proportion of one third of the width of the root evaluated, or even in the case of untreated root canals. As for the quality of the filling, it was considered inadequate when it was not homogeneous, with empty spaces between the filling and the prepared canal, or porosities within the obturator mass and also in untreated canals (Venskutonis et al., 2015). For the periapical condition, roots with periapical or lateral radiolucency or increased periodontal ligament space with thickening between 0.5 and 1 mm in at least one of the cutting planes were considered to have an altered periapex (Estrela et al., 2008). In patients with more than one root canal, the root canal with the worst condition was used for analysis (Venskutonis et al., 2015). Coronary restorations, intraradicular retainers, root resorptions, and tooth fractures were classified as present or absent (Figure 1).

Figure 1. (A) Presence of root retainer, root fracture, and thickening of the root periapex. Filling with apical limit of 0.90 mm, considered adequate. (B) Tooth with absence of coronary restoration. (C) Canine with the presence of two root canals and absence of lingual canal fillings. (D) Tooth with presence of intraradicular retainer and inadequate apical limit (subfilling). (E) Tooth with presence of intraradicular retainer, inadequate apical limit (overfilling), and presence of periapical lesion. (F) Tooth with inadequate apical (underfilling) and lateral limits. (G) Tooth with inadequate filling quality, with the presence of bubbles, and root resorption.



The data were tabulated using the SPSS® 17.0 software and then statistically treated using descriptive analyses of distribution and frequencies and associations. The Kolmogorov-Smirnov test was applied to verify the normality of the data and the chi-square test was used to analyze the associations. A significance level of 95% ($p \leq 0.05$) was adopted to interpret the results.

3 RESULTS

A total of 707 teeth from 280 CT scans were analyzed. The mean age of the patients evaluated was 49.36 years (median 52 years), 68.9% were female, and 31.1% were male. Table 1 presents the descriptive data of the study.

Of the teeth evaluated, 34.1% were maxillary anterior, 33.1% maxillary posterior, 27.6% mandibular posterior, and 5.2% mandibular anterior, with a higher prevalence for incisors between maxillary teeth (n=196) and molars between mandibular teeth (n=107).

Regarding the periapical condition, 62.5% of the teeth had an altered periapical condition, while 37.5% had a healthy periapical condition. Regarding the apical limit of filling, 67.9% of the teeth were adequate, and 32.1% were inadequate.

Table 1. Descriptive analysis of the data evaluated.

Variable	***N***	***%***
Sex		
Male	87	31,1
Female	193	68,9
Dental group		
Maxillary anterior	241	34,1
Maxillary posterior	234	33,1
Mandibular anterior	37	5,2
Mandibular posteiror	195	27,6
Apical limit of filling		
Adequate	480	67,9
Inadequate	227	32,1
Lateral Shutter Limit		
Adequate	528	74,7
Inadequate	179	25,3
Fill quality		
Proper	551	77,9
Inadequate	156	22,1
Periapical condition		
Healthy	265	37,5
Sick	442	62,5
Intraradicular retainer		
Present	231	32,7
Absent	476	67,3
Coronary restoration		
Present	658	93,1
Absent	49	6,9
Root resorption		
Present	106	15,0
Absent	601	85,0
Tooth fracture		
Present	13	1,8
Absent	694	98,2

The analysis of the association between the variables studied (Table 2) showed that there is no significant association between the presence of changes in the periapex and the different dental groups (maxillary teeth p=0.522; mandibular teeth p=0.525), presence of intraradicular retainers (p=0.305),

coronary restoration (0.400) and cases of root fracture (0.424). On the other hand, significant associations were observed between changes in the periapex and the apical limit of the filling (p=0.001), lateral limit of the filling (p=0.000), quality of the filling (p=0.030) and presence of root resorption.

Table 2. Association between the independent variables and the presence of alterations in the periapex.

Variable	Healthy n (%)	Sick n (%)	P Value*	Confidence interval
Dental group				
Maxillary anterior	89 (12.6)	152 (21.5)	0.522	1.004 (0.835-1.206)
Maxillary posterior	86 (12.2)	148 (20.9)		0.996 (0.824-1.204)
Mandibular anterior	14 (1.98)	76 (10.7)	0.525	0.960 (0.522-1.767)
Mandibular posterior	23 (3.25)	119 (16.9)		1.008 (0.899-1.130)
Apical limit of the filling			0.001	
Adequate	199 (75.1)	281 (63.6)		0.684 (0.536-0.872)
Inadequate	66 (24.9)	161 (36.4)		1.181 (1.070-1.304)
Lateral limit of the filling			0.000	
Adequate	217 (81.9)	311 (70.4)		0.611 (0.456-0.820)
Inadequate	48 (18.1)	131 (29.6)		1.164 (1.071-1.264)
Quality of the filling			0.030	
Adequate	217 (81.9)	334 (75.6)		1.084 (1.003-1.171)
Inadequate	48 (18.1)	108 (24.4)		0.741 (0547-1.005)
Intraradicular retainer			0.305	
Present	83 (31.3)	148 (33.5)		0.935 (0.750-1.167)
Absent	182 (68.7)	294 (66.5)		1.033 (0.930-1.147)
Coronary restoration			0.400	
Present	248 (93.6)	410 (92.8)		1.009 (0.968-1.051)
Absent	17 (6.4)	32 (7.2)		0.886 (0.502-1564)
Root resorption			0.000	
Present	24 (9.1)	82 (18.6)		1.117 (1.053-1.184)
Absent	241 (90.9)	360 (81.4)		0.488 (0.318-0.749)
Root fracture			0.424	
Present	4 (1.5)	9 (2.0)		0.741 (0.231-2.383)
Absent	261 (98.5)	433 (98)		1.005 (0.985-1.026)

* Chi-square test

4 DISCUSSION

Cone-beam computed tomography has high diagnostic accuracy in detecting changes in periapical bone tissue (Patel et al., 2010). The present study demonstrated that the presence of periapicopathy was associated with the apical limit of the filling, the lateral limit of the filling, the quality of the filling, and the presence of root resorption.

The apical limit is one of the major concerns regarding the treatment of the root canal system (Michelle et al., 2005). When there is an overinstrumentation, in other words, the radiographic apex is exceeded, the pulp stump and the periapical tissues are affected, resulting in tissue aggression (Holland et al., 1979) and, consequently, the tissue repair in this region is slowed down by the inflammatory process (Star et al., 2014). Thus, the literature suggests that the instrumentation and filling of the root canal system should be limited to the apex (Kojima et al., 2004; Swartz et al., 1983; Michelle et al., 2005). In addition, there is evidence that, in cases of overfilling, tissue repair of the periapical region after treatment may be delayed (Star et al., 2014).

On the other hand, when there is pulp necrosis, microorganisms and their by-products can persist in the most apical region of the canal, which promotes local inflammation and hinders tissue healing (Nair, 2006). These persistent inflammatory disorders of the periradicular tissues, caused by persistent microbial infection within the root canal system, are the etiology of apical periodontitis(Kakehashi*et al.*1965,1976 Sundqvist). Therefore, in relation to the apical extension of the filling, several studies in the literature show that the best results occur when the chemical-mechanical preparation and the filling of the root canal system are between 0-2 mm below the radiographic root apex (Gomes et al., 2015; Azim et al., 2016; Van der Veken et al., 2017; Nascimento et al., 2018; Kojima et al., 2004; Schaeffer et al., 2005). Some results show that there are up to 4.68 times more chances of finding a healthy periapex when the apical extension of the filling respects these limits, compared to cases of overfilling (Gomes et al., 2015).

Other important aspects are those involved with the three-dimensional filling of root canals: the lateral limit and the quality of the filling. When there is no adequate filling of the canal and, therefore, bacterial dissemination, an inflammatory process is installed, hindering apical healing (Nair, 2006) or causing apical periodontitis (Kakehashi*et al.*1965,1976 Sundqvist). Voids in the filling material provide residual bacteria with an ideal environment for the growth and transport of toxins to the periapex (Fernandez et al (2017). Therefore, eliminating voids that may harbour microorganisms during cleaning and enlarging/shaping, combined with the optimal lateral boundary and fill density, is essential for antimicrobial control (Estrela et al., 2014).

The association between root resorption and apical periodontitis was expected. Its occurrence is due to cementum resorption associated with the periradicular inflammatory response to bacteria or bacterial products that come out of the apical or lateral foramen. When the apical dentin is exposed,

the dentin tubules may allow bacteria and their products to have another established pathway to come into contact with the inflamed periradicular tissues, perpetuating inflammation and leading to ongoing resorption of dentin and cementum (Huang et al., 2019; Ricucci et al., 2014; Delzangles, 1988).

In addition to the quality of the endodontic treatment, studies have shown that coronary restoration in endodontically treated teeth is also associated with the periapical conditions (Cakici et al., 2016; Van der Veken et al., 2017; Vengerfeldt et al., 2017; Gambarini et al., 2018). Aa in vitro study suggested that unsatisfactory coronary restoration generates exposure of the root canal filling to microorganisms and their products, with reinfection of the root canal system in a relatively short period (Craveiro et al., 2015).

CBCT is superior to intraoral radiographs when it comes to detecting periapical lesions (Davies et al., 2015; Weissman et al., 2015; Sakhdari et al, 2016; Kanagasingam et al., 2017; Torabinejad et al., 2018; Ramis-Alario et al., 2019). When comparing the methods of simple periapical radiography, parallax radiographs, and CBCT, the prevalence of periapical lesions found in endodontically treated teeth was 41%, 38%, and 68%, respectively (Davies et al., 2015). When diagnosing a periapical region as healthy using two-dimensional radiography, there is a 56-61% chance that periapical disease is present (Kanagasingam et al., 2017). The present study showed that 62.5% of the periapex had alterations. This high rate corroborates studies that found prevalences of 51% to 78% (Davies et al., 2015; Gomes et al., 2015; Lemagner et al., 2015), in which the accuracy of cone beam CT scans was evidenced in showing apical periodontitis in early stages, such as increased periodontal ligament spaces and radiolucencies of smaller diameters.

Despite the high diagnostic accuracy of CBCT for most of the conditions evaluated, it is known that it is not indicated to evaluate the quality of dental restorations due to the high density of the filling material, and clinical and radiographic evaluations are more indicated for this purpose (Gomes et al., 2015; Nascimento et al., 2018). In addition, the non-association between fracture and periapical changes can be explained by the low number of teeth diagnosed with root fracture. CBCT has a lower sensitivity for detecting root fractures in the presence of radiopaque materials and metallic artefacts such as intraradicular retainers, as they can obscure the fracture line (Abdinian et al., 2016; Rabelo et al., 2017).

As this is a retrospective cross-sectional study, the question remains whether the periapical condition of the studied teeth is in the process of repair or progression, since the imaging exam provides static information on these dynamic processes.

5 CONCLUSION

It is concluded that unsatisfactory filling of root canals is a relevant factor for the presence of periapicopathies.

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The importance of interpreting complementary laboratory tests in the dental routine: A brief review

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ABSTRACT
In the context of the dental outpatient clinic, especially during surgical and invasive procedures involving the topical application of anesthesia, it is essential to carry out previous complementary and laboratory tests to assess the patient's general health status before the intervention. These tests play a crucial role in the early diagnosis of systemic diseases and in the follow-up of these conditions, aiming to control them to avoid interference with dental treatment. This study highlights the importance of several complementary exams in dental practice, offering clear and objective guidelines to the dentist on the interpretation of results, the appropriate request for exams, and the appropriate management of the patient.

Keywords: Laboratory Tests and Diagnostics, Hematological Tests, Dentistry.

1 INTRODUCTION

Laboratory tests and clinical anamnesis are fundamental tools for the diagnosis and follow-up of pathologies (Leite *et al*., 2016). In the dental context, complementary laboratory tests play a crucial role in daily clinical practice, especially in the prior assessment of the global health status of patients undergoing interventions such as oral surgeries, dental implant placement, biopsies, and bone grafts, thus providing a safer surgical approach (Monteiro *et al*., 2022).

However, it is imperative that the Dental Surgeon be trained to indicate and interpret such exams in order to prevent postoperative complications, such as drug interactions, infections and inflammations (Netto *et al*., 2009). In this context, the present study aims to develop a guide for Dentists, aiming to assist them in requesting and interpreting the results of the exams, elucidating the relevance and meaning of the changes observed, in addition to addressing their implications in surgical and invasive dental procedures.

2 COMPLEMENTARY LABORATORY TESTS

2.1 HAEMATOLOGICAL EXAMINATIONS

2.1.1 CBC

The blood count is an analysis that comprises the differentiation between the white and red series, involving the white and red blood cell count, the measurement of hemoglobin, the determination of the globular value, the leukocyte count and the platelet count. In dentistry, its primary application occurs when clinical signs and symptoms suggest a possible dysfunction or alteration in the blood system, such as anemia, viral, bacterial and fungal infections, inflammation, changes in wound healing, variations in platelet count, presence of tumors and manifestations such as pallor, weakness, fatigue, drowsiness and tiredness (Tonani; Ferreira, 2001).

The blood count is categorized into red series, comprising erythrogram, hematometry, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, red blood cells, hemoglobin, hematocrit, erythrocyte sedimentation, and white series, which includes data on leukocytometry, neutrophils, basophils, eosinophils, monocytes, and lymphocytes, in addition to the platelet that categorizes the amount of platelets.

2.1.1.1 Red Series

2.1.1.1.1 Erythrogram

Evaluation of the cells responsible for transporting oxygen in the body (red blood cells, called erythrocytes or red blood cells). The hematological profile of these cells is determined by erythrocyte count, hemoglobin quantification, hematocrit measurement, and morphological analyses (Failace; Fernandes, 2015).

2.1.1.1.2 Hematometry

The measurement of red blood cells in relation to total blood volume is known as a red blood cell count. The reference value for this count is approximately 4,500,000/ml for women and 5,000,000/ml for men (Tonani; Ferreira, 2001).

2.1.1.1.3 Mean Corpuscular Volume (MCV)

The MCV represents an index that quantifies the size of red blood cells. Red blood cells with MCV less than 80 are classified as microcytic, while values greater than 95 indicate macrocytosis. Normocytic red blood cells have a MCV within the range considered normal.

Generally speaking, variations in the size of red blood cells are described as anisocytosis. When there is a decrease in MCV, it may be associated with anemia, either due to iron deficiency or genetic

origin. On the other hand, elevated MCV is associated with certain types of anemia, alcoholism, or bone marrow changes (Naoum; Naoum, 2008; Tonani; Ferreira, 2001).

2.1.1.1.4 Mean Corpuscular Hemoglobin

It represents the actual proportion of hemoglobin in existence, with normal values ranging from 27 to 32. These values help in diagnosing the type of anemia, whether hyperchromic, normochromic, or hypochromic. Changes in hemoglobin levels may indicate conditions such as iron deficiency anemia, high alcohol consumption, thyroid dysfunction, vitamin B12 and folic acid deficiency (Tonani; Ferreira, 2001).

2.1.1.1.5 Mean Corpuscular Hemoglobin Concentration (HCMH)

It is the determination of hemoglobin concentration by erythrocyte. High values are suggestive of alcoholism or pathologies associated with the thyroid gland. HCCM concentrations below 30% indicate hypochromia, characterized by lower red blood cell staining compared to the normal pattern, resulting from a subnormal hemoglobin concentration. This condition can be attributed to disorders such as anemia, heart failure, or hypothyroidism (Failace; Fernandes, 2015; Tonani; Ferreira, 2001).

2.1.1.1.6 Erythrocytes

Red blood cells, also called red blood cells or erythrocytes, are the blood cells responsible for transporting oxygen in the body. Its reference values are between 4.2 and 5.9 million cells per microlitre (µL). A decrease in the concentration of these cells may indicate the presence of hemorrhage, anemia due to nutritional deficiency, or hemolysis. On the other hand, a concentration above the reference values suggests the possibility of polycythemia, respiratory failure, dehydration, or sepsis (Tonani; Ferreira, 2001).

2.1.1.1.7 Hemoglobin

The function of hemoglobin is to carry out the transport of oxygen. Its normal values are: between 11 to 17g/100ml. The evaluation of this substance is crucial in patients undergoing oral surgery, since anemic individuals face risks of complications during surgical procedures. The reduction in hemoglobin levels may result in anoxia during anesthesia administration, hindering healing due to decreased oxygen circulation in the tissues (Tonani; Ferreira, 2001).

2.1.1.1.8 Haematocrit

It is the percentage of volume occupied by red blood cells or red blood cells in the total volume of blood. Average values range from 42 to 45ml/%. When hematocrit values are low, a decrease in the

concentration of red blood cells in the blood is suggested, indicating possible clinical conditions such as anemia, excessive blood loss, kidney disease, iron deficiency, protein deficiency, or sepsis. On the other hand, an increase in hematocrit levels can be interpreted as a sign of dehydration, burns, or shock. Variations in hematocrit values may discourage the use of surgical procedures (Failace; Fernandes, 2015).

2.1.1.1.9 Wemossedimentation

It is the rate of sedimentation of erythrocytes used as a marker of inflammatory response. It has little clinical significance and the data generated are not specific (Tonani; Ferreira, 2001).

2.1.1.2 White Series

2.1.1.2.1 Leukocytometry

The white series refers to the total count and analysis of leukocytes, the defense cells present in 1 ml of blood, with a mean reference value between 4,000 and 10,000/mm³ (Malta *et al.*, 2019). These defense cells include neutrophils, eosinophils, basophils, rods, monocytes, and lymphocytes.

The evaluation of the white series is crucial to examine the responsiveness of the patient's body to viral, fungal and bacterial infections, as well as to inflammatory processes (Failace; Fernandes, 2015). The reduction in the count may indicate leukopenia, which is associated with medications such as immunosuppressants, post-irradiation chemotherapy, and chronic diseases. On the other hand, the elevation is called leukocytosis, and can be caused by leukemia and acute infections (Malta *et al.*, 2019).

2.1.1.2.2 Neutrophils

Neutrophils constitute the first line of immune defense, accounting for approximately 55% to 70% of total leukocytes. Its primary function consists of phagocytosis of microorganisms, directing themselves to foci of infection (Tonani; Ferreira, 2001). Reference values range from 3% to 5% (relative percentage) to 150 to 500/mm³ (absolute amount) for rod neutrophils, as well as from 55% to 65% (relative percentage) to 3,000 to 5,000/mm³ for segmented neutrophils. The reduction in the number of neutrophils is called neutropenia, and may indicate vitamin B12 deficiency, sickle cell anemia, mononucleosis, flu, among other conditions. On the other hand, elevation above normal (neutrophilia) suggests acute infections, postoperative infections, inflammation, among others. The importance of observing the left shift of neutrophils, associated with an unfavorable prognosis due to the presence of myelocytes and metamyelocytes in peripheral blood, is highlighted (Malta *et al.*, 2019).

2.1.1.2.3 Basophils

Basophils have a low blood concentration and are associated with the synthesis of histamine. The reference interval for its presence in the blood is between 0% and 1% (Tonani; Ferreira, 2001). A reduced count may suggest immune deficiency, pregnancy, hyperthyroidism, or adverse drug reactions. On the other hand, an increase in concentration may be indicative of myeloid leukemia, allergies, chronic inflammation, chickenpox, Hodgkin's disease, among other conditions (Malta *et al*., 2019).

2.1.1.2.4 Eosinophils

Eosinophils are crucial defensive cells in the fight against parasitic infections. Its benchmarks fluctuate between 2% and 4%. The addition of these cells is called eosinophilia, while their reduction is called eosinopia. The increase in eosinophil levels may suggest the occurrence of allergic processes, worm infestations, pernicious anemia, among others (Tonani; Ferreira, 2001).

2.1.1.2.5 Monocytes

Monocytes play a crucial role in the elimination and control of infections, actively participating in the removal of necrotic tissues and in the defense against tumor cells and foreign agents. The increase in its amount is called monocytosis, and may be associated with conditions such as bacterial infections, monocytic leukemia, protozoal infections, among others. On the other hand, the reduction in the concentration of these cells is called monocytopenia, and is related to factors such as malnutrition, aplastic anemia, and Gaucher's disease (a disease characterized by lipid storage) (Malta *et al*., 2019; Tonani; Ferreira, 2001).

Monocytes, when located in tissues beyond the bloodstream, are activated and differentiated into macrophages, representing 3 to 10% of the total defense cells (Lorenzi, 2006).

2.1.1.2.6 Lymphocytes

Lymphocytes represent 25% to 30% of the total peripheral blood cells, constituting the second most prevalent type in the immune defense line. They play a crucial role in the immediate response against cancer cells and infections, especially those of a viral nature. Some subpopulations of lymphocytes are responsible for the production of antibodies and actively participate in immunological memory processes, conferring protection against recurrent infections by the same pathogen.

The increase in lymphocyte count, known as lymphocytosis, can be triggered by acute viral infections (such as the flu), chronic viral infections (such as syphilis), lymphosarcoma, among other causes. On the other hand, the reduction in the amount of lymphocytes, called lymphopenia, can be associated with conditions such as malnutrition, AIDS, advanced stage of Hodgkin's disease, among

other etiologies (Malta et al., 2019; Lorenzi, 2006; Tonani; Ferreira, 2001). The reference values for lymphocytes are between 1,400 and 4,300 mm^3.

2.1.1.2.7 Platelet Count

It is the study of platelet counts, and they are very important in the coagulation process and control of hemorrhages, an important factor of hemostasis (Tonani; Ferreira, 2001). In the occurrence of a vascular lesion, platelets migrate to the affected site. At the end of this complex process, a thrombus is formed, stopping the hemorrhage. Normal platelet levels range from 150,000 to 450,000 per microliter (µL) (Lorenzi, 2006). However, up to values close to 50,000, there are no difficulties in initiating coagulation.

In situations where the platelet count is below 10,000/µL, there is an imminent risk of death due to the possibility of spontaneous bleeding. This condition is called thrombocytopenia. On the other hand, when the values exceed the upper limit, it is characterized as thrombocytosis. Assessment of platelet count is crucial pre-surgically to determine the patient's risk of bleeding. In addition, it is essential in the investigation of patients with hemorrhagic conditions or frequent ecchymosis (purple spots on the skin) (Failace; Fernandes, 2015).

2.1.2 Coagulogram

The coagulogram is essential in the evaluation of the patient's coagulation factors, verifying their ability to achieve adequate hemostasis during surgical procedures. It is recommended that these tests be performed as part of the preoperative evaluation of the patient. Among the tests that make up the coagulogram are bleeding time, coagulation time, prothrombin time, activated partial thromboplastin time, thrombin time and the international normalised ratio (Franco, 2001; Tonani; Ferreira, 2001).

2.1.2.1 Bleeding Time (TS)

It is the time it takes to stop bleeding no more than 4mm deep. The normal parameters of this indicator are between 2 to 8 minutes. An increase in TS may indicate thrombocytopenic purpura, especially in cases of infectious states. This parameter is associated with vascular problems and platelet count (Tonani; Ferreira, 2001).

2.1.2.2 Clotting Time (CT)

CT scans allow you to evaluate clotting factors, it is the time for blood to clot outside the blood vessels. Normal values can vary between 5 to 10 minutes. (Franco, 2001).

2.1.2.3 Prothrombin Time (TP)

The PT represents the interval necessary for the formation of the fibrin clot, being activated by the extrinsic coagulation mechanism. Normal values are between 10 and 12 seconds (Tonani; Ferreira, 2001). PT is an assessment of coagulation factors II, V, VII, and X (Franco, 2001). Elevations in values may suggest fibrinogen and prothrombin deficiency, as well as deficiencies in extrinsic coagulation factors, liver deficiency, or lack of vitamin K. On the other hand, values below normal may indicate administration of multivitamins, use of oral contraceptives, and hormone replacement therapy (Franco, 2001).

2.1.2.4 Activated Partial Thromboplastin Time (ATT)

The ATTT analyzes the intrinsic and common pathway of the coagulation cascade, and they are more sensitive to coagulation factors VIII and IX.

2.1.2.5 Thrombin Time (TT)

The test is done by analyzing the time of transformation of fibrinogen into fibrin. Its normal time is between 15-18 minutes (Tonani; Ferreira, 2001).

2.1.2.6 *International Normalised Ratio* (INR)

The INR (International Normalized Index) test is used to evaluate blood coagulation, and is intended for the detection of disorders in this process, for therapeutic follow-up with anticoagulants, such as warfarin, and for the analysis of hemorrhagic risk and liver function (Araújo; Domingues; Van Bellen, 2014). In healthy individuals, normal INR values are between 0.8 and 1.0. However, in patients treated with anticoagulants, there is a tendency towards higher values, usually oscillating between 2.0 and 3.0.

2.1.3 Hepatogram and Tests for Kidney Disease

The hepatogram plays an indispensable role in the analysis of hepatic, renal and bile duct functions. It is an assessment of paramount importance for the dentist, particularly in the context of certain drug prescriptions that have the potential to affect the activities of these vital organs, and may exacerbate existing deficiencies. These tests are of great relevance in the preoperative evaluation of the patient, since liver deficiencies can influence coagulation factors, hindering homeostasis and tissue healing.

2.1.3.1 Oxalecetic Transaminase (TGO) or Aspartate Aminotransferase (AST) and Pyruvic Transaminase (TGP) or Alanine Aminotransferase (ALT).

The enzyme oxaloacetic transaminase (GOT), produced predominantly in the liver, is also found in other organs, such as the heart, kidneys, muscles, and brain. Pyruvic transaminase (TGP), in turn, is mostly synthesized in the liver, and abnormal values indicate, for the most part, liver disorders or deficiencies. Elevations of these enzymes may be suggestive of liver cell damage, infections, tumors, liver diseases, among other conditions (Leite *et al*., 2016). The reference values for GOT are between 5 and 40 U/L, while for GOT, they range from 7 to 56 U/L (*American Gastroenterological Association,* 2002).

2.1.3.2 GT Range

The enzyme gamma glutamyl transferase, known as gamma GT, is synthesized predominantly in the liver and can also be detected in the pancreas and heart. The quantitative evaluation of this enzyme provides the analysis of hepatic, bile duct and pancreatic activities (Leite *et al.,* 2016). High GT gamma values can suggest several conditions, such as excessive alcohol consumption, liver cirrhosis, liver dysfunction, and pancreatitis, among others. The reference ranges established are as follows: for females, 8 to 41 U/L, and for males, 12 to 73 U/L (*American Gastroenterological Association, 2002).*

2.1.3.3 Bilirubin

Bilirubin, a product of blood filtering by the liver, is normally excreted in the feces and urine. Elevated bilirubin in the blood indicates abnormality. There are two forms: indirect bilirubin, associated with blood disorders such as pernicious anemia, hemolytic anemia and hemoglobinopathy, and direct bilirubin, whose increase is linked to factors such as excessive alcohol consumption, hepatitis, biliary obstruction, liver tumors, among others. Reference values are < 1.2 mg/dL (< 20 micromol/L) (*American Gastroenterological Association*, 2002).

2.1.3.4 Serum Creatine

Creatinine analysis is essential for the assessment of renal function. This test quantifies the blood glomerular filtration rate (GFR) and is used to assess renal function and determine the appropriate dosage of drugs excreted by the kidneys. The reference parameters are between 0.60 and 1.2 mg/dL for women, and 0.70 and 1.3 mg/dL for men (Inker; Schmid; Tighiouart, 2012).

2.1.3.5 Urea

Urea, which originates from the catabolism of proteins ingested by the patient as a food source, is synthesized by the liver and subsequently secreted into the bloodstream. The kidney, in turn, performs the filtration responsible for the excretion of urea in the urine. High concentrations of urea in plasma may signal liver and kidney dysfunction such as kidney failure and dehydration. Reference parameters for blood urea levels are in the range of 20 to 50 mg/dL (Small; Bawega; Burrows, 2021).

2.1.4 Tests for Diabetes Mellitus

Diabetes mellitus is characterized by dysfunction in insulin secretion and varying degrees of peripheral insulin resistance, resulting in hyperglycemia. There are two main types: type 1, marked by the absence of insulin production due to autoimmune destruction of beta cells in the pancreatic islets; and type 2, characterized by insulin resistance (*American Diabetes Association*, 2022). For diagnosis and monitoring, it is recommended to perform Fasting Glucose and Glycated Hemoglobin (HbA1C) tests (Holt; Devries; Hess-Fischl, 2021).

2.1.4.1 Fasting Blood Glucose

To perform this test, a fast of 8 to 12 hours is required. The range considered normal is 70 to 99 mg/dl. Values between 100 mg/dL and 125 mg/dL indicate altered fasting glucose or prediabetes, while equal to or greater than 126 mg/dL may suggest diabetes (*American Diabetes Association*, 2022).

2.1.4.2 Glycated Hemoglobin (HbA1C)

Glycated hemoglobin, or HbA1c, is a blood test that evaluates the average blood glucose over the last 90 to 120 days. HbA1C is a form of hemoglobin that is chemically bound to a sugar, reflecting increased blood glucose. It is not necessary to be fasting for collection, and the reference values are: Normal = 4.5 to 5.6%, Prediabetes or risk of diabetes mellitus = 5.7 to 6.4%, Diabetes mellitus = ≥ 6.5% (*American Diabetes Association*, 2022).

2.2 SEROLOGICAL TESTS

2.2.1 HIV

When HIV infection is suspected, screening tests are performed that include HIV antibodies and antigens, such as p24 antigen. Positive results for the p24 antigen may emerge two weeks after the initial infection. In case of positivity, tests are performed to detect HIV-1 and HIV-2, as well as a test to quantify HIV RNA in the blood. HIV-1 is more pandemic, fast-moving, and infectious, while HIV-2 is endemic, slower, and less infectious (*The American Foundation for AIDS Research,* 2023). To monitor infection and perform safe dental procedures, CD4 count and viral load tests may be ordered.

Low CD4 counts increase vulnerability to serious infections due to immunosuppression. With effective treatment, the viral load decreases, and the CD4 count recovers (Buttò *et al*., 2010).

2.2.2 Syphilis

Syphilis, a sexually transmitted infection caused by *Treponema pallidum*, can present oral lesions, requiring proper management by the dental surgeon for diagnosis. VDRL (*Venereal Disease Research Laboratory*) and FTA-ABS (Fluorescent Antitreponemal Antibody Absorption Test) are used for diagnosis (Rotta, 2005). VDRL, which is simpler and more common, can be positive between 2 and 6 weeks after contamination, but carries a risk of false-positive results. The more specific treponemal tests have a shorter immunological window, and can be positive 7 to 10 days after the first lesions. FTA-ABS, once positive, remains positive even after the patient is cured. Currently, the VDRL is used for screening, and the FTA-ABS for confirmation after a positive result in the first test (Avelleira; Bottino, 2006).

2.2.3 HBSAG Exam

Hepatitis B virus (HBsAG) surface antigen testing diagnoses hepatitis B, a serious viral infection in the liver. The result is positive reactive and non-negative (Ferreira, 2000).

2.2.4 Testing For Hepatitis C (ANTI-HCV)

The Anti-HCV test is performed to detect antibodies against the hepatitis C virus, a viral liver infection that can lead to serious complications. Reference values are either non-reactive (negative) or reactive (positive) (Strauss, 2001).

3 FINAL CONSIDERATIONS

Complementary laboratory tests represent indispensable allies in the daily practice of dentistry, playing crucial roles in diagnostic processes, clinical interpretations and detailed patient evaluations. They are invaluable resources, playing a key role in treatment planning and postoperative management.

Acknowledging the magnitude of the contribution of these procedures is essential to understanding the true evolution of contemporary dental practice. By deepening our understanding of the intricate details provided by laboratory tests, we not only enrich our diagnostic process, but also pave the way for the implementation of more effective and, above all, personalized treatment strategies.

In an increasingly complex clinical landscape, the effective integration of laboratory data not only improves diagnostic accuracy, but also guides more informed therapeutic choices. This recognition of the interconnectedness between laboratory science and everyday clinical practice drives

excellence in the dental approach, providing practitioners with the ability to translate advanced scientific knowledge into meaningful clinical interventions.

Therefore, we emphasize the continuous importance of investing in an in-depth understanding of complementary laboratory tests, as such knowledge not only strengthens the diagnostic basis, but also represents a differential in the offer of personalized and effective treatments to our patients. This constant pursuit of excellence contributes not only to the individual advancement of professionals, but also to the collective progress of contemporary dentistry.

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Root caries in elderly patients: A narrative review

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ABSTRACT

Root caries is a common condition that affects oral health in the elderly, due to risk factors such as gum recession, reduced saliva, and systemic diseases, in addition to the use of medications, characterized by the deterioration of dental tissues in the region of the roots of the teeth due to caries. Prevention and treatment include regular dental care, topical fluoride, and remineralizing agents to prevent lesion progression. In cases of cavity formation, restorative treatment is indicated. In extreme cases of tooth substrate loss, tooth extraction may be the only choice. This work aimed to describe the characteristics of root caries lesions and review the literature on their concept, particularities, and management, in addition to discussing the different forms of intervention and choices of material adopted. For this, articles were researched between the years 2013 and 2023, through searches in Scielo, Pubmed and Banco Periódico da Capes databases, using as descriptors: root caries AND/OR elderly AND/OR dentistry. Within the inclusion criteria, complete articles were selected, relevant to the topic, that could be accessed in full, whether in Portuguese or English. Awareness about the importance of oral health in the elderly and access to adequate dental services are essential to prevent and treat root caries in this population. Promoting healthy oral hygiene habits and educating about risk factors also play a crucial role in reducing the incidence of this disease and increasing the quality of life among the elderly.

Keywords: Root caries, Therapy, Diagnosis.

1 INTRODUCTION

Root caries (RC) is a progressive and chronic lesion, mainly affecting the root surface and potentially involving cementum, dentin, or enamel near the cement junction (DIAS et al., 2020). This problem is related to the aging of the individual and to parafunctional causes, which can lead to gingival retraction, leaving the tooth root exposed, which suffers a more accelerated wear due to the absence of enamel in the region. All this, added to a high microorganic load and cariogenic diet, influences the process of pH changes, microbial dysbiosis and, consequently, demineralization of this tooth portion (ASKAR et al., 2020).

Therefore, it is also necessary to highlight the influence of oral biofilm in this process. Microorganisms play a crucial role in human health by contributing to the development of the immune system and promoting resistance to pathogens. However, they have the potential to infect the tissues of the hopedeiro, negatively impacting the individual. S. mutans, as well as A. *viscosus* and *A. naeslundi are identified as the most common in CR* (TAKAHASHI, 2016).

Global epidemiological indicators, based on various diagnostic criteria such as the root caries index (CRI), the decayed, full and healthy root index (RDFS), and the International Caries Detection and Evaluation System (ICDAS) criteria for root caries, suggest that the prevalence of root caries ranges from 23% to 96% of the adult population (USAGA-VACCA et al., 2021).

Usaga-Vacca et al. (2021) also mention that the variation in diagnostic criteria and methodologies used in different studies may contribute to the reported prevalence rates. In addition, factors such as age, oral hygiene practices, diet, systemic health conditions, and access to dental care may influence the prevalence of RC.

Therefore, approaches that are more targeted to certain population types should be preferred, aiming at the appropriate treatment of root caries lesions. All of this revolves around an accurate diagnosis as well as understanding the dynamic process of its development (BIDINOTTO et al., 2018).

2 METHODOLOGY

A search for articles was conducted in the Scielo, Pubmed, and Capes Periodical Databases, searching for publications from the last 10 years (from 2013 to 2023). The articles were selected by reading the titles and abstracts to determine their relevance to the proposed theme.

The search for articles was done using the descriptors: tooth root, carie, aged, descriptors duly registered in the Decs/Mesh descriptor library, with the boolean operator AND. Respecting the established time limit. The search resulted in a total of 59 articles.

The following criteria were adopted for the exclusion of articles and their problematization in relation to: a) articles that had no influence on the area cited and the topic addressed; b) articles that related the descriptors to other areas of health and scientific knowledge other than dentistry; d) incomplete publications or those in which only abstracts were made available, e) and duplicate articles.

After the pre-selection, they were submitted to the criteria already mentioned here and from their fulfillment, a more careful analysis of the publications was initiated, taking into account the pertinence and relevance within the construction of the project, to include them. A total of 37 articles were selected to be part of this review.

3 NARRATIVE REVIEW

3.1 CONCEPT AND PREVALENCE

RC is defined as a non-cavitated or cavitated lesion below the cement cement junction without involving the adjacent enamel (ALQRANEI et al, 2020). It is a problem that results from the imbalance in the process of dental demineralization and remineralization, linked to the consumption of fermentable carbohydrates, the individual's level of exposure to the cariogenic challenge, and oral hygiene practices. Such a condition affects a large proportion of the world's population, regardless of

gender, age, and ethnicity (WHO, 2020). With the aging population and the maintenance of teeth in the elderly, caries control, especially on root surfaces, becomes crucial (SUBBIAH & GOPINATHAN, 2018).

Throughout the In recent decades, studies conducted in different countries have reported an average prevalence of RC in the elderly between 30-60% (MITWALLI et al., 2019). Due to factors that alter oral health in the elderly population, the WHO has included oral health as an important component of its active aging policy, which promotes healthy living, disease prevention, and a focus on improving the quality of life of older adults, aiming to reduce the proportion of untreated coronal and root caries (HENDRE et al., 2017).

CR has the ability to develop rapidly, as the acids produced by the bacteria during this process spread in the biofilm towards the cementum or dentin, covering the surface of the root that lacks enamel and dissolving it. The tooth naturally responds to this invasion by forming hypermineralized sclerotic dentin to slow microbial advancement toward the pulp (WONG et al., 2017; OLIVEIRA et al., 2018).

The gingival margin of the CR lesion may lie below the gingiva, which makes it difficult to remove the biofilm. These lesions are usually large from a mechanical point of view and deep from a biological point of view, due to their proximity to the pulp chamber, and have a tendency to bypass the root, which makes restorative treatment more challenging (SLAYTON et al., 2018; MEYER-LUECKEL et al., 2019).

The appearance of caries in the elderly occurs differently compared to young adults, mainly due to its location, which is more frequent in the root region. This often occurs as a result of associated periodontal diseases and the physiological changes that occur in this age group, such as reduced salivary flow, resulting from the chronic use of various medications (VAN STRIJP and VAN LOVEREN, 2018; ZHANG et al., 2020).

3.2 MICROBIOTA ASSOCIATED WITH ROOT CARIES

The oral cavity is home to a great diversity of microorganisms, made up of more than 1,000 different species. Some of these microorganisms have the ability to produce acids as a result of the metabolism of carbohydrates from the diet. This leads to a reduction of pH in the dental biofilm. In this condition, the physicochemical balance between tooth minerals, biofilm fluid, and saliva is disrupted, resulting in the dissolution of the mineral content of dental tissues and the appearance of carious lesions (TAN et al., 2017; CAVAZANA et al., 2018).

There is still no clear consensus on the microbiota associated with CR. Distinct patterns and individual differences in microbial composition were observed, although the predominance of *Actinomyces spp*. has been associated as a potential causative agent of this condition (PATEL et al., 2018). However, *Actinomyces spp*. has recently been evidenced to be metabolically active in both

decayed root surface biofilms and healthy root surfaces (SEIFO et al., 2019), suggesting that these organisms are more site-specific related rather than dysbiosis.

Other studies indicate that *S. mutans* and *Lactobacillus* play a relevant role in root caries. The joint presence of these species has been correlated with a higher risk of CR (URQUHART, et al., 2019).

According to Vanstrijp et al. (2018), the composition of dental plaque in active or inactive CR lesions is composed of less than 10% of *S. mutans* and 73% *of Lactobacillus spp*. in relation to the total microbiota. This indicates that other microbial species may also contribute to the development and progression of root caries.

The results present in the literature indicate that the microbiota associated with root caries is more diverse and complex than previously thought. While *S. mutans and Lactobacillus spp*. have been considered important cariogenic organisms, their prevalence in root caries lesions is relatively low. This suggests that a more comprehensive understanding of microbial ecology and interactions within the biofilm is needed to fully understand the etiology and progression of root caries (WIERICHS et al., 2018; WONG et al., 2017; ZHAO et al., 2018).

3.3 CLASSIFICATION AND DIAGNOSTIC SYSTEMS

The diagnosis of root caries is mainly based on clinical findings. Regarding clinical signs, they are based on the difference in cement color, changes in the contour of the root surface, and evident cavitation (ALQRANEI et al., 2020). The detection of root caries lesions by tactile and visual means continue to be the most indicated for diagnosis (FEE et al., 2020).

Lesions in early stages, with no obvious signs of cavitation, can hinder early detection. Thus, the diagnosis of root lesions should be based on the activity of caries lesions (ALQRANEI et al., 2020). Although some authors argue that the presence of cavitation is not sufficient for diagnosis, hardness or "softening" should be taken into account as a diagnostic criterion, as well as the location, close to the gingival margin, where biofilm retention may occur (PRETTY, 2017).

CR lesions can be classified as active and inactive, related to coloration and hardness. Active lesions are characterized as yellowish or brownish lesions, with the presence of biofilm and a leathery consistency. Inactive lesions, on the other hand, are brownish or black, with a firm consistency and usually without the presence of accumulated biofilm. The use of interproximal radiographs may also be indicated to aid in the diagnosis of root lesions, especially when they are subgingival (ALQRANEI, 2020).

3.4 ROOT INJURY MANAGEMENT

After the diagnosis of this lesion, it is necessary to restore oral health through the treatment of choice. The extent, depth of the lesion, sensitivity, and desired aesthetics directly influence the choice of treatment. Another point to be observed is the degree of risk of caries to which the patient is exposed (SARFATI & TIRLET, 2018).

It is recommended to treat active root carious lesions according to their location and depth, prioritizing non-invasive strategies that promote the remineralization of the lesions (DAMÉ-TEIXEIRA et al., 2017).

3.4.1 Prevention

The preventive approach to avoiding tooth decay involves essential care, such as proper oral hygiene, including regular brushing of teeth at least three times a day with a soft-bristled brush and flossing correctly to reach hard-to-reach areas. These measures are essential to remove plaque and prevent the accumulation of biofilm, thus contributing to the prevention of caries. (PHILIP, et al., 2018; DIAS, et al., 2020).

In addition, it is important to offer patients appropriate oral hygiene instructions that are tailored to their individual abilities. In some cases, such as in older adults with special needs, it may be necessary to rely on the collaboration of caregivers to ensure proper oral hygiene. Preventing tooth decay is an ongoing effort that requires the active participation of the patient, caregivers, and oral health professionals. By taking these preventative measures, it is possible to significantly reduce the risk of developing tooth decay and maintain good oral health. (DIAS, et al., 2020).

No less important, another means of prevention is through a balanced diet, where reducing the consumption of sucrose (sugar) helps prevent caries. Sucrose is a substrate for cavity-causing bacteria, which produce acids that damage tooth enamel. Having a balanced diet, with low consumption of sugary foods and drinks, contributes to the prevention of caries (DA, et al., 2014).

Use of antimicrobial agents such as chlorhexidine 0.12% and fluoride are commonly used in the prevention of caries. Chlorhexidine is an effective antiseptic against bacteria present in the mouth, while fluoride strengthens tooth enamel, making it more resistant to demineralization caused by the acids produced by bacteria. Fluoride is widely used in gel form for professional application, in toothpastes and mouthwashes. Fluoride remains the most effective and cost-effective protective agent in preventing caries. Therefore, its use is fundamental in prevention protocols (PHILIP, et al. 2018).

The relationship between fluorides and caries prevention is well established through epidemiological observations, chemical studies, animal experiments, and clinical trials. Fluoride interferes with carious lesions by reducing demineralization and activating enamel and dentin remineralization, which slows the progression of the disease. It also acts to reduce the solubility of

enamel and dentin in acid, promoting remineralization and resulting in the reduction of caries (FERREIRA, et al., 2013).

Another alternative for prevention would be Silver Diamino Fluoride (DFP), a bactericidal agent that reduces the growth of cariogenic bacteria, inhibits demineralization and promotes the remineralization of enamel and dentin. Its application in adequate concentrations has been shown to be effective in the prevention and treatment of root caries in the elderly (ZHAO, et al., 2018).

It is essential that the use of fluorides, whether in the form of toothpastes, gels or other products, is done according to the personalized recommendations of the oral health professional, taking into account factors such as age, risk of caries, history of dental diseases and individual conditions. In this way, it is possible to take advantage of the benefits of fluoride in the prevention of caries, maintaining oral safety and health (PINHEIRO, et al., 2020).

3.4.2 Invasive Management

Non-invasive treatment is not always a viable choice, especially when the RC lesion already has aesthetic impairment, such as dark brown or black lesions. It is necessary to associate measures to control diet, oral hygiene, and the use of fluorides associated with restorative interventions (HEASMAN et al., 2017).

Invasive interventions involve the selective removal of decayed tissue and restoration of the resulting cavity, and aim to stop the cavitation process and restore the tooth while maintaining its function and appearance by replacing the affected parts of its structure. However, it is worth noting that these interventions are curative and should be accompanied by non-invasive interventions to comprehensively treat and prevent disease progression. (PARIS, et al., 2020).

During the restoration procedure, difficulties related to the clinical characteristics of RC may arise, such as moisture control, access to the cavity, adhesion to different types of substrates, subgingival location, cavity shape that is not always retentive, marginal maladaptation, and proximity to the pulp. (PARIS, et al., 2020).

Regarding the particularity of root lesions in elderly patients, age-related changes in tooth structure can contribute to a high rate of failure in restorations. Over time, the dentin tubules decrease in diameter and number, which causes a reduction in permeability, hypomineralization of the root dentin, and alteration of its mechanical properties. In addition, the adhesion of restorative materials to root tissues is difficult to perform, especially when performed on sclerotic dentin, which is common in root carious lesions (FEJERSKOV & NYVAD, 2017, GÖSTEMEYER, et al., 2019).

The longevity of dental restorations is influenced by several factors, such as the choice of restorative material, the type of adhesion, the quality of light curing, finishing and polishing, patient habits, and periodic maintenance. Proper use of insulation, whether relative or absolute, can minimize

restoration failures by controlling humidity. However, in cases of subgingival root carious lesions, it is challenging to apply isolation with a rubber sheet, making it necessary to assess the need for clinical crown augmentation or access through gingival flaps, following the principles of minimal-intervention dentistry (BURROWS, 2020; GAVRIILIDOU & BELIBASAKIS, 2020).

3.5 CHOICE OF RESTORATIVE MATERIAL

In dentistry there are several restorative materials available, with composite resin and glass ionomer being the most used, so that in each treatment plan, it is possible to choose the most appropriate material for the case. Restorative materials, in addition to their primary function of restoring function and aesthetics, must meet requirements such as the maintenance of pulp vitality and periodontal health (NOBRE, et al., 2022).

Glass ionomer-based materials are considered fluoride reservoirs and are often used to restore root caries lesions. These materials can be "replenished" with topical applications of fluoride as well as fluoride that lies in the medium. Recent evidence shows that fluoride-releasing restorative materials inhibit the emergence of recurrent caries on restored root surfaces (FERREIRA, et al., 2013).

In recent years, high-viscosity glass ionomer cements (VSC) have been the preferred option for the restoration of CR lesions in the elderly. The quality of the product and the primary properties of the restorative CIV are closely related to its performance, and may be temporary or permanent. However, they have aesthetic insufficiency for dental mimicry (NAVARRO, et al., 2021)

Some regions have relevant aesthetic interference, and there is a need for perfect camouflage of the region. In terms of aesthetics, composite resins have shown excellent results, as they are able to faithfully reproduce dental characteristics and offer a wide range of color options. For aesthetic involvement in the buccal surfaces of maxillary anterior teeth, composite resin should be considered the best treatment option (DIAS et al., 2020).

4 DISCUSSION

The prevalence of CR in the elderly reaches 30-60%, mainly due to the increase in life expectancy and the prolonged maintenance of functional dentition (SUBBIAH & GOPINATHAN, 2018). It is estimated that by 2050 the world population over 65 years of age will increase from 12% to 22% and root caries is believed to be one of the main challenges (ALQRANEI et al., 2017). According to the findings of Paris et al (2020), aging is related to a reduction in intrinsic capacities and an increase in general diseases. Because oral health is intertwined with systemic health, disease consequences and interventions need to be considered.

CR develops through repeated cycles of demineralization associated with the loss of the organic collagen matrix in the dentin. As the structure of dentin and cementum is less mineralized than that of

enamel, the pH value required for tooth loss is higher in dentin than in enamel, 6 and 5.4, respectively (DAMÉ- TEIXEIRA et al., 2017). This fact may explain the rapid progression of acids produced by bacteria in the biofilm towards dentin and cementum (WONG et al., 2017).

Although there is still no consensus regarding the microbiota of root caries, a predominance of *Actinomyces spp. has been found, however* S. mutans *and* Lactobacillus *play a relevant role in RC (URQUHART, et* al., 2019). According to Takahashi & Nyvad (2016), Actinomyces species are dominant even in advanced stages of the disease and, while in enamel bacterial invasion occurs only after adamantine destruction, root surfaces are invaded at an early stage of the caries process.

The diagnosis of RC should be based on the signs and symptoms and the tactile and visual method is the most indicated to establish the activity of the lesions (FEE et al., 2020). Yellowish lesions, with the presence of biofilm and leathery consistency, are characterized as active lesions, while darkened lesions, firm consistency, and no biofilm accumulation characterize inactive lesions (ALQRANEI, 2020).

According to Usaga-Vacca et al. (2021), some factors such as age, diet, oral hygiene practices, and systemic conditions can influence the prevalence of RC. Thus, preventive measures such as proper hygiene result in effective control of bacterial biofilm (PHILIP, et al., 2018). In addition, a balanced diet with low consumption of sugary foods also contributes to the prevention of caries disease (FEIJÓ & IWASAKI, 2014).

The non-invasive management of RC consists of the frequent use of fluoride toothpastes together with diet control, which is already effectively found in the literature, different from restorative treatment (FERREIRA et al., 2013). According to the findings of Ekstrand (2016) suggests that toothpaste with a high concentration of fluoride provides better caries prevention in CR lesions in the elderly population than traditional toothpaste containing fluoride.

The treatment of RC is based on the activity of the disease and becomes quite challenging due to the difficulty in controlling humidity, as well as the retention of the restorative material and difficulty in performing absolute isolation, in cases that are subgingival (SCHWENDICKE & GÖSTEMEYER, 2017). Therefore, there is no gold standard treatment for these lesions, making it necessary to control the progression and measure the prognosis of each lesion (ALQRANEI et al, 2020).

When progression cannot be prevented and cavities form, invasive treatment should be performed. The invasive management of RC consists of sealing the cavities with the purpose of paralyzing the progression of the disease and restoring the tooth (ABOU NEEL et al, 2016). According to Spezzia (2017), glass ionomer cement, both conventional and resin-modified and high-viscosity, can be indicated for the treatment of RC. However, glass ionomers, even with their ability to chemically bind to the tooth structure, have inferior aesthetics to composite resin (HEASMAN et al, 2017).

It is important to note that for long-term restorations, it is necessary to evaluate primary properties of the material such as compressive strength, microhardness, resistance to abrasion/acid erosion, and fluoride release (NAVARRO, et al., 2021). According to Dias et al (2020), in a systematic review, they found that the composite resin has a higher survival rate than the conventional glass ionomer, as well as the resin-modified one.

5 CONCLUSION

- The tissues that form root structures have characteristics in relation to tooth enamel and these characteristics can influence the response of each of the dental tissues to cariogenic challenges.
- In general, RC has a higher incidence in the elderly than in younger patients due to the increase in factors related to aging. However, early diagnosis through clinical examination is essential to identify lesions in their early stages.
- Management of RC can be based on prevention, such as through healthy eating habits and proper oral hygiene.
- Restorative treatment is often compromised by the inaccessibility of the lesion, and both glass ionomer cement and composite resin can be used.

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CTZ (chloramphenicol, tetracycline and zinc oxide) obturator paste for primary teeth: An important approach in pediatric dentistry

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ABSTRACT

The maintenance of the deciduous dentition in the oral cavity until the moment of its physiological exfoliation is extremely important, and the performance of pulp therapy is indicated when the cariogenic process is installed in a broad and advanced way, reaching the pulp tissue of the dental element. The most common treatment in these cases is pulpectomy, where the filling of primary teeth is performed using obturator pastes. The objective of this study is to review and discuss the literature on the antibiotic obturator paste based on tetracycline, chloramphenicol and zinc oxide and eugenol, called CTZ. This is a paste whose treatment does not require instrumentation of the root canals, being a procedure of tissue repair and sterilization of lesions (known as LSTR). The PubMed and Scielo databases were consulted using the keywords: "endodontic treatment" AND "LSTR". The 10 most current articles and also the articles considered most relevant were used. It has been observed that CTZ paste is not yet widely used, despite not being a new paste. Due to the practicality of the technique without instrumentation indicated for necrotic deciduous teeth, its use has grown, as well as scientific studies on it. In conclusion, the technique of using the CTZ paste is very effective, conferring great advantage in the treatment of non-cooperative patients, as it is easy, simple, and can be performed in a single session, presenting antibacterial power.

Keywords: Endodontics, Root canal filling, Primary tooth.

1 INTRODUCTION

The main goal of pulp therapy in primary teeth is to maintain the integrity and health of the teeth and supporting tissues while maintaining space, function, and aesthetics. The indications and types of pulp therapies depend on the pulp diagnosis, which can be classified as: normal pulp (symptomatology-free and responsive to vitality tests), reversible pulpitis (mild pulp inflammation,

but recoverable), irreversible pulpitis (the pulp has inflammation unable to regenerate), and necrotic pulp (AAPD, 2022).

The procedure of tissue repair and sterilization of lesions, called LSTR, is known as an endodontic treatment in which there is no instrumentation of the root canals and has been discussed since 1990 (Hoshino *et al*., 1996). Instead, a paste based on different antibiotics is used only in the pulp chamber, which is intended to disinfect the root canals (Coll *et al.*, 2020a; Coll *et al*., 2020b). This method has been used as an option to potentially replace traditional pulpectomy, as it is simpler and faster to perform and does not require multiple visits, even for teeth with periapical lesions (TAKUSHIGE T *et al*., 2004).

In endodontic pastes, the antibacterial activity is essential, and several other properties are desirable, such as biocompatibility, radiopacity, absence of tooth discoloration or aggression to the successor permanent tooth germ, degradation similar to the physiological process of resorption of the deciduous tooth, low solubility in water, among others. (SEGATO RAB *et al*., 2016).

Among the antibiotic pastes used with the LSTR technique, the paste consisting of chloramphenicol, tetracycline and zinc oxide and eugenol, called CTZ, has been reported in the literature as a promising option (MOURA J *et al.,* 2021).

In view of the diversity of endodontically treating deciduous teeth, and in view of the possibility of using a pulp treatment with less time, which is extremely important for the management of infant behavior, this study aims to describe the use of CTZ paste (Chloramphenicol, Tetracycline and Zinc Oxide and Eugenol), in order to bring knowledge to dentists about this option.

2 METHODOLOGY

The present work is a literature review, with a bibliographic search based on scientific articles on endodontic treatment of deciduous teeth with CTZ paste. The search tools were online databases, such as PubMed (www.pubmed.org) and Scielo (https://scielo.org). The search strategy included the following keywords: "*endodontic treatment*" AND "*LSTR"* and was conducted in February 2023. The most relevant articles published in the last 10 years were selected for bibliographic research, as well as classic articles that the authors considered pertinent.

When the complete study was not available in the databases, the search was used through the Portal de Periódico/CAPES (www.periodicos.capes.gov.br) platform. A descriptive analysis of the articles was performed and the data were organized in such a way as to provide relevant information about the use and benefits of the CTZ folder.

After a broad reading of the articles of choice, the main information was selected in order to organize the references for the complete development of the objective proposed to the present work.

3 LITERATURE REVIEW

Pulp therapy in primary teeth has been suggested since 1932 as a method for maintaining these teeth, which would otherwise be lost (KUBOTA, GOLDEN, PENUGONDA, 1992). Pulpectomy in primary teeth is an approach that requires more time in the chair and, when it comes to dental treatment for children, resources that spend less time have a greater interest in pediatric dentistry. There is a major impact of pulpectomy on behavior management in the pediatric population and uncertainties about the effects of root canal filling materials on the development of the successor permanent tooth (HOLAN & FUKS AB, 1993).

A technique that has been gaining more visibility over time is lesion sterilization and tissue repair (LSTR), which has been proposed as an alternative approach that seeks to facilitate the disinfection of carious dentin lesions, pulp infections, and periapical lesions in primary teeth (HOSHINO *et al.*, 1989), with the advantage of being simpler and faster. LSTR has been proposed as an option to potentially replace conventional pulpectomy, as it is simpler and faster to perform and does not require multiple visits, even for teeth with periapical lesions (TAKUSHIGE *et al*., 2004). LSTR is also known as non-instrumental endodontic treatment (NIET) and consists of non-mechanical disinfection of root canals and the use of a paste made of a mixture of antibiotics, placed at the entrance of root canals (NAKORNCHAI, BANDITSING, VISETRATANA, 2010).

Cappiello et al. in 1964 developed a paste for filling/filling root canals in primary teeth. The paste is composed of chloramphenicol, tetracycline and zinc oxide, compounded with eugenol as an aqueous carrier and is currently known as CTZ paste (powder base obtained by compounding pharmacy, in ratios of 1:1:2, chloramphenicol/tetracycline/zinc oxide, respectively). This method avoids the need for canal instrumentation, which can reduce the child's time in the chair, in order to facilitate the management of child behavior (CAPPIELLO, 1964). The folder follows the same principles as the LSTR. This paste consists of broad-spectrum and bacteriostatic antibiotics (GAETTI *et al.,* 2014). Zinc oxide has a low absorption rate when used in pastes to fill the root canals of primary teeth, and eugenol also has antimicrobial action (HARINI, BHAT, HEGDE, 2010).

The technique of applying the CTZ paste is considered easy, simple and can be performed in a single session, it has antibacterial power, promoting the stabilization of bone resorption and not causing tissue sensitivity. In addition, it does not require prior root canal instrumentation, regardless of the pulp diagnosis, offering a great advantage in the treatment of uncooperative patients, facilitating the management of pediatric patient behavior and, consequently, reducing operative time (FERREIRA *et al.*, 2019).

Pastes containing antibiotics have shown great clinical relevance. In a research cited by the article by Moura et al. in 2021, CTZ paste was used, which in its composition two antibiotics were inserted: tetracycline and chloramphenicol. The first drug is an antimicrobial that acts against a large

number of bacteria, as well as aerobic, facultative anaerobic and spirochete bacteria, it acts against Gram (+) and Gram (-) microorganisms (GONÇALVES & SILVEIRA, 2010). The second is a broad-spectrum bacteriostatic antibiotic, which can also be bactericidal in high concentrations or when used against highly sensitive microorganisms. It is active against several gram-negative bacteria, has excellent activity against all anaerobic microorganisms that can develop in the channels (ANDRADE, 2008).

Another component of the paste is zinc oxide and eugenol, its activity is mainly a result of the potent antibacterial action of eugenol, and it has analgesic properties extracted from cloves. When released in the paste, it has therapeutic effects on dentin and pulp and is considered to be the component of essential oils that best reduces the bacterial activity of species such as *Staphylococci*, *Micrococci*, *Bacilli* and *Enterobacteria* for more than 30 days (GONÇALVES & SILVEIRA, 2010).

According to studies carried out by Freire et al. (2021), CTZ caused a yellowish color in the solution, which became even more intense over time. This is probably due to the presence of tetracycline, which gives such a coloration to the CTZ paste. The release of pigments by CTZ in an aqueous medium may strengthen the theory described in the literature that the material represents a risk factor for color change in successor permanent teeth, causing yellowish or brownish stains due to the impregnation of tetracycline with dental tissues (BOAST, CURTIS, GWEE, 2016). However, there is no strong evidence on this effect, and the occurrence of defects in the enamel of permanent teeth seems to be more related to the inflammatory process in the periapical region of the deciduous tooth (COSTA *et al.*, 2017).

In 2015, Lima and collaborators developed a study with mice to observe the biocompatibility of CTZ paste. A study group of 54 mice received subcutaneous tissue implants from polyethylene tubes containing CTZ (manipulated paste) or calcium hydroxide-based paste (Biodynamic® brand powder plus distilled water) or, as a negative control, empty tubes. Biocompatibility was evaluated on days 7, 21 and 63, totaling nine groups of six animals each. After the experimental intervals, the implant areas were removed and submitted to histological processing. After 7 days, all groups had severe acute inflammatory infiltrates. Inflammation was reduced over the 21 days in the CTZ paste group. Mild chronic inflammatory infiltrates were observed after 63 days in the CTZ group and in the calcium hydroxide paste group. From then on, this study concluded that CTZ and calcium hydroxide pastes demonstrated similar biocompatibility with subcutaneous tissue in this experimental animal model.

Successful endodontic treatment of teeth with pulp necrosis requires the reduction or elimination of infection within the root canal system. Drugs used in pulp therapy of primary teeth must have antimicrobial activity and be biocompatible, particularly given the proximity of contact in the furcation and periapical regions (SILVA *et al.*, 2010, FIDALGO *et al.*, 2011).

In 2016, the author Lúcia de Deus Moura et al. published a study evaluating children who had their primary first molars with necrotic pulp treated endodontically with CTZ paste (MOURA et *al.*, 2016). The study was conducted with children attended by the Pediatric Dentistry Clinic of the Federal University of Piauí (UFPI), from 2010 to 2014. In total, 28 children aged between 4 and 10 years were included, and 38 first deciduous molars diagnosed with pulp necrosis were used. The treatment protocol was: initial periapical x-ray, anesthesia, absolute isolation with a rubber dam, coronary opening and removal of dental caries, location of the root canals, irrigation of the pulp chamber with saline solution, drying with sterile cotton, insertion of the CTZ paste at the entrance of the root canals, isolation of the CTZ with a thin layer of gutta-percha, Restoration with non-provisional restorative material available on the day and final periapical x-ray. The patients' teeth were evaluated clinically and radiographically over 36 months. Clinical success was considered when there was no abscess and tooth mobility was compatible with its chronological age. Radiographic success was considered when there was an absence of radiolucent region in the apical region and in the furcation region. The researchers found 100% clinical success and 93% radiographic success and suggested CTZ paste as a therapy for necrotic primary first molars.

Another Brazilian study evaluated the clinical and radiographic results of endodontic treatments in 36 deciduous teeth treated with CTZ antibiotic paste, performed from 2008 to 2010. Of the 36 deciduous teeth analyzed, 15 (41.6%) presented clinical and radiographic alterations. Clinically, color changes were observed in 2 incisors, 2 maxillary molars, and 6 mandibular molars; 3 cases of pain and 2 cases with the presence of fistula in the lower molar group. Enamel hypoplasia was the only clinical alteration observed in permanent successor teeth (30.0%). As for the permanent successor teeth, enamel hypoplasia was the only clinical finding observed. Of the 10 permanent successor teeth evaluated, only 1 incisor and 2 maxillary premolars revealed this finding. These premolars were successors of deciduous molars with expressive external root and bone resorption, as observed on diagnostic radiographs.

4 DICUSSION

The term "lesion sterilization and tissue repair" (LSTR) is used to refer to endodontic therapies using drug combinations to eliminate or minimize the amount of microorganisms present in the root canal system of the tooth with necrotic pulps without prior chemical-mechanical preparation (TAKUSHIGE *et al*., 2004). Despite this, the author Maysa Lannes Duarte and collaborators in 2020 mentioned that deciduous teeth with pulp necrosis, especially those with periapical lesions, certainly improve the clinical prognosis when using a combination of irrigation solutions, despite the fact that the treatment of LSTR does not employ irrigation.

A major challenge faced by pediatric dentistry is to develop biomaterials that have antimicrobial, as well as biocompatible and resorbable properties, for deciduous teeth with necrotic pulp (Silva et al. 2010, Barja-Fidalgo et al. 2011, Queiroz et al. 2011). CTZ paste has great potential as a treatment option for endodontically compromised primary teeth in young children, especially those with difficulties in behavior management. One application for the CTZ folder is for users of public health services due to the large patient load in such facilities and the ease with which general practitioners can perform these procedures due to technical simplicity, good clinical outcomes, and cost-effectiveness (CAPIELLO, 1964). Another factor that is very relevant to SUS is the fact that they have low-cost components in their composition (OLIVEIRA *et al.*, 2013).

In 2016, Lúcia de Deus Moura et al. published a study evaluating children who had their primary first molars with necrotic pulp endodontically treated with CTZ paste. Patients evaluated in this case report showed no adverse signs or symptoms after completion of treatment with CTZ paste. When clinical evaluation was associated with radiography, there was a high percentage of success. (MOURA *et al.*, 2016). However, studies conducted by Lokade et al. in 2019, CTZ paste is used in group III (pulp chamber filled with CTZ paste) and failure was observed in one month of follow-up. Considering that at 6 months of clinical life, as well as the radiological follow-up, there was a 90.9% success rate. The failure was due to pain, gingival swelling, formation of the sinus tract, clinically and radiologically, there was an increase in the periodontal ligament (DPL), increased interradicular radiolucency, internal resorption, and discontinuity of the dura mater lamina in both cases. At twelve months of clinical and radiographic follow-up, there were 81.8% and 63.6% success rates, respectively. Clinically, the main reasons for clinical failure were pain, gingival edema and sinus tract formation in all four teeth and radiologically four teeth presented with internal resorption, along with increased interradicular radiolucency and another four teeth showed increased PDL, increased interradicular radiolucency and discontinuity of the lamina dura. The twelve-month success rate of CTZ in this study was lower compared to that of Deus Moura (100% clinical and 93% radiographic). This may be due to the difference in evaluation criteria (LOKADE *et al.*, 2019).

Biocompatibility is the ability of a material to promote an appropriate biological response in a given application. That is, although a biocompatible material may not be inert, the reaction caused by a test material should not pose an unacceptable physiological risk when compared to other scientifically approved materials (Peters, 2013). In the 2015 study by Lima et al., samples taken from mice containing CTZ paste showed progressive darkening over time, which may have been caused by the tetracycline component. CTZ paste was associated with an intense initial inflammatory response during the first few days of the experiment. At the end of the experiment, a mild chronic inflammatory process was observed, with a qualitative and quantitative decrease in collagen fiber density and tissue thickness. This finding suggests that CTZ was biocompatible and had therapeutic properties.

The use of tetracycline in the treatment is questionable, as it can cause tooth staining, the ingestion of this antibiotic during the period of odontogenesis causes darkening (LACERDA *et al*,. 2012). Because of this, its use is not indicated for anterior teeth due to the risk of aesthetic damage, as well as during odontogenesis, which ends around 7-8 years of age (LIMA *et al.*, 2021). However, in 2020, Sousa et al. found a higher percentage of enamel defects in teeth with a predecessor extracted by necrosis without endodontic treatment than in teeth treated with CTZ (SOUSA et *al.*, 2020). According to Freire et al. in 2021, defects in the enamel of the successor tooth may be more related to the inflammatory process in the periapical region of the deciduous tooth, resulting from the carious process, without the material being a determining factor (FREIRE et al., 2021). In 2016, Reis et al. conducted a study to evaluate the incidence of enamel stains in 180 premolars and endodontic treatment in their deciduous predecessors, and it was identified that the appearance of stains occurred, however, without statistically significant difference, suggesting that tetracycline does not act locally and that any staining that may occur would be due to inflammation in the periapical region generated by pulp involvement of the deciduous predecessor (REIS *et al,*.2016).

Although the CTZ paste is not a new discovery, it is still little used in dentistry courses in Brazil, about only 2.4% (Costa et al., 2012). This resistance is probably due to the care in the use of the drugs of its composition, more precisely tetracycline, which poses the risk of staining the crown of the permanent successor. It is worth emphasizing that enamel hypoplasia can be a consequence of systemic, traumatic, environmental or genetic events that occur during the development of teeth, interfering with the normal formation of the enamel matrix, causing defects and irregularities on its surface. In general, it can be stated that any nutritional deficiency or serious systemic disease may be capable of producing enamel hypoplasia, since ameloblasts constitute one of the most sensitive groups of cells in the body, with regard to metabolic function (Ribas and Czlusniak, 2004). Therefore, it cannot be stated that the occurrence of enamel hypoplasia in permanent teeth that preceded deciduous teeth treated with CTZ is due to endodontic treatment using this paste.

5 CONCLUSION

In view of the information presented in the review, it is concluded that the technique of using CTZ paste is easy, simple, can be performed in a single session, has antibacterial power, promotes stabilization of bone resorption and does not cause sensitivity to tissues. In addition, it does not require instrumentation of the root canals, before or after disinfection, which confers a great advantage in the treatment of non-cooperative patients. However, care should be taken in view of the disadvantage of crown pigmentation of the treated primary tooth.

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Análise antropométrica de mandíbulas humanas como estrutura anatômica para determinação sexual

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RESUMO
A identificação forense após fatalidades é dificultada frente à decomposição cadavérica, sendo o reconhecimento pela ossada o primeiro a ser oportunizado com a definição do sexo do esqueleto analisado. Estudos recentes demonstram que a mandíbula pode ser utilizada como parâmetro no diagnóstico sexual por ser suscetível à atividade da musculatura mastigatória, e que esta é diferente entre os sexos. Entretanto, ressalta-se que fatores étnicos também afetam o formato da mandíbula. O estudo objetivou elaborar um padrão regional de determinação sexual, a partir da mandíbula, por meio da análise de materiais ante e post mortem da população de interesse. Foram analisados em 386 radiografias panorâmicas: altura do ramo, altura do corpo, altura do mento, altura do forame mentual, distância entre os côndilos, distância entre os ângulos mandibulares, distância entre os processos coronoides, distância entre os forames mentuais, largura do ramo, largura da incisura, comprimento mandibular de ângulo a mento, distância entre o forame mentual e o mento, distância entre o forame mentual e o ramo, posição do forame mentual em relação aos dentes posteriores, e presença de uma flexura na borda posterior do ramo na altura do plano oclusal. Os resultados foram avaliados através de testes estatísticos e os padrões reconhecidos para a região de interesse foram testados em mandíbulas maceradas. Conclui-se que a definição de mandíbulas masculinas é dada pela distância entre os côndilos e os ângulos mandibulares, enquanto mandíbulas femininas são determinadas pela distância entre os processos coronoides e pelos comprimentos mandibulares de ângulo a mento bilateralmente.

Palavras-chave: Mandíbula, Dimorfismo sexual, Radiografia panorâmica.

1 INTRODUÇÃO

A identificação forense após fatalidades é dificultada frente à decomposição cadavérica, sendo o reconhecimento pela ossada o primeiro a ser oportunizado, permitindo a definição do sexo, estimativa da idade e da estatura e, até mesmo, o traçado da afinidade populacional do esqueleto em análise[1]. Nesse cenário, estudos revelaram que o estrutura óssea mais confiável para a determinação do sexo de um indivíduo é a pelve, sendo o crânio considerada a segunda estrutura óssea mais sexualmente dimórfica[2]. Ademais, embora os crânios masculinos e femininos sejam formados pelos

mesmos ossos, a medicina e a odontologia legal são amparadas pelos aspectos sexuais e antropométricos distintos destes[3], tendo em vista o menor grau de desenvolvimento das superestruturas ósseas femininas em relação às masculinas. Nessa circunstância, acidentes anatômicos do crânio como processos mastoides, margens supraorbitais e glabela são considerados sexualmente dimórficos[4].

Em acréscimo à pelve e ao crânio, a mandíbula é considerada uma útil estrutura para a determinação sexual de um esqueleto desconhecido e suas medidas vêm sendo estudadas desde o início do século XX[5]. O potencial desse osso na pesquisa forense tem sido explorado porque mesmo em casos nos quais o crânio não é encontrado intacto, a mandíbula sozinha pode desempenhar um importante papel na determinação do sexo e, como a articulação que a une ao crânio decompõe-se rapidamente após a morte, esse elemento esquelético torna-se uma importante variável na identificação de cadáveres, já que pode ser encontrado isoladamente do restante do corpo. A exemplo disso, acidentes anatômicos como o ângulo mandibular apresentam diferenças entre os sexos[6].

Em consonância a estudos anteriores, Ishwarkumar *et al.*[7] propõe que todos os pontos da mandíbula que sofrem deposição, reabsorção e remodelação óssea têm o potencial de se tornarem sexualmente dimórficos, sendo o côndilo e o ramo as regiões mandibulares que apresentam as mudanças morfológicas mais notórias durante o crescimento. À medida que a atuação da musculatura é considerada um fator decisivo sobre o crescimento ósseo, acredita-se que essas diferenças sexuais mandibulares decorrem de uma força muscular muito maior em homens do que em mulheres, uma vez que existe uma diferença em relação a tamanho, força, angulação e tensão da musculatura mastigatória entre os sexos[8]. Na literatura, diversas pesquisas mostraram que as maiores dessemelhanças mandibulares entre os sexos se manifestam no ramo[5,7,9], ângulo[5,10-11], corpo[5,7,10] e forame mentual[5,8,10,12]. Também têm sido documentados estudos demonstrando dimorfismos sexuais mandibulares no processo coronoide[5], na incisura da mandíbula[5], no côndilo[5,9-10] e no mento[5].

A identificação humana é um dos mais ricos campos de pesquisa na Odontologia Forense, e essa expansão dos estudos no campo da perícia pode ser explicada pelo fato de que as diferenças étnico-regionais interferem diretamente nos padrões fenotípicos de uma população. Por isso, um método antropológico que apresente altos níveis de precisão no tangente à diferenciação sexual em uma determinada amostra, pode exibir resultados menos precisos em outra população[9]. A exemplo disso, Suazo Galdames et al.[13] constataram que a confiabilidade do osso nasal no diagnóstico do sexo de um indivíduo é menor em compilados multirraciais, uma vez que o tamanho desse elemento esquelético varia substancialmente entre as etnias. No tangente à mandíbula, as diferenças raciais, genéticas e regionais envolvidas na atividade mandibular durante os primeiros estágios de crescimento e desenvolvimento podem afetar no formato e tamanho desse osso, além das características sexualmente dimórficas que esta possa apresentar[7].

No Brasil, embora estudos tenham sido realizados para a identificação sexual a partir da análise da mandíbula, muitos desses métodos foram testados em apenas uma das 5 regiões do país, o que requer que essas pesquisas sejam estendidas para outras áreas a fim de se garantir sua validade, especialmente por causa da extensão do território brasileiro e da vasta miscigenação de sua população[9]. Adicionalmente a isso, fatores como estilo de vida, hábitos mastigatórios, condições hormonais[14] e genéticas afetam, também, o formato da mandíbula. Posto isso, o presente estudo objetivou, principalmente, identificar possíveis acidentes anatômicos e medidas mandibulares que possam demonstrar diferenças sexuais, auxiliando o trabalho forense de identificação de cadáveres. Em acréscimo a isso, esta pesquisa almejou diferenciar e observar estruturas e medidas do corpo e ramo mandibulares que possam auxiliar na determinação do sexo de um indivíduo desconhecido a partir da análise da mandíbula, revisando as medidas obtidas em mandíbulas maceradas com sexo conhecido, e realizando uma análise qualitativa a fim de se observar diferenças visuais entre mandíbulas de indivíduos de ambos os sexos.

2 METODOLOGIA

O projeto para o desenvolvimento desta pesquisa foi submetido e aprovado pelo Comitê de Ética em Pesquisa da Universidade Federal de Uberlândia, com o CAAE 49922121.6.0000.5152.

O estudo foi baseado na análise documental de 386 radiografias panorâmicas pertencentes aos arquivos mortos de 2020 e 2021 de uma clínica de radiologia e tomografia da cidade de Uberlândia. Esta é uma pesquisa de caráter básico, hipotético-dedutivo, descritivo, ex-post-facto e quanti-qualitativo, a qual foi desenvolvida de forma online acessando os arquivos para análise, após autorização, criação e liberação de acesso pelos gestores da clínica detentora dos documentos que foram investigados.

As radiografias analisadas foram originalmente realizadas para fins de diagnóstico, planejamento e/ou tratamentos odontológicos, sendo que todas as imagens foram feitas com o Sirona, utilizando o programa SIDEXIS 4. Para a avaliação das radiografias panorâmicas foi utilizado o programa SmartRIS Versão 1.30 – 2019.07.12.

Sabe-se que a radiografia panorâmica é uma técnica de imagem da seção do corpo que origina imagem larga e curvada, representando as arcadas dentárias maxilar e mandibular e suas estruturas de suporte[15]. No entanto, precauções devem ser tomadas ao se realizar medidas absolutas e comparações relativas por intermédio de radiografia panorâmica, pois a distorção imagética é inerente a esta técnica. Vale ressaltar que as maiores deturpações ocorrem nas mensurações horizontais e oblíquas. Posto isso, foi necessário fazer um cálculo da distorção das imagens a fim de se garantir a confiabilidade das medidas absolutas e comparações relativas realizadas, valendo-se desse método radiográfico[16]. Em relação à distorção produzida pela radiografia panorâmica, sabe-se que esta é de 25%, adotando-se um

valor padrão, e essa redução percentual apenas foi realizada nas medidas látero-laterais que se localizavam nos extremos laterais do exame, sendo elas: distância entre os côndilos mandibulares, distância entre os processos coronoides da mandíbula e distância entre os ângulos mandibulares.

Para a pesquisa, foram utilizadas radiografias panorâmicas digitais que pudessem ser observadas como sendo de indivíduos maiores de 18 anos (considerando a presença de terceiros molares erupcionados ou totalmente formados a partir da análise apical destes dentes). Posto isso, as imagens radiográficas de qualidade ruim e nas quais fosse possível observar a ausência de pré-molares, dentes supranumerários, patologia óssea, fratura mandibular, implantes, ou próteses não removíveis foram descartadas do estudo.

Nesse contexto, foram analisadas as seguintes informações em cada imagem panorâmica no que diz respeito a mensurações de estruturas (Quadro 01):

Quadro 01: Estruturas mensuradas em cada radiografia panorâmica

	Estrutura mensurada	**Definição da mensuração**
1	Altura do ramo mandibular	Medida que se estende desde ponto mais alto do côndilo até o final da curvatura do ângulo
2	Altura do corpo mandibular	Medida que se estende desde o ponto à frente da borda anterior do ramo até a base do corpo da mandíbula, formando uma reta perpendicular com esta
3	Altura do mento a partir da base ao ponto mais alto da margem alveolar	Medida que se estende desde a crista interalveolar entre os incisivos centrais até a base do corpo da mandíbula, formando uma reta perpendicular com esta
4	Altura do forame mentual a partir da base da mandíbula	Medida que se estende desde a borda inferior do forame mentual até a base do corpo da mandíbula, formando uma reta perpendicular com esta
5	Distância entre os côndilos mandibulares	Medida que se estende entre as bordas laterais dos côndilos da mandíbula
6	Distância entre os ângulos mandibulares	Medida que se estende entre os pontos mais curvos dos ângulos da mandíbula
7	Distância entre os processos coronoides da mandíbula	Medida que se estende entre as bordas posteriores dos processos coronoides
8	Distância entre os forames mentuais	Medida que se estende entre as bordas mediais dos forames mentuais
9	Largura do ramo mandibular entre as bordas anterior e posterior	Medida que que se estende desde a borda anterior do ramo até a borda posterior deste, na região de transição entre corpo e ramo
10	Largura da incisura mandibular entre os pontos mais altos dos processos condilar e coronoide	Medida que se estende desde o colo mandibular até a borda posterior do processo coronoide
11	Comprimento mandibular de ângulo a mento	Medida que se estende desde o ponto mais curvo do ângulo da mandíbula até o ponto médio da base da mandíbula
12	Diâmetro do forame mentual	Medida que se estende entre as bordas medial e lateral do forame mentual
13	Distância entre o forame mentual e o mento	Medida que se estende desde a borda medial do forame mentual até o ponto médio da base da mandíbula
14	Distância entre o forame mentual e o ramo mandibular	Medida que se estende desde a borda medial do forame mentual até a borda posterior do ramo mandibular
15	Classificação da posição horizontal do forame mentual	1-forame mentual anterior ao primeiro pré-molar, 2-forame mentual alinhado com o primeiro pré-molar, 3-forame mentual entre os pré-molares, 4-forame mentual alinhado com o segundo pré-molar, 5-forame mentual entre o segundo pré-molar e o primeiro molar, 6-forame mentual alinhado com o primeiro molar

16	Classificação da presença de um ponto mais curvo na borda posterior do ramo mandibular na altura do plano oclusal	+1 na presença da flexura da borda posterior do ramo mandibular na altura do plano oclusal, 0 na presença da flexura da borda posterior do ramo mandibular em outros planos que não o oclusal, -1 na ausência de flexura da borda posterior do ramo mandibular na altura do plano oclusal

Fonte: Autoria própria, 2019

Em sequência, os dados coletados foram analisados através da estatística descritiva de porcentagem, no programa BioEstat 5.0, e verificada a significância através de dois testes com $p<0,05$. Para isso, os dados foram separados quanto a estrutura óssea mensurada e quanto ao sexo a que pertenciam. No que diz respeito às mensurações únicas, a exemplo da distância entre os côndilos mandibulares, estas foram comparadas entre os sexos a partir do teste de Mann-Whitney. Sob esse mesmo teste estatístico, foram feitos os cruzamentos de medidas pares de mesmo antímero entre os sexos, isto é, uma estrutura óssea que é bilateral teve sua mensuração do lado direito cruzada com a medida deste mesmo acidente anatômico do antímero direito do sexo oposto. Sob essa mesma premissa, foram feitos os cruzamentos entre os sexos de mensurações bilaterais do lado esquerdo. Já no tangente aos cruzamentos entre o mesmo sexo, as estruturas que são bilaterais foram comparadas entre si por meio do teste de Wilcoxon.

Uma vez feitas as análises das radiografias panorâmicas e depois de realizada a análise estatística das informações coletadas, foi executado um experimento com 20 mandíbulas maceradas para verificar a validade dos resultados encontrados. Nesse cenário, o material utilizado foi disponibilizado pelo Departamento de Anatomia Humana (DEPAH) do Instituto de Ciências Biomédicas (ICBIM) da Universidade Federal de Uberlândia (UFU), Uberlândia, MG, onde a pesquisa foi realizada.

No contexto da pesquisa, foram utilizadas mandíbulas que pudessem ser observadas como sendo de indivíduos maiores de 18 anos (considerando a ausência de dentes decíduos). Posto isso, as mandíbulas quebradas e nas quais fosse possível observar a presença de patologia óssea, histórico de fratura mandibular e presença de implantes foram descartadas do estudo.

A partir do estabelecimento da amostra do material anatômico, e depois de realizada a seleção das mandíbulas maceradas segundo os critérios de inclusão e exclusão, o experimento de verificação dos resultados obtidos a partir do estudo sobre as radiografias panorâmicas contou com 2 pesquisadores. O primeiro investigador, tendo conhecimento do sexo das mandíbulas, enumerou-as e disponibilizou-as em uma sala do DEPAH /ICBIM /UFU. Feito isso, o segundo pesquisador classificou, quanto ao sexo, as peças anatômicas dispostas levando em consideração as medidas previamente obtidas durante a avaliação das radiografias panorâmicas.

3 RESULTADOS

Todas as dimensões apresentadas (tabelas 01 e 02) são os valores mínimos e máximos encontrados, além das médias simples, das medidas obtidas da análise das radiografias panorâmicas, sendo que todas foram mensuradas em centímetros (cm), com exceção da posição horizontal do forame mentual e a presença de um ponto mais curvo na borda posterior do ramo mandibular na altura do plano oclusal.

Tabela 01: Resultados masculinos

Medida	Menor valor	Maior valor	Média
Altura do ramo mandibular direito	5,4450	7,6508	5,8649
Altura do ramo mandibular esquerdo	5,3183	7,3058	5,8137
Altura do corpo mandibular direito	1,7804	3,6362	2,5357
Altura do corpo mandibular esquerdo	1,8955	3,4820	2,4823
Altura do forame mentual a partir da base da mandíbula do lado direito	0,7947	1,6955	1,0832
Altura do forame mentual a partir da base da mandíbula do lado esquerdo	0,8064	1,6542	1,0686
Largura do ramo mandibular entre as bordas anterior e posterior do lado direito	2,1263	4,2736	2,8768
Largura do ramo mandibular entre as bordas anterior e posterior do lado esquerdo	2,0309	4,0345	2,8642
Largura da incisura mandibular entre os pontos mais altos dos processos condilar e coronoide do lado direito	1,3426	2,6048	1,7645
Largura da incisura mandibular entre os pontos mais altos dos processos condilar e coronoide do lado esquerdo	1,2555	2,5660	1,7537
Comprimento mandibular de ângulo a mento direito	7,6380	10,2054	8,0488
Comprimento mandibular de ângulo a mento esquerdo	7,4109	10,3135	7,8864
Diâmetro do forame mentual direito	0,1799	0,5568	0,2850
Diâmetro do forame mentual esquerdo	0,1639	0,5644	0,2868
Distância entre o forame mentual e o mento do lado direito	2,3629	3,8669	2,7841
Distância entre o forame mentual e o mento do lado esquerdo	2,2884	3,8216	2,7056
Distância entre o forame mentual e o ramo mandibular do lado direito	5,4571	7,8319	5,9408
Distância entre o forame mentual e o ramo mandibular do lado esquerdo	4,9124	7,5358	5,8597
Altura do mento	2,2400	3,6224	2,7255
Distância entre os côndilos mandibulares	12,1179	15,0527	12,3840
Distância entre os ângulos mandibulares	10,7530	14,4420	11,2011
Distância entre os processos coronoides mandibulares	7,2393	10,1794	7,9110
Distância entre os forames mentuais	3,8043	6,8185	4,7485

Fonte: Autoria própria, 2019

Tabela 02: Resultados femininos

Medida	Menor valor	Maior valor	Média
Altura do ramo mandibular direito	4,7204	6,9406	5,7282
Altura do ramo mandibular esquerdo	4,7200	6,8531	5,7538
Altura do corpo mandibular direito	1,9280	3,3496	2,5927
Altura do corpo mandibular esquerdo	1,9280	3,2463	2,5741
Altura do forame mentual a partir da base da mandíbula do lado direito	0,7932	2,8376	1,0817
Altura do forame mentual a partir da base da mandíbula do lado esquerdo	0,7864	2,3770	1,0789
Largura do ramo mandibular entre as bordas anterior e posterior do lado direito	1,8282	4,1767	2,9286
Largura do ramo mandibular entre as bordas anterior e posterior do lado esquerdo	1,9310	4,3635	2,9495
Largura da incisura mandibular entre os pontos mais altos dos processos condilar e coronoide do lado direito	1,0230	2,7920	1,8330
Largura da incisura mandibular entre os pontos mais altos dos processos condilar e coronoide do lado esquerdo	1,0878	2,7735	1,8314
Comprimento mandibular de ângulo a mento do lado direito	6,9189	10,2811	8,5490
Comprimento mandibular de ângulo a mento do lado esquerdo	6,8497	10,1724	8,3882
Diâmetro do forame mentual direito	0,1654	0,4967	0,2932
Diâmetro do forame mentual esquerdo	0,1654	0,4646	0,2874
Distância entre o forame mentual e o mento do lado direito	2,3779	4,1757	2,9814
Distância entre o forame mentual e o mento do lado esquerdo	1,9786	3,7282	2,8580
Distância entre o forame mentual e o ramo mandibular do lado direito	4,7437	7,5361	6,0810
Distância entre o forame mentual e o ramo mandibular do lado esquerdo	4,7277	7,4093	6,0970
Altura do mento	2,1527	3,4736	2,7531
Distância entre os côndilos mandibulares	11,2748	14,9920	13,0398
Distância entre os ângulos mandibulares	10,0770	14,2218	11,9107
Distância entre os processos coronoides mandibulares	7,1997	12,1998	11,2815
Distância entre os forames mentuais	4,0117	6,4097	5,1017

Fonte: Autoria própria, 2019

Em relação aos resultados das características não mensuradas em cm, observou-se que, para ambos os sexos, a classificação da posição horizontal do forame mentual nos dois antímeros apresentou maior contingente de classificações na posição 4. De maneira análoga, a observação da presença de um ponto mais curvo na borda posterior do ramo mandibular, bilateralmente, na altura do plano oclusal, mostrou um maior número de ausência em homens e mulheres.

Para a conferência dos resultados em mandíbulas maceradas, foram selecionadas as mensurações que, na análise estatística, apresentaram $p>0,05$ e diferença métrica da média entre os sexos maior ou igual a 3 mm (Tabela 03), porque a discrepância métrica observada entre os sexos deveria ser palpavelmente medida com um paquímetro digital pelos pesquisadores. Sendo assim, as medidas realizadas em mandíbulas secas foram: distância entre os côndilos mandibulares, distância entre os ângulos mandibulares, distância entre os processos coronoides mandibulares, distância entre

os forames mentuais e comprimento do corpo mandibular de ângulo a mento dos lados direito e esquerdo.

Tabela 03: Mensurações conferidas em mandíbulas maceradas

Medida	p-valor (unilateral)	p-valor (bilateral)	Diferença métrica da média entre os sexos (cm)
Distância entre os côndilos mandibulares	< 0,0001	< 0,0001	0,6558
Distância entre os ângulos mandibulares	< 0,0001	< 0,0001	0,7096
Distância entre os processos coronoides mandibulares	< 0,0001	< 0,0001	3,3705
Distância entre os forames mentuais	0,0019	0,0039	0,3532
Comprimento do corpo mandibular de ângulo a mento do lado direito	< 0,0001	< 0,0001	0,5002
Comprimento do corpo mandibular de ângulo a mento do lado esquerdo	< 0,0001	< 0,0001	0,5018

Fonte: Autoria própria, 2019

4 DISCUSSÃO

Sob o pretexto de que a mandíbula tem tido seu potencial amplamente investigado no que diz respeito à determinação do sexo de um indivíduo não identificado, é imprescindível compreender os aspectos que levam mandíbulas de homens e mulheres a expressarem diferenças morfológicas. Nesse sentido, as dissemelhanças mandibulares entre os sexos têm origem, principalmente, na diversidade de tamanho, força, angulação e tensão da musculatura entre homens e mulheres[8]. Durante a mastigação, as mulheres exercem menor força muscular, fazendo com que as estruturas ósseas nas quais se inserem os músculos mastigatórios sejam mais delicadas[14].

No tangente ao papel muscular no desenvolvimento mandibular, vale ressaltar que, além de suportar as forças mastigatórias oclusais, a mandíbula ainda resiste à ação de todos os músculos da mastigação que nela se inserem[17]. Nesse cenário, a compreensão das trajetórias de dissipação de forças dos músculos que se inserem na mandíbula torna-se imperativa para o entendimento do crescimento mandibular e, consequentemente, para a percepção da origem das diferenças sexuais impressas nesse osso. A exemplo disso, o músculo masseter, juntamente com a sua contraparte, o pterigoideo medial, geram forças que se escoam pelas bordas posterior e inferior da mandíbula. Já o músculo pterigoideo medial, em contrapartida, por exercer uma força que tende a dobrar a mandíbula, desempenha uma grande tensão no mento, de maneira a tornar necessário um reforço ósseo nessa área. Em relação ao músculo temporal, sua atividade gera forças que se dissipam por uma trajetória que começa no processo coronoide e prolonga-se para baixo, até o corpo mandibular, promovendo um espessamento ósseo da margem anterior da mandíbula[17]. Cabe ressaltar, ainda, que os próprios locais de inserção desses músculos na mandíbula determinam regiões de maior aposição óssea que diferenciam esse osso entre os sexos[13].

No presente estudo, a primeira estrutura mandibular que mostrou diferença estatisticamente significativa entre os sexos foi a distância entre os côndilos mandibulares, conclusão compatível com os estudos de Lopez-Capp[5], Ortiz[18] e Alves & Deana[10]. No entanto, ao contrário dos resultados propostos por Lopez-Capp[5] e Alves & Deana[10], esta pesquisa encontrou uma maior amplitude bicondilar em mulheres do que em homens, apresentando uma média de valores de 17,3864 cm para essa medida no sexo feminino e de 16,5121 cm para o sexo masculino. Essa diferença observada pode ser explicada pela atuação do músculo pterigoideo lateral sobre os côndilos mandibulares. Isso porque, como o músculo pterigoideo lateral se origina na lâmina lateral do processo pterigoide do osso esfenoide e se insere no colo mandibular e na cápsula da articulação temporomandibular[19], pode-se dizer que o músculo em questão, ao ser contraído, realiza uma tração nos locais de inserção em direção à linha média. Tendo em vista que a musculatura masculina é mais forte que a feminina, os côndilos masculinos teriam uma maior tendência de se encontrarem mais próximos à linha média, justificando uma menor amplitude bicondilar em relação à feminina. Todavia, a ação do músculo pterigoideo lateral na morfologia mandibular não se resume, apenas, aos côndilos.

Sabe-se que a maior densidade óssea observada no mento cria um esteio de resistência que busca anular não somente a tendência de torção da mandíbula quando os músculos pterigoideos laterais estão em ativação simultânea, mas também seu dobramento[17]. Diante disso, entende-se que a atividade desse músculo exerce uma força de forma a aproximar os corpos mandibulares em direção ao plano sagital. Consequentemente, uma maior potência dos músculos pterigoideos, como é observado na musculatura masculina, seria capaz de aproximar entre si, além dos côndilos, os corpos mandibulares. Sob esse espectro, como os forames mentuais são estruturas localizadas no corpo da mandíbula, espera-se que a amplitude entre essas duas aberturas seja menor no sexo masculino em relação ao feminino. De maneira análoga, essa expectativa se concretizou na presente pesquisa, uma vez que a distância entre os forames mentuais mostrou média de 5,1017 cm nas mulheres e média de 4,7485 cm nos homens.

No tocante à distância entre os ângulos mandibulares, o cruzamento entre as medidas masculinas e femininas demonstrou significância estatística para essa mensuração. Nas mulheres, observou-se um média de 15,8810 cm na amplitude bigonial e, nos homens, o valor médio encontrado foi de 14,9349 cm. Em consonância com os estudos de Carvalho *et. al*[9], Lopez-Capp[5] e Alves & Deana[10], a distância entre os ângulos mandibulares pode, de fato, diferenciar mandíbulas de sexos diferentes. Entretanto, as pesquisas de Lopez-Capp[5] e Alves & Deana[10] trouxeram valores maiores no sexo masculino em todas as medições. Nesse âmbito, é válido ressaltar que características anatômicas podem justificar a diferença nos desfechos obtidos. Considerando que o músculo masseter e o pterigoideo medial se inserem no ângulo mandibular, cada um em uma das faces, e como esses músculos se originam no arco zigomático e na face medial da lâmina lateral do processo pterigoide

respectivamente[19], quando ativados, realizam uma tração nos locais de inserção em direção ao plano sagital e, também, cranial. Sob a premissa de que o vigor muscular masculino é maior, a tendência de aproximação dos ângulos em relação à linha média seria maior nesse sexo, explicando os menores resultados encontrados no presente estudo. Uma possibilidade plausível para os diferentes resultados em diferentes pesquisas deve-se ao grupo investigado e a eventuais vieses metodológicos como o uso de diferentes instrumentos de medição.

Acerca da distância entre os processos coronoides, as pesquisas previamente avaliadas não demonstraram resultados promissores para essa estrutura mandibular no concernente à diferenciação sexual. Mesmo assim, essa mensuração foi avaliada pelo potencial de dimorfismo sexual que apresentava por ser a inserção de um importante músculo da mastigação. A partir disso, a presente investigação encontrou relevância estatística para a amplitude entre os processos coronoides para fins de determinação sexual. Em relação aos valores obtidos, a média feminina foi de 11,2815 cm e a masculina de 10,5481 cm. Novamente, as mulheres demonstraram valores médios maiores, o que pode ser respaldado, também, pela atividade da musculatura mastigatória. Isso porque, como o músculo temporal se origina no assoalho da fossa temporal e se insere na face medial do processo coronoide[19], pode-se dizer que a atividade desse músculo realiza uma tração no local de inserção em direção cranial, de modo a elevar o processo coronoide e levá-lo em direção ao plano sagital. Portanto, já que a musculatura masculina é mais forte que a feminina, os processos coronoides masculinos teriam uma maior tendência de se encontrar mais próximos ao plano sagital, diminuindo a amplitude entre os processos coronoides em relação à mesma distância no sexo feminino. Uma importante observação para que pesquisas anteriores não apresentassem resultados relevantes para esta medida, deve-se aos diferentes formatos do esqueleto do crânio/face. Se o indivíduo tiver um formato triangular de ápice no mento, apresentará uma inserção do músculo temporal mais medialmente localizada em relação à origem, favorecendo assim uma tração lateral dos processos coronóides. No caso de um formato crânio/face quadrado ou oval a origem e a inserção estariam aproximadamente no mesmo plano, favorecendo um tracionamento sem lateralização ou medialização dos processos coronoides. Em caso de crânio/face triangular com base na mandíbula e ápice no terço superior da face, considerando origem e inserção do músculo temporal, o tracionamento seria para medial, induzindo a um fechamento da distância intercoronoide. Nota-se que a diferença do público investigado e a heterogeneidade da população brasileira favorece resultados mais generalizáveis devido à grande miscigenação.

Ainda sob essa perspectiva, a ação do músculo temporal provocaria uma segunda diferença entre mandíbulas de homens e mulheres, que é a largura da incisura mandibular. Tendo em mente que esse músculo da mastigação tencionaria o processo coronoide em direção cranial, a distância entre essa estrutura e o colo do processo condilar da mandíbula seria reduzida nas amostras masculinas, o que, de fato, aconteceu no presente estudo. Enquanto a média da largura da incisura mandibular foi 1,83

cm nos dois antímeros femininos, os homens mostraram média de 1,76 cm no lado direito e 1,75 cm no lado esquerdo.

No que diz respeito à altura dos mentos, essa mensuração mostrou-se sexualmente dimórfica. Como já foi expresso, o mento é uma região reforçada por corticais espessas e um trabeculado ósseo mais denso, característica fundamental para fazer com que a mandíbula suporte as forças criadas pela ação dos músculos pterigoideos quando ativados bilateralmente. Adicionalmente, é importante salientar que, além de ser submetido a forças de tração pela musculatura, o mento é sujeitado à pressão decorrente da oclusão dentária. Como a força de fechamento da mandíbula, que leva os dentes de encontro um ao outro, é dependente da musculatura mastigatória, e tendo em vista a maior potência dos músculos masculinos em relação aos femininos, entende-se que a pressão sofrida pelo mento nos homens é maior, de forma que a altura dessa estrutura será menor no sexo masculino. Esse evento pode ser observado nos resultados da pesquisa, uma vez que a média da altura do mento masculino foi de 2,7255 cm, enquanto a feminina foi de 2,7531cm.

Cabe acrescentar que o esteio de reforço ósseo existente no mento pode ser utilizado para justificar outra medida sexualmente dimórfica observada no presente estudo, o comprimento do corpo mandibular. Entretanto, ao contrário dos resultados obtidos por Ishwarkumar *et al.*[7], os valores femininos mostraram-se maiores nesta pesquisa. Nas mulheres, o comprimento mandibular de ângulo a mento mostrou média de 8,5490 cm no lado direito e média de 8,3882 cm no antímero esquerdo. Já no sexo masculino, os valores médios obtidos foram de 8,0488 cm e 7,8864 cm respectivamente. Nessa esfera, a diferença observada entre os sexos para essa medida pode ser explicada pela combinação entre a densidade óssea do mento e as trajetórias mandibulares. Isso porque sabe-se que o crescimento do corpo da mandíbula é influenciado pelas trajetórias que atravessam essa região óssea. A primeira delas, a trajetória basilar, se estende do mento à região posterior do ramo e é concebida, principalmente, pela atividade do músculo temporal. Devido à sua origem na fossa temporal e inserção na face medial do processo coronoide[19], esse músculo cria uma tração que tende a alongar o ramo da mandíbula quando contraído, bem como toda a região óssea percorrida pela trajetória basilar, inclusive o corpo mandibular. Sob essa perspectiva, seria factível imaginar que os homens, pelo maior vigor muscular, apresentariam o corpo da mandíbula maior do que as mulheres. Todavia, o alicerce ósseo mentual, combinado à atividade da trajetória alveolar, que dissipa as forças oclusais transmitidas pelos alvéolos até às faces interna e externa da mandíbula[11], criam um movimento de retrotração que projeta o mento em direção dorsal. Posto isso, como a musculatura masculina exige mais desse reforço ósseo mentual e da trajetória alveolar, o mento dos homens se encontra mais próximo do plano coronal e, consequentemente, do ângulo mandibular, o que justifica as menores medidas coletadas para o comprimento mandibular masculino.

Ao encontro dos resultados obtidos por Ishwarkumar *et al.*[7], Lopez-Capp[5] e Ortiz[18], este estudo avaliou que o ramo mandibular é uma das estruturas sexualmente dimórficas na mandíbula. Por receber grande influência da musculatura mastigatória, essa estrutura óssea é uma importante via da disseminação das forças provocadas pela atividade muscular, abrigando quase todas as trajetórias da mandíbula. Por esse motivo, após estudo conduzido com mandíbulas maceradas, Carvalho *et al.*[9] defendeu a utilização desse acidente anatômico como um preciso padrão de determinação sexual a baixo custo. Os resultados divulgados por esse autor, bem como aqueles obtidos por Lopez-Capp[5], demonstraram uma acurácia superior a 70% na utilização da altura do ramo mandibular como parâmetro de diferenciação sexual. Numericamente, a presente pesquisa obteve, para essa mensuração, resultados masculinos maiores do que os femininos. As amostras masculinas mostraram média da altura do ramo de 5,8649 cm e 5,8137 cm para os antímeros direito e esquerdo, enquanto as coletas femininas apresentaram médias de 5,7282 cm e 5,7538 cm respectivamente.

Por fim, no que tange o experimento desenvolvido com mandíbulas maceradas, observou-se que as medidas que viabilizaram, seguramente, a identificação de mandíbulas masculinas foram a distância entre os côndilos mandibulares e a distância entre os ângulos mandibulares. Já as mensurações que permitiram a determinação sexual de mandíbulas femininas foram a distância entre os processos coronoides e os comprimentos do corpo mandibular direito e esquerdo. Logo, defende-se que a diferenciação sexual de mandíbulas seja feita, prioritariamente, por meio de análises radiográficas, sendo que a avaliação não-digital deve ser utilizada, apenas, quando o método digital não estiver disponível. Ademais, ressalta-se que o presente estudo apresentou limitações, a exemplo da amostra restrita de mandíbulas maceradas, uma vez que as peças com sexo seguramente pré-determinado eram pouco numerosas.

5 CONCLUSÕES

Posteriormente à análise dos resultados encontrados, concluiu-se que:

a) Existem diferenças métricas entre mandíbulas dos sexos masculino e feminino;

b) As mensurações mandibulares de estruturas ímpares látero-laterais que dizem respeito à distância entre os côndilos, à distância entre os ângulos, à distância entre os processos coronoides e à distância entre os forames mentuais são as que mais favorecem a determinação sexual de uma mandíbula a partir de parâmetros métricos, ao exame radiográfico, por apresentarem diferenças iguais ou superiores a 3 mm entre homens e mulheres;

c) As medições mandibulares de estruturas pares anteroposteriores que concernem o comprimento do corpo da mandíbula de ângulo a mento direito e esquerdo são as que mais favorecem o dimorfismo sexual mandibular, ao exame radiográfico, tendo por base

quesitos métricos, uma vez que são as medidas que apresentam diferenças iguais ou superiores a 3 mm entre os sexos;

d) As medidas mandibulares referentes à distância entre os côndilos e à distância entre os ângulos mandibulares são as que mais favorecem, na avaliação não-digital, a identificação sexual de mandíbulas masculinas;

e) As dimensões relacionadas à distância entre os processos coronoides e aos comprimentos do corpo da mandíbula de ângulo a mento direito e esquerdo são as que melhor viabilizam, na avaliação manual com paquímetro, a definição sexual de mandíbulas femininas;

f) Devido à maior exatidão e menor possibilidade de erros metodológicos, na diferenciação do sexo por meio da antropometria mandibular, deve-se priorizar mensurações digitais, utilizando-se a manual apenas quando a primeira não for possível ou como complementar.

g) Tendo em vista a extensão do território brasileiro e a vasta miscigenação de sua população, sugere-se a condução de novos estudos acerca da utilização da mandíbula como estrutura anatômica para a determinação sexual. Adicionalmente a isso, fatores como estilo de vida e hábitos mastigatórios, por alterarem o formato mandibular, corroboram para essa necessidade de realização de novas pesquisas. Finalmente, como o presente estudo demonstrou como limitação uma amostra reduzida de mandíbulas maceradas para a conferência dos resultados radiográficos, sugere-se que os novos experimentos aumentem o número de peças anatômicas analisadas.

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Assessment of oral health literacy in adolescents: Instruments validated in Brazil

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ABSTRACT
Adolescence is a stage of life where there are major physical and biological transformations concomitant with psychological and social ones, which occur with the development of sexuality and which influence the human being's personality and other aspects of life. Health literacy (HL) can be understood as an individual's ability to access, understand, evaluate and put into practice basic health information. Adolescent oral health literacy (OHL) is an area that is little explored, despite the importance of this formative stage in the individual approach to healthy lifestyles and behaviors. The objective of this study was to carry out an integrative literature review on research instruments validated in Brazil for OHL among adolescents. The search strategy was carried out in August 2023, with a broad search for studies that assessed OHL in adolescents, in the Virtual Health Library (VHL), US National Library of Medicine (PubMed) and Scientific Electronic databases. Library Online (Scielo). The keywords used were "health literacy" and "oral health" and "adolescents". Inclusion criteria: free full texts; only: articles, books and documents, clinical trials, meta-analyses, controlled and randomized trials, analyzes and systematic reviews; without limitations of date or language. Exclusion criteria: studies without the three descriptors present in the text simultaneously, theses and monographs, abstracts, letters to the editor. 47 articles were found in VHL, 118 in PubMed and 13 in Scielo. Nineteen articles were analyzed and presented according to: author, title, year of publication, type of study, objectives, sample size and age group, sample recruitment, data collection tool, limitations and health outcomes. The only research instrument on adolescent OHL validated in Brazil was the BREALD-30 questionnaire, a Brazilian version of the Rapid Estimate of Adult Literacy in Dentistry, which measures literacy through word recognition. An important research gap in this field was revealed.

Keywords: Health literacy, Oral health, Surveys and questionnaires, Teenagers.

1 INTRODUCTION

In adolescence, the life stage of major discoveries and emotional instabilities, we observethe influence of interpersonal relationships on risk or health protection behaviors (Jorge *et al.*, 2018). With

the development of sexuality, major physical and biological transformations concomitant with psychological and social transformations are found. These transformations influence the personality of human beings among other aspects of their lives (Barbosa *et al.*, 2020). At this important stage of human training, health promotion strategies are needed to incorporate healthy behaviors that last throughout life. Most Brazilian health policies are targetedat children or adults. Among adolescents, the majority of actions have been curative, not contemplating health promotion efficiently. Preventive policies and actions aimed at the adolescent are necessary, considering their previous knowledge skills and motivation in the development of social, personal, self-knowledge and life skills, so that their choices are in favorof a healthy life (Sørensen *et al.*, 2012; Rocha *et al.*, 2017). When considering health promotionpolicies, Health Education (LS) is configured as an existing proposal.

The expression LS seems to have been translated into Brazilian Portuguese since 1991, from when instruments were used, created or improved to evaluate the levels of LS, in distinct populations (Pinheiro, 2021; Martins *et al.*, 2022). "Health literacy", "Health literacy", "Health literacy" are the translations of the term "*health literacy*" into Brazilian Portuguese. Thetheoretical model presented in 2012 was translated into Brazilian Portuguese in the same year, but the publication was only available in 2015 (Martins *et al.*, 2015). Initially, the Dictionary of Health Sciences Specialties (DECS) introduced the term "health literacy" as the translation of theterm "*health literacy*." The Brazilian Health Literacy Network (REBRALS) has asked DECS management to change the translation of the term "*health literacy*" from "health literacy" to "health literacy", since the terms "literacy" and "literacy" have different meanings in Brazilian Portuguese (Soares, 2004; Tfouni, 2002). In Portugal, the translation of the term "*health literacy*"into Portuguese is "Health literacy". This Portuguese term has also been considered in Brazil. Therefore, in Brazil, publications are available that consider the three translations presented. Theterm "*health literacy"* appears to have been first used by James Dixon in 1959 in Philadelphia (Pennsylvania, United States), citing it as one of the tools that could be used in health disaster situations as pandemics, for economically disadvantaged populations (Dixon, 1959).

In 2008, the World Health Organization (WHO) considered LS as an intermediate determinant in health fundamental to empowerment and equity in health. Initially, the LS definition considered people's need for prior knowledge, skills, and motivation to access,understand, evaluate, and apply health-related information. In 2021, the term Letrada Organization in Health (OLS) (Abrams *et al.*, 2014) was considered in the definition of LS, sinceit was realized that the organization of the health service can corroborate for people to access, understand, evaluate and apply health-related information. It has to be considered that other models have been developed around the world (WHO, 2008; Sørensen et al., 2012; Abrams *et al.*, 2014; Martins *et al., 2015; Nutbean & Lloyd, 2021; Sørensenet al., 2022).*

Children, adolescents, the elderly, ethnic minorities, people with special needs and the disadvantaged stand out as vulnerable groups at low levels of LS. In this context, awareness of the

importance of LS as a determinant of people's quality of life has stood out. LS levels can be assessed by considering different health conditions. Among these conditions, LSB levels have been assessed since 2015 (Junkes *et al.*, 2015; Lima *et al., 2019;*

The quality of the tools for assessing LSB levels should be considered in the context of research, teaching and health services. Thus, in 2012, a *delphi* study was conducted, with the participation of 47 *experts* on the subject, who sought standardization and definition of terms referring to the evaluation of the quality of measuring instruments. In this study, the following steps were presented to assess the quality of the measuring instrument: reliability, validity, responsiveness and interpretability. Reliability refers to the internal consistency and reproducibility of the measurement, as well as the evaluation of measurement errors. Validity is subdivided into content and face validity; construct validity and discriminant validity. Responsiveness refers to the ability of the measuring instrument to identify changes in what is being measured as a consequence of observable facts or interventions that are intended to alter the *scores* being measured in the measuring instrument. Interpretability, on the other hand, concerns the interpretation of the results of the evaluations that consider the measuring instrument (Mokkink, *et al.*, 2012). LS has been identified, since 2022, as a heterogeneous phenomenon, with diverse origins and evolving (Martins *et al.*, 2022, Martins, *et al.*, 2023). Instruments have been developed that evaluate LS considering the general health of people, as well as instruments directed to certain health conditions or specific populations (Marques e Lemos, 2017). Regarding oral health, some instruments have been developed (Cruvinel, *et al*., 2017; Bado, *et al*., 2018; Firmino, et al., 2020; Lins,et al., 2020). However, it seems that instruments that aim to evaluate oral health literacy (BLS) among adolescents are scarce. It is therefore proposed to identify and evaluate instruments used in Brazil for measuring LSB levelsamong adolescents.

2 METHODS

The literature review called integrativa provides expanded information on a subject, making up a body of knowledge. It uses judicious research methods employed to provide the bestknowledge produced about a given research problem, so that these are critically evaluated by professionals with clinical skills and then incorporated into care practice. It presents different purposes such as defining concepts, reviewing theories or methodological analysis of studies ona given topic (Ercole *et al.*, 2014), allowing also the combination of data from empirical and theoretical literature that can be directed to the identification of spaces in the areas of studies.

2.1 IDENTIFICATION

This integrative literature review, with different methods combined, aimed at broadeningthe possibilities of analysis of scientific knowledge regarding the validation of questionnaires onadolescent

BLS in Brazil. This method synthesized the results obtained in research on the theme, in a comprehensive, systematic and orderly manner. The synthesis of knowledge about the current validated methods for measuring the LSB of adolescents in Brazil can point out possiblescientific gaps to be addressed in future studies. For a broader coverage for the identification of data, a broad question containing the central terms of the search was elaborated, generating the guiding question that guided the review: which instruments for the assessment of adolescent BLSwere validated in Brazil?

2.2 SEARCH STRATEGY

The search strategy was conducted in August 2023, with a broad search for studies that evaluated LSB in adolescents. Research was carried out on articles in the databases Virtual Library on Health (VHL), *US National Library of Medicine* (*PubMed*) and*Scientific Electronic Library Online* (*published*). The keywords used were identified in the Descriptors in Health Sciences (DeCS), of which the terms in Portuguese were used: "literacy in health" *and* "oral health" *and* "adolescents". During the database search, only the "*and*" connective was used to make combinations of the terms.

2.3 ELIGIBILITY CRITERIA

To meet the inclusion criteria, the following studies were eligible: articles, books and documents, without date or language limitations. With regard to the exclusion criteria, studies were not eligible without the three descriptors present in the text simultaneously, theses and monographs, abstracts, letters to the editor, studies involving LS not specific for Dentistry or thatused instruments not validated for use in Brazil, duplicity articles in the researched bases, articlesnot available in full. The process of inclusion and exclusion of this integrative review followedthe *recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyzes* -PRISMA, and for transparency in reporting the results (Hutton *et al.*, 2015), a flowchart was used indicating this procedure, presented in the results of the research, in Figure 1.

2.4 ANALYSIS OF ARTICLES

Only two of the authors evaluated the articles independently, by title, objective, methodology, results, and conclusion, during the search in the databases. In moments of persistent disagreements between these two authors, the last author was consulted, for havingmore experience in scientific research.

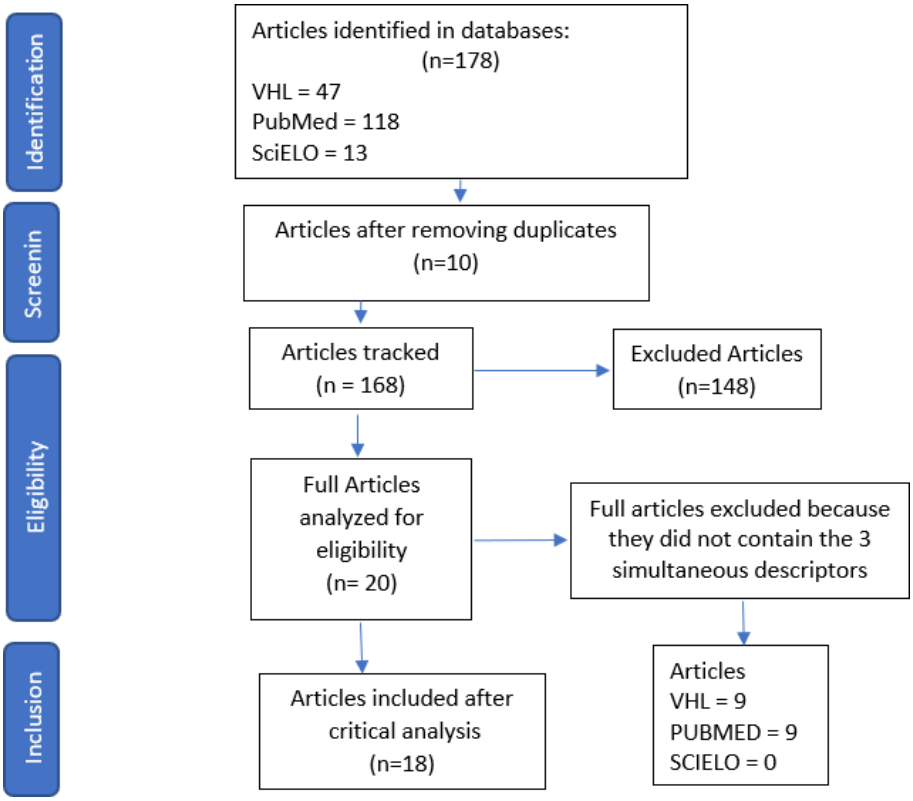
3 RESULTS

According to the combination of the keywords selected in DeCS and the pre-establishedsearch filters, the survey resulted in 47 articles in VHL, 118 in *PubMed* and 13 in *Scielo*. After reading the

title, the objective, the methodology, the results, the conclusion and the application of the eligibility (inclusion) and ineligibility (exclusion) criteria, they were selected: 13 in the VHL; 16 were elected in *Pubmed* and no articles were elected in *Scielo*. All were read in full foreligibility to be certified, leaving, then, 19 articles selected through the search strategies.

The process flow chart for this integrative review is depicted in Figure 1.

Figure 1: Flowchart of the process of exclusion and inclusion of the integrative review, following PRISMA recommendations.



Source: Survey data, 2023.

During the process of reading in full the articles selected for this research, the main resultswere extracted in a synthesized form. The publication period of the 18 articles ranged from 2015 to 2022, with 17 in the English language. All articles are quantitative and epidemiological. The presentation of the results obtained was made in a descriptive manner by means of Table 1, wherethe nine articles found in *PubMed* and the ten articles found in the VHL are distributed in chronological order. Only the data considered most relevant for the present study were evidenced,and presented according to: author, year of publication, location, database, type of study, objectives, sample size, age group and sample recruitment, data collection tool, limitations and health outcomes.

Table 1: Distribution of the 18 articles found in VHL and Pubmed in August 2023 on validated questionnaires fororal health literacy in adolescents, as to author, title, year of publication and database; type of study; objectives; sample size, age group and sample recruitment; data collection tool; limitations and outcomes in health.

Author, year/ Place of study, Database	**Study design**	**Objectives**	**Sample size, age group and recruitment**	**Tool data collection**	**Limitations**	**Health outcomes**
Tsé Carrie K, *et al.*, 2015. Hong Kong, ChinaPubmed	Pilot study, transverse, experimental, randomized	Conduct a pilot study to evaluatethe effectivenessof three majormedia outlets -Twitter, Facebook and YouTube - in supporting adolescent's LSB	Random sample 22 adolescents(aged 14 to 16) from an English school	Social media use and dental experience were collected through a questionnaire. One LSB preand post test(REALD-30)	Cross-sectional study, small sample number, Self-reported experience, participants wererecruited group high socioeconomic status	Audiovisual social mediafrom Facebook and YouTube canbe more Effective fororal healthpromotion (SB) in a Sample ofschool teens
Neelima M, *et al.*,2018. Mysoe, India. Pubmed	Cross-sectional study	Evaluate LSBand SB statusamong adolescents from pre-university colleges	401 (201 adolescents from public and 200, private schools) aged 15 to 20. 50 adolescents paired by gender, drawnby simple random sampling	Structured questionnaire socio-demographic information, previous medical and dental visits, oral hygiene and dietary practices. WHO Oral Health Assessment Form forAdults-2013 and Rapid Estimate Adult Literacy in Medicine REALMD-20 scale	Cross-sectional study, urban areaonly, major cultural differences. The questionnaire usedmeasures there cognition of SB-related words, nottesting the conceptual understanding of what is read	The LSB was significantly associated with the typeof institution,course, dental history and number ofdental visits
Muhammad Ashraf, 2018. Saudi Arabia. Pubmed	Population-based cross-sectional study	Investigate the frequency ofgoing to thedental office andits predictors among adolescent males	376 maleadolescents aged 13 to 14 years.Multi-stage random sampling to recruit participants from publicschools	WHO SB Questionnairefor Children	Cross-sectional study Data collection male only. Data collection of girls by male researchers was difficult due to Arab culture. Self-referenced data	Going to the dental officewas commonin males. Painwas the reasonand a predictorfor dental care,and a smallproportion ofadolescents had dental appointments to routine dental examinations

Khudanov, Bakhtinur *et al.*, 2018. Tashkent, Uzbekistan. VHL	Experimental randomized educational trial longitudinal	Determine if anSB EducationProgram Using a*Qscan* Device could improvethe state of oralhygiene and O LSB of adolescents	One hundred adolescents aged 14 to 16 years, randomization of swappedblocks: (i) control group (traditional learning) and (ii)experimental group (Qscandevice-based learning that allows visualization ofbiofilm through fluorescence)	Socio-demographic questionnaire, knowledge, attitude behavior. SBwas examined (plaque index, cpod, periodonto) atbaseline, 6 months and 18 months after interventions Knowledge, behavior and attitude questionnaire	Sample collectedin the same areawith equal financial condition. The useof *Qscan* allowedeach dentist to select the mostsevere area of the mouth in particular, while educating students	The inclusionof QLF light-induced fluorescence technology ina learningprogram school was helpful in improving the state of oral hygiene and LSB of Uzbekistan's adolescents
Wiener R. Constance *et al.*, 2020. West Virginia, USA, Pubmed	Randomized educational trial Experimental transverse control	Determine whether a peer-assisted learningapproach wouldimpact SB knowledge/attit udes/beliefs and skills for high school children	245 high school students. between 13 and20 years of age, 52.3% of themale sex. Convenience sampling. Cluster designating schools: one for intervention with use of media or a control, with SBhandouts	Pre-test and post-test with evaluation of SB knowledge/atti tudes/beliefs and a self-report of brushing and flossing (SB behaviors)	Cross-sectional study, self-reported brushing	Peer-assisted learning for knowledge oforal hygieneattitudes andbehaviors had similar results when the teacher provided handouts and activity sheets or when providing interactive media and technologies
Dutra, Laio da Costa, *et al.*, 2019Campina Grande,Paraíba, Brazil, VHL	Analytical population-based cross-sectional study used pilot study STROBE s	Investigate whether the Ability to recognize andread SB terms is associated withthe number ofteeth with carious lesions cavitated in adolescents	746 adolescents, 15 to 19 years. probability sampling by two-stage conglomerates (schools and teenagers) stratified by cityadministrative district and typeof school (publicor private)	Parents answered asociodemogra phic questionnaire and adolescents BREALD-30	Cross-sectional study The questionnaire usedmeasures there cognition of SB-related words, nottesting the conceptual understanding ofwhat is read	There is a needfor dentists to improve theiruse of language when communicatin g with patients, for decision making. Adolescents with lowerlevels of BLShad a higher number of teeth with cavitated carious lesions, regardless oftheir socioeconomic level and history of dental visits

Lima, Larissa Chaves Morais de,*et al.*, 2019. Campina Grande,PB, Brazil. VHL	Questionnaire validation with analytical and cross-sectional approach to evaluate psychometric properties (reliability and validity)	To evaluate the psychometric properties of the Portuguese version of theRapid Estimateof Adult Literacy inDentistry (BREALD-30) applied to adolescents	750 adolescents: 375 aged 12 and 375 aged 15 to19, 10 publicschools and 17 private schools randomly drawn. Presentswere evaluatedon the day ofdata collection	Semi- structured questionnaire, objective questions addressing sociodemographic characteristics, questionnaire Brazilian Economic Classification, BREALD-30 and *Functional Literacy*. Clinical data on dental caries Indicator (FLI)	Cross-sectional study The questionnaire usedmeasures therecognition of SB-related words, not testing the conceptual understanding ofwhat is read Self-applicable questionnaire. Local cultural issues	BREALD-30 has shown satisfactory psychometric properties foruse in adolescents Brazilian. Considering Brazil's sizeand culturaldiversity, it will be interesting to observe whether psychometric properties are maintained with adolescents from other regions
Lopes, Roanny Torres, *et al.*, 2020. Campina Grande, Paraíba, Brazil. VHL	Cross- sectional, analytical study with pilotstudy.	Evaluate sociodemographic, family, and behavioral factors associated withLSB in adolescents	746 adolescents aged 15 to 19 years. (16 public and 16 private) from 131 urban schools. Probabilistic sampling by conglomerates complex samples	Socio-demographic questionnaire was sent to parents, scaleof assessmentof adaptabilityand family cohesion, screening test alcohol, smoking andinvolvement with substances, type of dental service used inthe last consultation, BREALD-30	Cross-sectional study The questionnaire usedmeasures there cognition of SB-related words, nottesting the conceptual understanding ofwhat is read	Brazilian adolescents with better socioeconomic status, from families with "entangled" cohesion and "rigid" or "structured" adaptability and whose parents were married showed betterlevels of LSB
#Neves, Érick Tássio Barbosa, *et al.*, 2020. Campina Grande, Paraíba, Brazil. VHL	Cross-sectional study with pilot study	To evaluate the association between the prevalence of cavitated toothdecay and LSBfamily characteristics and sociodemographic factors in early adolescence	740 12-year-old schoolchildren. 520 pupils from 14 public schools and 249 pupils from 18 private schools,selected at random	Diagnosis ofdental caries.Responsible for students provided information on sociodemographic data and students provided information onthe characteristics of the BREALD-30 family. Economic Classification Criteria, FACES-III	Cross-sectional study The questionnaire used measures there cognition of SB-related words, nottesting the conceptual understanding of what is read	A low level of BLS, sociodemographic factors,and a low levelof familialcohesion arepredictors of cavitated caries lesionsin early adolescence

Neves, Érick Tássio Barbosa, *etal.*, 2021. Paraíba, Campina Grande, Brazil VHL	A population-based, observational, analytical cross-sectional study used a pilot study	To evaluate the association of contextual and Individual factors with LSBin early adolescence	740 12-year-old adolescents. randomly selected by probability sampling byconglomerates in two stages of Campina Grande schools.14 public and 18private schools. 520 public and 249 privateschools. 29 left	Eight variables were considered andsocioeconomic information collected with caregivers. Brazilian version of *Family Adaptability and Cohesion Scales*(FACESIII) to measurefamily functionality, and BREALD-30	Cross-sectional study The questionnaire usedmeasures there cognition of SB-related words, nottesting the conceptual understanding of what is read	Individual and contextual factors were associated with BLS inearly adolescence. Female gender, mother's schooling above 8 yearsand balanced family function wereassociated with better*scores*. Adolescents enrolled in schools with higher failurerates had s*lightly* worseLSB scores
Lima, Larissa Chaves Morais, *et al.*, 2021. Campina Grande, Paraíba, Brazil. VHL	Cross-sectional and analytical study STROBE	Evaluate the association between functional literacy andrecognition ofthe word "bruxism" among adolescents	375 12-year-old schoolchildren and 368 from 15 to 19 years. Public and privateschools. Samplesample calculation, withan increase of20% in the total number of	Parents/caregi vers respondedto a socio-demographic judgment. BREALD-30, recognition ofthe word "bruxism" wasused as a dependent variable	Cross-sectional study The questionnaire measures the recognition of SB-related words, not testing the conceptual understanding ofwhat is read.	Recognition ofthe term"bruxism" among 12-year-olds was influenced bythe presence ofhealth insurance and higher level of functional literacy. At theage of 15, hewas influencedby the higherlevel of functional literacy, thelower numberof people athome, the higher level of schooling ofthe person incharge and going to the dentist

Silver, Isolda Mirelle de Lima Ferreira, *et al.*, 2021[a]. Campina Grande, Brazil. Pubmed	Cross- sectional, analytical, school-based study used pilot study	Explore the association between familycohesion and self-perception of the need fordental treatmentamong adolescents	746 pupils aged 15 to 19 enrolledin 16 public and privateschools, randomly selected in thecity's six administrative districts. Sampling conglomerate probabilistic analysis carriedout in two stages. The students were selected by simple samplingdraw at each school	Parents/guardians provided information on sociodemographic data. BREALD-30. Supervised brushing, topical fluoride application and clinical examination. Diagnosis of tooth decayusing Nyvad criteria. FACES III: self-perception need dental treatment, toothache, cohesion and family adaptability	Cross-sectional study, self-report.The questionnaire used measures there cognition of words related to SB, not testing theconceptual understanding ofwhat is read	Tooth decay,pain and toothloss, and family cohesion haveinfluenced self-perception of the need fordental treatment in adolescents. Include environmental assessment family is ofgreat relevance in the expansionof healthy behaviors in adolescents
Silver, Isolda Mirelle de Lima Ferreira, *et al.*, 2021[b]. Campina Grande, Brazil. Pubmed	Population-based cross-sectional analytical study used pilot study	Investigate whether LSB and schoolcontext are associated with caries untreated teeth in the anteriorteeth of adolescents	746 students aged 15 to 19. Probabilistic cluster samplingin two traineeships (schools andadolescents). 32 schools were selected by random drawwith proportional distribution of teenagers in thesix administrative districts of the city	Parents completed a sociodemographic questionnaire and absence/presence of private health plan.Two examiners were trained for the diagnosis ofdental caries using the Nyvad and BREALD-30 criteria	Cross-sectional study The questionnaire used measures the recognition of words related to SB, not testing theconceptual understanding ofwhat is read	The presenceof tooth decay, toothache reported in thelast 6 months,tooth loss, andfamily cohesion of the agglutinated type influenced the self-perceptionof the need fordental treatment in adolescents aged 15 to 19years
Lopes, Roanny Torres, *et al.*, 2021. Campina Grande,Paraíba, Brazil. VHL	Cross- sectional, analytical study with pilot study	Evaluate associations between BLS and family, sociodemographic and dentalservice characteristics in adolescents.	740 adolescents aged 12 years. probabilistic cluster samplingin 14 public schools and 18private ones,simple randomization procedure. cluster.	BREALD-30, FACES III and asked about the type ofdental service(public or private) they used in the last consultation. Socio- economic Questionnaire to Caregivers	Cross-sectional study The questionnaire usedmeasures the recognition of words related to SB, not testing theconceptual understanding ofwhat is read.	Adolescents with female sex, rigid andstructured connected family structure, mother's schooling above 8 years,caregiver's ageabove 38 years and privatedental service type showed the best level of LSB

Moura, Mirella de Fatima Liberato, *etal.*, 2021. Cajazeiras, Paraíba, Brazil. VHL	Cross- sectional, randomized, pilot study	Investigate associations between family environment, adolescents with ADHD, and BHS with experience of early adolescent caries	448 12-year-olds in publicand private schools randomized	SNAP IV, FACES III,CPOD, BREALD-30	Cross-sectional study Lack of a definitive diagnosis for ADHD. The questionnaire usedmeasures recognition of SBA-related words by not testing conceptual understanding of what is read	Adolescents with more symptoms of ADHD, lower BLS, lower household income, and families withmore residentsin the household had greater experience of caries
He, Jinfeng *et al.*, 2022. Longhua District, Shenzhen, China. Pubmed	Analytical, cross-sectional,multi-level analysis	assess the effectsof socio-demographicfactors, dental status, SB knowledge and health-related behaviors indental visits inadolescents 12 years old	953 adolescentsof 12 years, ofwhich 48.3% were public schools and 51.7% were private; 49.1% (n=468) wereboys. Two-stage probabilistic cluster sampling. Thenthe schools were randomly selected withprobability proportional tosize	Self-reported questionnaire with demographic variables, socioeconomic situation, dietary habit,SB behavior, SB-related knowledge, SB-related attitude; The codified oral impactscale on daily performance (OIDP) andSB-related quality of life impact (QVRS)	Cross-sectional study Failed to collect economicfamily historydata. Main study outcome self-reported higher risk of memory bias	The dental visits of 12-year-old adolescents in the district of Longhua were affected by multidimensional factors. Strengthening SB educationand cultivating good oralhygiene habitscan be a viableintervention toimprove effectively the overall level ofSB in adolescents
Ardekani, F Movaseghi, *et al.*,2022 Shiraz, Fars, province ofIran. Pubmed	Randomized educational (experimental) trial transverse controlled	Determine theeffect of theory-based educationon the behaviorof SB and itspsychological determinants, including LSB	162 high school girls aged 14-15. allocation wasmade at thecluster level, 4 schools were randomly divided into control and experimental groups; intervention groups (n = 77)and control groups (n = 85)	A questionnaire to evaluate demographic information, knowledge, behaviors of SB and thePMT constructsLSB Protection Motivation Theory and another questionnaire to evaluate knowledge inSB	Cross-sectional study Study conducted only with girls. Girls who abandoned research. Self-report	After educational intervention, mean SB improved inthe group.There was adecrease in the biofilm index

Baskaradoss, Jagan Kumar *et al.*, 2022. Kuwait, Kuwait. Pubmed	Cross- sectional, population-based study	Evaluate the association between caregiver BLSand SB status ofspecial youth	214 specialyoung pair/caregiver 6 to 12 years and 12 to 21 years.Two-stage cluster samplingtechnique: fourspecial youth schools were randomly selected	Respondents reported on demographic and socioeconomic factors, medical and dental condition of the specialchild. Comprehensive Measure of Knowledge inSB (CMOHK) questionnaire. Gingival indexand plaque index were examined	Cross-sectional study, non-probabilistic sampling for selection of participants, low levels of caregiver conceptual knowledge and cultural issues	Lower levels of caregiver BLS were associated with higher plaque scoresfor your child. Marketing campaigns awareness to improve LSBand caregiverattitude can help improveoral hygiene for special young people

Source: Survey data, 2023.

4 DISCUSSION

Few questionnaires have been developed to evaluate the LSB of adolescents (Tse *et al*, 2015), and these instruments must demonstrate good psychometric properties, for this they need to be evaluated as to their quality (as evaluation of reliability, validity, responsiveness and interpretability). The evaluation of questionnaires used in scientific research on this topic for adolescent audiences is important to ensure that the results obtained are accurate and reliable, ensuring that they can be generalized to the target population. The tools for evaluation, when they demonstrate adequate psychometric properties, are useful and capable of presenting scientifically robust results (Keszei *et al.*, 2010; Mokkink *et al.*, 2010), and can collaborate withhealth professionals in identifying failures in health education and improving SB policies, allowing an intervention closer to the reality of the population in which they operate (Lins *et al*,2020). Only five evaluation instruments described in the world literature measure LS in adolescents (9 to 19 year-old participants) (Perry, 2014). Although most of these evaluation instruments have good internal consistency for this age group, there is a shortage of valid instruments to evaluate the construct in adolescents (Perry, 2014; Vilella, *et al.*, 2016).

In Brazil, until the end of 2015, there was only one instrument for measuring the LSB in adolescents, translated and validated into Brazilian Portuguese, the *Brazilian Rapid Estimate of Adult Literacy in Dentistry* (BREALD-30), (Baldo e Mialhe 2019; Tsé *et al., 2015; Lins 2020) and therefore an emerging theme in* the scientific community (Bado e Mialhe, 2019). A low levelof LSB is one of the predictors of cavitated caries lesions in adolescence, associated with socioeconomic factors and a low level of family cohesion (Neves *et al.*, 2020), correlated with low values of social capital (Knorst, 2022). The adolescent's LSB is an area little explored, in spite of the importance of this formative stage in the individual approach to lifestyles and healthybehaviors. Although some authors (Lins *et al.*, 2020;

Neves *et al.*, 2021) claim that there is a gapin the literature on instruments for evaluating LSB in adolescents, LSB levels have been evaluated among Brazilian adolescents.

According to Lins *et al.* (2020) , only four LSB evaluation instruments have validation for use in Brazil in adults, and, only one of these has demonstrated validity and reliability for application in adolescents in the country, *Brazilian Portuguese version of the Rapid Estimate ofAdult Literacy in Dentistry, BREALD-30.* The present review of integrative literature meets theseauthors, because it also came across this same instrument in most Brazilian investigations on thesubject, analyzed (Dutra *et al*., 2019; Lima *et al*., 2019; Lopes *et al*., 2020; Moura *et al*., 2020; Neves *et al*., 2020; Lopes *et al*., 2021; Neves *et al*., 2021; Prataet al.org (see recital 21). The research that evaluated LSB in Hong Kong adolescents (Tse *et al.*, 2015) used the same validated instrument for Japan, Rapid Estimate of Adult Literacy in Dentistry, REALD-30, with14 to 16 year olds; In India, *Rapid Estimate Adult Literacy in Medicine and Dentistry*, REALMD-20, for 15 to 20 year olds (Neelima *et al.[1], 2018)* was used; And in Kwuait, the Comprehensive Measure of Oral Health Knowledge tK, was applied to people 6 to 1 2 years and 12 to 21 years of age (Baskarados The other studies analyzed (Wiener *et al.*, 2020; Khudanov *et al.*, 2020; Neves *et al*., 2021) did not mention the questionnaire used to measure the LSB of adolescents intheir research.

The questionnaires mentioned above are different in terms of structure, content and psychometric properties. REALMD-20 was developed as a tool that evaluates the patient's abilityto read medical and dental terminology. It is a brief 20-item screening tool that is used to evaluateLSB and help fill the blank space of doctor-patient communication. The high feasibility of the tool saves time for the doctor/dentist, with easy-to-understand instructions for participants (Neelima *et al.*, 2018). It has not yet been used in epidemiological studies beyond the validationprocess, making it impossible to analyze and compare the results, as well as to evaluate the effectiveness of the tools in the national territory (Lins *et al.*, 2020).

The REALD-30 was developed especially for the context of SB. It consists of 30 commondental words with varying degrees of difficulty, which were taken from the dictionary of the *American Dental Association*. Words or terms from brochures and written materials provided todentists and patients were also included. It is based on an interview, requiring participants to readaloud a list of 30 words related to SB, in a time of 2 minutes (Tsé *et al.*, 2015).

According to Junkes *et al.* (2015), the BREALD-30 is a Brazilian version of the *Rapid Estimate of Adult Literacy in Dentistry*, which also consists of 30 dental words, which the respondent must read aloud, covering etiological, anatomical, preventive and curative aspects ofadverse oral conditions. The instrument measures the LSB based on word recognition, organizedin ascending order of difficulty of pronunciation.

Most articles using BREALD-30 presented the analysis of only one skill relative to LSBas a

limitation of research (Firmino *et al.*, 2017). There is a decontextualization of the words presented to the interviewee, which are randomly arranged for the reading, not allowing the examiner to distinguish whether the individual understands and is capable of applying the item in his daily life in a critical manner, or whether he was merely able to pronounce it. By evaluating the construct in its multidimensionality, this type of tool for measuring the degree of LSB fails, although it makes possible a quick and easy administration, as well as a general analysis of the level of literacy of the individual

Most of the epidemiological studies found in this review using BREALD-30 were conducted in Paraíba, Northeast of the country (Dutra *et al*., 2019; Lima *et al*., 2019; Lopes *et al.*, 2020; Moura *et al*., 2020; Neves *et al*., 2020; Lopes *et al*., 2021; Neves *et al*., Prata *et al*. 2021).

The surveys presented an irregular national distribution, which impaired the analysis of the degree of LSB in the different demographic and socioeconomic contexts of Brazil. The lack of data in the other regions of the country, in contrast to the greater concentration of studies in the South (60%), reflects the need for a fairer disposition of the investigations (Lins *et al.*, 2020).

In the category of conceptual knowledge, the CMOHK stands out (Baskarados *et al.*, 2022). It was developed by a group of American researchers (Macek *et al.*, 2010). It consists of 23 questions: 10 questions that evaluate the basic knowledge of the interviewees, six questions that evaluate the knowledge about prevention and treatment of dental caries, five questions that evaluate the knowledge about prevention and treatment of periodontal disease, and two questionsthat evaluate oral cancer. This instrument has no validated version for Brazilian Portuguese.

Articles were also located that present validated instruments for Brazilian Portuguese forthe evaluation of LSB in adults, which could be adapted for the adolescent public. Among theseinstruments are the three questionnaires: Brazilian Short version of the Oral Health Literacy Assessment (OLHA-B-15) (BADO, *et al*., 2018); Short-form of Health Literacy Dental Scale (HeLD-14) (Mialhe *et al., 2020) and Brazilian Oral Health Literacy-Adults Questionnaire (BOHL-AQ) (Almeidaet al., 2022).* The *Oral Health Literacy for Diabetics* (OHL-D) questionnaire (Martins *et al.*, 2020) was validated for adults diagnosed with diabetes mellitus. And the two *Brazilian Portuguese version of the Hong Kong OHL Assessment Task for PediatricDentistry* (HKOHLAT-P) (Firmino, 2019; Firmino *et al.*, 2020) andShortForm of the Brazilian Oral Health Literacy Assessment Task for Pediatric Dentistry(BOHLAT-P-30) (Firmino, 2022)have been validated for parents/guardians of pediatric dental patients.

This integrative literature review presented as a limitation the low amount of evidence found on LSB evaluation instruments in adolescents validated in Brazil, limiting the ability to understand how LSB can affect the health of adolescents within the school environment in the long term. However, he employed judicious research methods providing the best knowledge produced about the investigated problem, and the results could support the critical evaluation ofprofessionals, to then be incorporated

into the practice of care. In addition to the fact that no studies were found that consider all the potential factors associated with LSB among adolescents,the need for the development and evaluation of LSB instruments for this age group in the countrywas verified.

The use of validated questionnaires in the country to measure the LSB of adolescents is important because it allows an accurate and reliable assessment of the knowledge and understanding of adolescents about basic information and services of SB. This can help healthcare professionals identify gaps in the methods of health education currently employed andimprove SB policies, allowing intervention closer to the reality of the population in this age groupin which they operate. In addition, the use of these questionnaires can help identify adolescents with low LSB levels and provide information for the development of specific educational programs to improve the knowledge and understanding of these adolescents about SB.

5 FINAL CONSIDERATIONS

The only research instrument on adolescent BLS validated in Brazil was the BREALD- 30 questionnaire, a Brazilian version of the *Rapid Estimate of Adult Literacy in Dentistry*, whichmeasures literacy through word recognition. There has been an important lack of research in thisfield. It is suggested to apply this questionnaire in adolescents from different regions and contextsof the country, as well as the validation of other instruments, with different approaches, to measure LSB based on the ability of the adolescent to search, understand and use SB information.The validation of questionnaires on this topic in the country could allow professionals to intervene in education and SB closer to the reality of the population in which they operate. By considering the LSB levels recorded among school adolescents, public health managers can develop strategies that aim to assist humanized SB, thus improving the quality of life of the adolescent school community (teachers and students), their family and their surroundings.

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Hydrocephalus secondary to diverticulum in the quadrigeminal lamina, a case report

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ABSTRACT
Diverticula of the ventricular system are a difficult and rare pathology, but their proper identification provides a better therapeutic plan and effective resolution. Easily mistaken for cysts, and most located in the ventricular atrium. Diverticula respond well to treatment with ventriculoperitoneal shunts (PVD) and endoscopic terceivoventriculostomy (ETT).

Keywords: Quadrigeminal diverticulum, Hydrocephalus.

1 INTRODUCTION

Diverticula of the ventricular system are a difficult and rare pathology, but their proper identification provides a better therapeutic plan and effective resolution. Easily mistaken for cysts, and most commonly located in the ventricular atrium. Diverticula respond well to treatment with ventriculoperitoneal shunts (PVD) and endoscopic terceivoventriculostomy (ETT).

2 OBJECTIVE

To report a case of diverticulum in the quadrigeminal lamina.

3 METHODOLOGY

Case report of HSVP-Jundiaí –SP. The following descriptors were searched: diverticulum; hydrocephalus; quadrigeminal and cyst in the pubmed databases.

4 CASE REPORT

T.D.S.M, 20 years old, diagnosed with Kartagener syndrome in follow-up with APAE (Associations of Parents and Friends of the Exceptional), due to delay in NPMD (neuropsychomotor development). The patient started vomiting and bilateral papilledema, and cranial resonance imaging (see Fig. 1, 2, 3) was requested, with and without contrast, showing obstructive hydrocephalus secondary to cyst in the quadrigeminal cistern and aqueductal stenosis, in addition to agenesis of the cerebellar vermis and corpus callosum.

As previously mentioned, despite the cognitive delay, she did not present any other alteration on neurological physical examination.

It was decided to perform an endoscopic third ventriculostomy with aqueductoplasty, showing during the procedure that it was a diverticulum and not a cyst as previously suspected.

The patient progressed with improvement in the clinical picture and in the control on non-contrast-enhanced cranial tomography (see Fig. 4). Currently, the patient is under outpatient follow-up with no new changes.

Figure 1 - Non-contrast T1-weighted MRI. Showing dilatation of the supratentorial ventricles and the diverticulum (arrow).

Figure 2- Sagittal T2-weighted MRI - Diverticulum (arrow) can be visualized

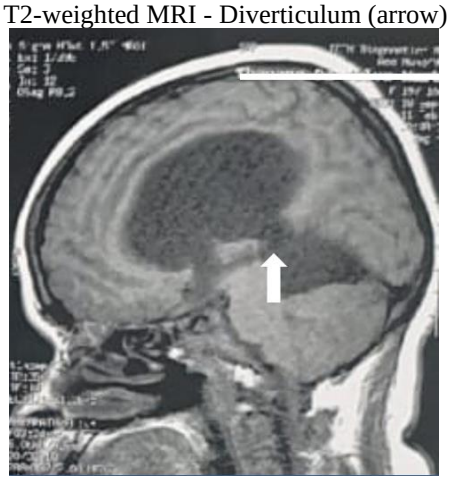

Figure 3 - T2-weighted MRI - Coronal Cut - Diverticulum (arrow) may be evidenced

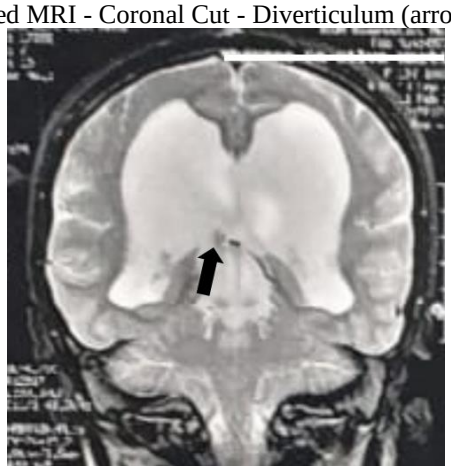

Figure 4 - Postoperative CT scan showing reduction of the diverticulum and presence of grooves in the convexity.

5 DISCUSSION

Ventricular diverticula are a subpial collection of cerebrospinal fluid resulting from rupture of the ependymal surface in the ventricular system.

They arise as a result of severe and chronic obstructive hydrocephalus1. It is believed that it may occur in about 25% of patients with severe long-term hydrocephalus1.

Due to their rarity, these diverticula can often be confused with arachnoid cysts, as described in the literature2,3.

The ventricular atrium would be the most common site of diverticula, which is justified by the fragility of its wall in this region, which is more influenced by the chronic increase in intracranial pressure4

The main symptoms are those related to chronic hydrocephalus, such as headache and delay in neuropsychomotor development and even field deficit and visual acuity related to the anterior visual system as described by Kapila, A, et al.[5.]

Among the treatments found in the literature for this disease, PVD, endoscopic fenestration of the diverticulum, and more recently TVE are suggested as the only and resolutive treatment, being considered as the gold standard for the treatment of obstructive hydrocephalus, reducing intraventricular pressure and reversing the pathophysiology of diverticulum formation.

In this case, after the performance of TVE, the patient progressed with significant improvement, with no new complaints to date and maintaining outpatient follow-up.

6 CONCLUSION

In the presence of a lesion with intraventricular cystic characteristics, especially in the ventricular atrium, and consequent obstructive hydrocephalus, the possibility of a diverticulum should be considered, with SVT being a good diagnostic and therapeutic option, with low surgical morbidity

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Functional and esthetic rehabilitation of a patient with squamous cell carcinoma of the tongue: Case report

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ABSTRACT

The present case history reports describes a clinical course from diagnosis to the functional and esthetic rehabilitation of a patient with squamous cell carcinoma of the tongue (SCCT). Radical approaches for SCCT often result in severe deficiencies and reduced quality of life. In this case the treatment included total glossectomy with flap pectoral muscle reconstruction and radiotherapy. An interdisciplinary team worked together to functional rehabilitation of the patient, carried in two phases: preoperative assessment and post-operative reconstruction. The findings from this case showed that functional and esthetic rehabilitation promote social rehabilitation in patients with SCCT treated with radical approaches.

Keywords: Squamous cell carcinoma, Tongue, Glossectomy, Rehabilitation and quality of lif.

1 INTRODUCTION

Squamous cell carcinoma of the tongue (SCCT) is the most common type of malignant tumor of the oral cavity (Keiichi O. & Hitoshi Y., 2019). The treatment of choice is surgery or radiotherapy, or a combination of both (T Singh and M Schenberg, 2013). Advanced lesions require a more radical approach that may involve partial or total glossectomy with or without neck dissection and tongue reconstruction with regional flaps or distant-donor free flaps (Liang Y *et al*., 2015). These radical approaches may result in severe deficiencies and are associated with impairments in speech, mastication, and swallowing and a reduced quality of life (Pankaj K. Et al., 2018). Functional rehabilitation is essential in treating patients with SCCT, especially when functions important for social

life are involved (Romeo U *et al*., 2013). Esthetic rehabilitation is also recognized as an important aspect for these patients and helps in restoring the patients' social life. An important goal of prosthodontics treatment is to improve the quality of life by improving function and esthetics (Fierz J *et al.*, 2013). [7] Prosthodontics treatment involves many steps and requires the expertise of an interdisciplinary team involving a number of different professionals.

This case history report describes the clinical course from diagnosis to functional, esthetic, and social rehabilitation of a patient with SCCT, and highlights the importance of an interdisciplinary team working together to achieve a better quality of life for the patient.

2 CASE HISTORY REPORT

A 53-year-old man was referred with history of a lesion of the tongue that caused pain and difficulty during chewing and swallowing. Physical examination of the oral mucosa revealed an ulceration in the left side of the tongue, extending from the dorsum of the tongue to the floor of the mouth, with 1 month of evolution. The ulceration had a necrotic basis with an elevated and indurated border, and caused severe pain to the patient on touch (**Fig. 1A**). The tongue was indurated and without movement. There was cervical lymph node involvement in the submandibular region. The patient had a 35-year history of cigarette smoking, but his medical history was otherwise unremarkable. The findings were suggestive of SCCT. An incisional biopsy of the lesion was performed and the tissue was submitted for histopathologic examination, which revealed moderately differentiated SCC. The patient subsequently referred to an oncologist and a head and neck surgeon. A definitive diagnosis of SCCT with invasive growth, T3N2bMx was made, and the patient was treated with total glossectomy with flap pectoral muscle reconstruction (**Fig. 1B**), with neck dissection and radiotherapy, which was started 45 days after surgery and lasted for two months.

In the preoperative assessment, a complete head and neck examination was carried out and radiographs were made for overall evaluation, oral prophylaxis, periodontal treatment, and extractions of all the mandibular teeth and almost all the maxillary teeth, except the maxillary right second premolar, maxillary right canine, maxillary right lateral incisor, maxillary right central incisor, maxillary left central incisor and, maxillary left lateral incisor. Preparation and fabrication of restorations were performed. Several oral hygiene protocols were applied and appropriate instructions were provided to the patient to prevent complications of anticancer therapy.

Post-operative reconstruction: Esthetic and functional rehabilitation was performed by direct restoration, which was followed by the construction of a palatal augmentation prosthesis (PAP). For this purpose, a complete denture cast was constructed in irreversible hydrocolloid (**Fig. 2A**), and casting with gypsum cement and teeth waxing were performed subsequently. The objective was to impart a harmonious smile to the patient and obtain a guide cast for reconstruction in composite resin.

The cast was developed in condensation silicone (Zetaplus/ Oranwash, Zermach) and clipped on the incisal part, thereby maintaining the palatal plate, as shown in **Fig. 2A**.

This guide was used after removal of tooth decay, restoration of defects, and tooth preparation. The cavities were cleansed and disinfected with chlorhexidine 2% (FGM), and after washing and drying, were filled with photopolymerizable glass ionomer (Vitrebond, 3M/Espe). They were then primed with 37% phosphoric acid (Ultraetch, Ultradent) for 30 s on the enamel and for 15 s in the dentin, and after washing and drying, were hybridized with a photopolymerizable primer and adhesive (Scothbond MP Plus, 3M/Espe). The guide was then positioned on the cleft of the prepared palatine teeth and served as a basis for reconstruction with nanohybrid composite resins A3D, A3B, and A3E (Z350, 3M/Espe) using a stratified technique. Each increment of composite resin was polymerized for 20 s with a Valo curing light (Ultradent). After completion of the restorations, Sof-lex disks (3M/Espe) were used for finishing. A few days later, felt discs soaked in aluminum oxide-based polishing paste (Cosmedent) were used for polishing, as shown in **Fig. 2B**.

After this step, casting was once again performed to plan and study the insertion axis of the PAP, and the cast was adjusted and acrylic guides were constructed for subsequent intraoral adjustment of the rests, bars, and opposing and retaining clips. New functional molding was carried out to generate a master template, and thus, the metallic structure of the PAP was constructed. After approval of the master template, the PAP was constructed (**Fig. 3A-B**) and installed (**Fig. 4A-B**).

Fig 1. A, ulceration in the left side of the tongue, extending from the dorsum of the tongue to the floor of the mouth. B, total glossectomy with flap pectoral muscle reconstruction.

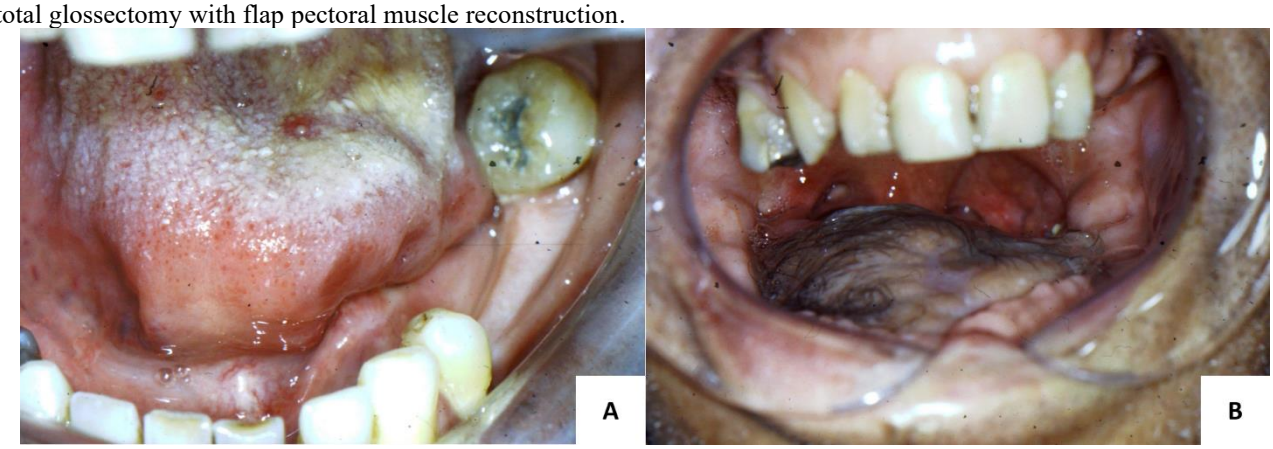


Fig 2. A, Guide cast for reconstruction in composite resin. B, Intraoral findings after complete restorations and polishing.

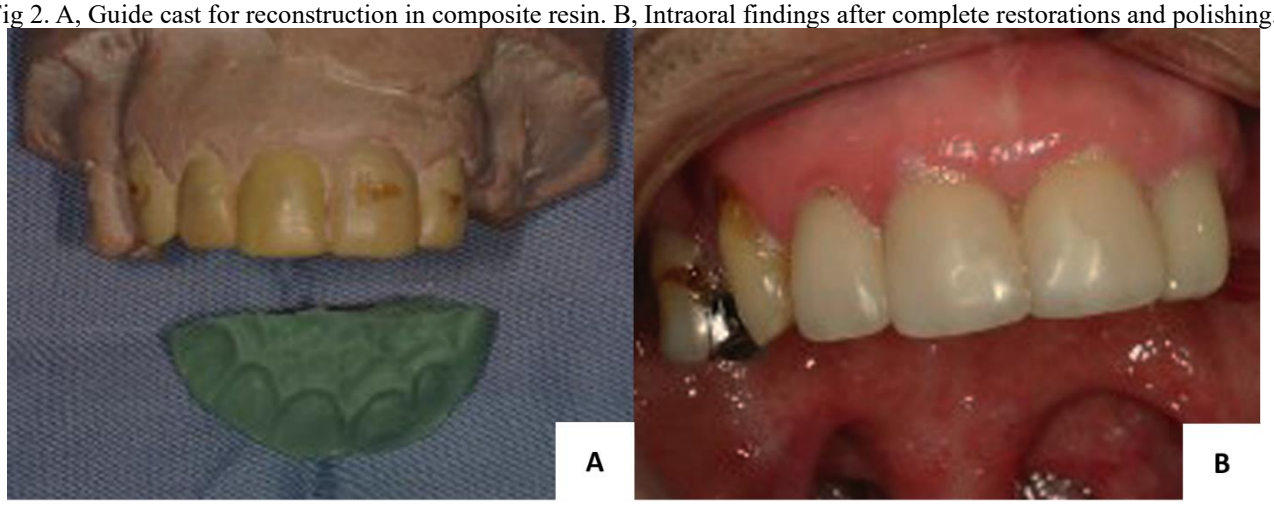


Fig 3. A, Metallic structure view of palatal augmentation prosthesis maintaining palatal plane in resin. B, Frontal view of palatal augmentation prosthesis.

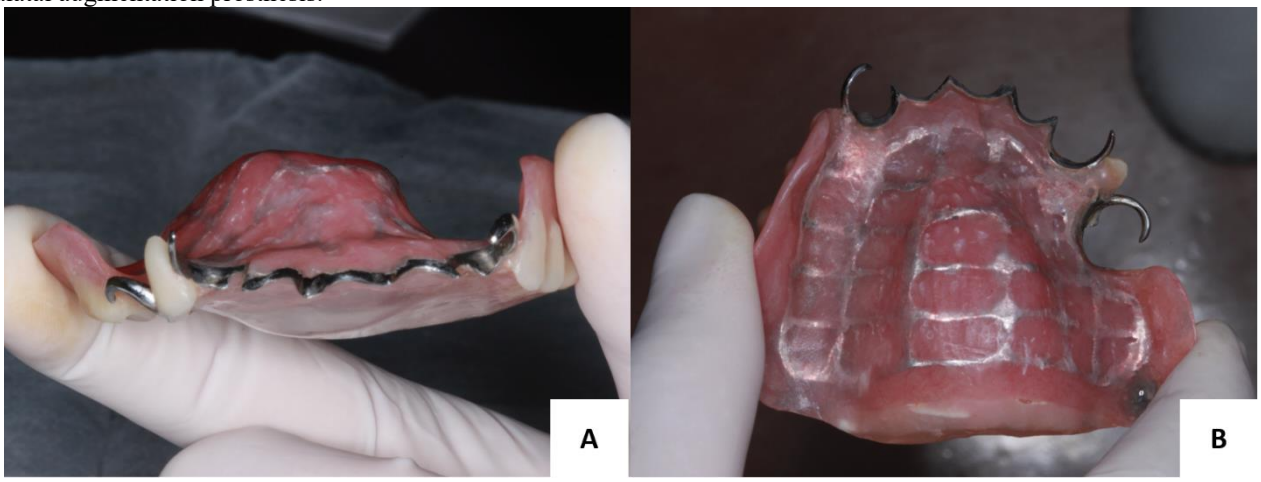
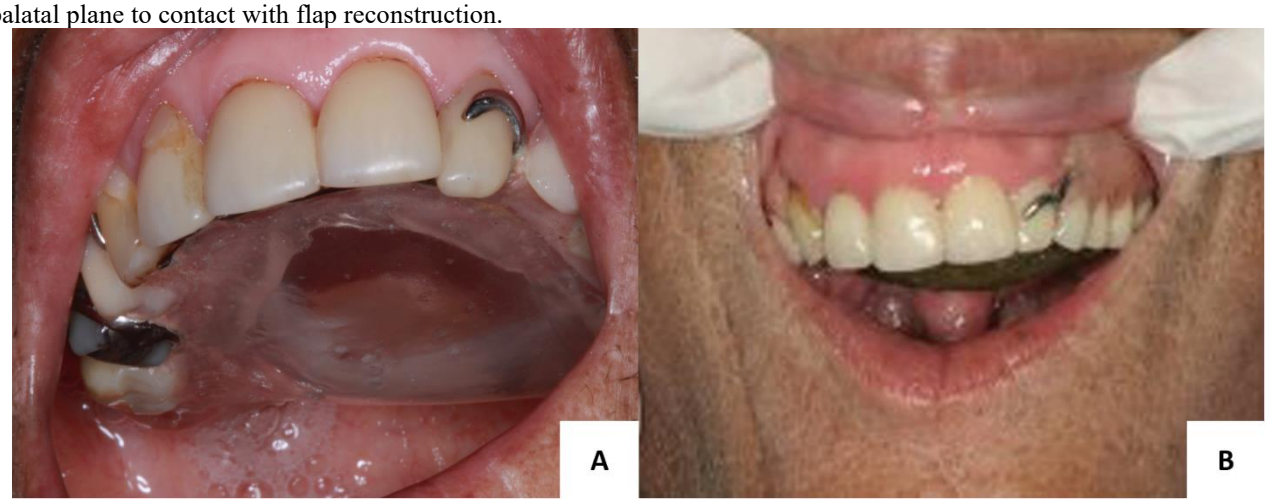


Fig 4. A, Intraoral view of palatal augmentation prosthesis insertion. B, Same palatal augmentation prosthesis promoting palatal plane to contact with flap reconstruction.



3 DISCUSSION

The tongue is a complex and important organ that provides palatal and tooth contact for speech, propels the food bolus towards the oropharynx, and contains receptors that mediate the sense of taste

(Kentaro O *et al*., 2014). Given these clinical functions, SCCT, which needs be treated surgically through glossectomy, would adversely affect the quality of life of the patients by affecting their functionality. After the procedure, the palate/lingual contacts are impaired because of decreased tongue mobility, which results in impairment in speech, chewing, and swallowing (Carvalho V & Sennes LU, 2016). Because glossectomy is an extremely disabling surgical procedure, requiring tooth loss, tissue loss, and/or loss of tissue stability, esthetics is impaired. In addition, all the changes mentioned above result in a social impact (Carvalho V & Sennes LU, 2016).

Patients diagnosed with SCCT often have an oral cavity with missing teeth, open carious lesions, and periodontitis. A diversified approach based on different aspects is necessary, and the patient may often be left with few if any teeth, especially in the jaw affected by the tumor resection, which further complicates functional and esthetic rehabilitation.

In this case history the patient was diagnosed with SCCT with invasive growth, T3N2bMx and treated with total glossectomy and reconstruction with pectoral muscle flaps. The reconstructive techniques ensured patient survival and partial restoration of function, but the flaps were fixed to the floor of the mouth and showed only slight vertical movement, which was not enough for touching the palate like the natural movement of the tongue that assists in swallowing and speech production. In addition, the procedure required extraction of all the mandibular teeth and almost all the maxillary teeth, thereby impairing the patient's function, esthetics, and social life.

A palatal augmentation prosthesis (PAP) is defined as a palatal prosthesis that allows reshaping of the hard palate to improve tongue and palate contact during speech and swallowing and facilitates restoration of function (Payal Rajender Kumar *et al*., 2019; Tomonori Y *et al*., 2022; Bachher GK & Dholam KP, 2010). In addition to restoration of function, the secondary goal of ensuring a satisfactory esthetic outcome was achieved by reconstruction with composite resins using a stratified technique. The interdisciplinary nature of the team, which was composed of a pathologist, stomatologist, periodontist, maxillofacial surgeon, prosthetic specialists, and speech pathologist, played an important role in ensuring a better quality of life for the patient.

The findings from this case suggest that functional and esthetic rehabilitation that promote social rehabilitation are perfectly possible in patients with SCCT treated with radical approaches, althoug the life expectancy of these patients is often short.

4 CONCLUSIONS

This report highlights the importance of functional and esthetic rehabilitation in patients who undergo a radical approach for the treatment of the SCCT. These patients are affected physically and mentally; thus, the functional rehabilitation achieved by PAP and the esthetically acceptable results

obtained by reconstruction with composite resins using a stratified technique could together improve the social life and the overall quality of life of the patient.

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Use of calcium hydroxide as an intracanal medication in permanent teeth: A brief review of the literature

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ABSTRACT
Endodontic treatment aims to reduce bacterial contamination in permanent teeth with pulp necrosis. The success of root canal treatment is directly related to the neutralization and reduction of pathogenic microorganisms, so it is essential to carry out an adequate chemical-mechanical preparation and employ the use of auxiliary medications, in order to combat the maximum of resistant microorganisms. Among these medications, calcium hydroxide stands out for its breadth of beneficial properties to the canal and adjacent tissues, being the drug of first choice, as it has antimicrobial and repair-inducing characteristics.

Keywords: Endodontic treatment, Intracanal medication, Calcium hydroxide.

1 INTRODUCTION

Endodontics is a specialty of Dentistry popularly known as root canal treatment, responsible for treating pathologies that affect the dental pulp and periapical tissues. Endodontic treatment consists of different phases, including modeling, cleaning and filling of root canals, which aims to restore the function of the dental element (ZAIA, 2008).

Successful endodontic therapy comprises the chemical-mechanical preparation of root canals, using instruments and irrigation solutions, with the aim of promoting the cleaning and modeling of root canal systems. The treatment aims to eliminate microorganisms through the removal of the pulp tissue and the use of intracanal medication will complement this process, since in order to obtain the repair and cure of the pathologies, the elimination of the infection is indispensable (ESTRELA; ESTRELA PÉCORA, 2003; SINGH et al., 2013).

The ideal intracanal medication has the function of assisting in the reduction of microorganisms, acting as a physicochemical barrier, reducing the inflammatory process, neutralizing toxic products, preventing periapical reinfection, reducing periapical symptomatology and providing repair of the tissues involved (SOARES; GOLDBERG, 2011).

The most commonly used medications to remove bacteria inside root canals are: phenolic compounds, camphor paramonochlorophenol, formalin tricresol, formocresol, glutaraldehyde, iodoform, calcium hydroxide, corticosteroids and antibiotics (NERY et al., 2012).

Professionals find it difficult to choose the ideal medication due to the great diversity of products found in the dental market (LOPES and SIQUEIRA, 2015). Based on the literature, the most widely used drug in endodontics has been calcium hydroxide due to its antimicrobial action and induction of repair by the formation of mineralized tissue (NERY *et al.*, 2012).

The purpose of this study is to conduct a brief review of the literature on the use of calcium hydroxide as an intracanal medication in the endodontic treatment of permanent teeth.

2 METHODOLOGY

- A literature search was performed using the following keywords in Portuguese: "Endodontic treatment" AND "Intracanal medication" AND "Calcium hydroxide"; and in English: "Endodontic treatment" AND "Intracanal medication" AND "Calcium hydroxide intracanal", in the following databases: Scielo and PubMed, between the years 1999 to 2022.
- A total of 34 articles were found, of which 23 were selected according to their relevance to the present study.

It was selected as a reference book: Endodontics, Biology and Technique, 4th edition, by the authors Lopes and Siqueira.

3 LITERATURE REVIEW

When the bacteria reach the dental pulp, an acute inflammatory process begins. The purpose of this response is to find and eliminate the antigen, remove the degenerated tissues, and prepare the affected area for tissue repair. A series of vascular events must be initiated for this to occur, aiming at

the arrival of defense cells to the compromised region. This acute infectious process is accelerated, lasting from minutes to three days and, depending on the amplitude of the aggression, the antigen will be eliminated and the tissues will be repaired. If this does not occur, the microorganisms invade the root canal system and chronic inflammation is installed (LACERDA *et al.*, 2016).

When pulp necrosis occurs due to trauma or caries infection, the presence of chronic lesions in the periapex due to the microbial and toxic content of the necrotic pulp cavity is frequently observed. Therefore, endodontics is recommended with emphasis on the disinfection phases (LACERDA *et al.*, 2016).

In the chemical-mechanical preparation phase, sanitation is responsible for reducing root canal contamination. Although a significant reduction in microorganisms is observed soon after the end of the cleaning, disinfection and modeling process, it is necessary, in some cases, to use medication between sessions in order to enhance the process (ESTRELA; FIGUEIREDO, 1999).

3.1 MICROBIOTA

The dentin tubules, open cavity, periodontal membrane, bloodstream, caries and defective restorations are used as access routes by microorganisms. The tooth reacts in various ways to the presence of microorganisms, which can trigger reversible and irreversible inflammatory processes. If reversible reactions are not treated, irreversible inflammations will occur and, consequently, more severe inflammation will settle reaching the periradicular tissues, leading to the formation of periapical lesions (LOPES and SIQUEIRA, 2015).

As bacterial density and the number of species increase because of pulp exposure, this tissue is affected by higher concentrations of toxic bacterial products. Thus, the tissue portion in direct contact with the offending agent undergoes severe inflammatory changes, culminating in necrosis (LOPES and SIQUEIRA, 2015). The main ecological factors that influence the composition of the microbiota, within this system, are oxygen tension, type and amount of available nutrients. In addition, pH, temperature and host resistance are also important influences in this process (LEMOS, 2001).

Knowledge about the microorganisms present and predominant in root canal infections and periapical tissues is essential for the adoption of a conduct aimed at microbial control, for the choice of intracanal medication and for subsequent stimulation of tissue repair (LACERDA *et al.*, 2016).

In the oral cavity, the amphibiontic microbiota (a varied set of microorganisms commonly found colonizing a certain site of the organism, coexisting harmoniously with the host) is composed of about 800 species of bacteria. Strict anaerobic bacteria predominate in the contaminated channels, accompanied by some facultative anaerobic bacteria and, infrequently, aerobic bacteria (LACERDA *et al.*, 2016)

3.2 ENDODONTIC INFECTIONS

The bacteria use the dentin tubules, pulp exposure and periodontium as access routes to the root canals, thus causing pathologies involving the pulp and periradicular tissues. (LOPES; SIQUEIRA, 2015).

There are three types of infections – primary, secondary, and persistent. Primary infection occurs in teeth without endodontic treatment and with pulp necrosis, with a predominance of Gram-negative bacteria. Secondary infection, on the other hand, occurs after the failure of endodontic treatment, with root canal contamination during or after treatment. And the persistent infection is the one that has been maintained after the disinfection procedures have been carried out and consists of the resistance of microorganisms to endodontic treatment, as is the case of *Enterococcus. faecalis.* Its cause is associated with both the microorganisms of the primary infection and those of the secondary infection. (LACERDA *et al.*, 2016).

3.3 *ENTEROCOCCUS FAECALIS*

The bacterium *E. faecalis* is a Gram-positive facultative anaerobic disease found in cases of endodontic failure. This microorganism has some properties, such as great capacity to adapt to adverse conditions, growth aptitude in the form of a biofilm or single colony, the ability to penetrate the dentin tubules, characterizing its high predominance in persistent infections. In addition, *E. faecalis* also has the ability to maintain itself in a viable but non-cultivable state, which is a mechanism of adaptation to the adverse conditions of the microenvironment, such as low concentration of nutrients, high salinity and extreme pH, in which the bacterium loses the ability to grow in culture, but maintains its virulence and possibility of dividing again at the moment when the place becomes once again beneficiated. (LACERDA *et al.*, 2016).

3.4 CALCIUM HYDROXIDE

Since the 1970s, histological studies have shown that better repair results after endodontic treatment occur after the use of intracanal medication with calcium hydroxide. Among the options available on the market, calcium hydroxide stands out due to its expressive antimicrobial properties and repair induction. (HOLLAND; OTOBONI; SOUZA; et al., 2003).

Calcium hydroxide in its pure form is a white, alkaline powder (pH 12.8), poorly soluble in water. This strong base is obtained from the calcination (heating) of calcium carbonate. With the hydration of calcium oxide, calcium hydroxide is obtained and the reaction between this and carbon dioxide leads to the formation of calcium carbonate (LOPES; SIQUEIRA, 2015). This powder can be mixed with aqueous or viscous vehicles, thus producing an alkaline paste. Due to its high pH, calcium

hydroxide has a broad antibacterial effect. Its dissociation is slow and steady, thus having a controlled and long-lasting therapeutic action. (SIRÉN et al., 2014).

Widely used in endodontics, calcium hydroxide has excellent bacteriostatic and bactericidal action, thus exerting its antimicrobial effect. This drug is considered a reference in clinical practice due to its biological properties, such as antimicrobial effect combined with the ability to favor the tissue repair process. (NERY *et al*., 2012). Calcium hydroxide dissociates into calcium and hydroxyl ions and the action of these ions explains its biological and antimicrobial characteristics, which are manifested by enzymatic actions both on bacteria and on bacteria. the Tissues. Your employment in Endodontics by its Antimicrobial property, it enhances the disinfection of the root canal system, also acting in the periapical repair process. (STAR; FLOWERS 1999).

The antimicrobial activity of calcium hydroxide is due to the release of hydroxyl ions from its dissociation in an aqueous medium. Hydroxyl ions are highly oxidizing free radicals, being extremely reactive, binding to biomolecules close to their site of formation, i.e., where calcium hydroxide was applied. Its lethal effect occurs through the following mechanisms: loss of bacterial cytoplasmic membrane integrity, enzymatic inactivation, and DNA damage (LOPES; SIQUEIRA, 2015). However, before using calcium hydroxide as an intracanal medication, it is necessary for the professional to have scientific knowledge about the inflammatory process of the pulp and the infections involved. (SOUZA FILHO, *et al* , 2010).

Endodontic infections are classified as: primary, secondary, or persistent infection. Primary infection includes anaerobes, bacilli, and Gram-negative infections. This bacterial load can be partially eliminated after adequate instrumentation of the root canals. (SOUZA FILHO *et al.*, 2015).

It is extremely important to fully identify the microbiota, and the degree of severity of an endodontic infection is related not only to the presence of microorganisms, but also to the amount found in the infected site. (SAINTS *et al*., 2015).

The secondary infection originates from a professional intervention, involving microorganisms that were not initially present in the endodontic treatment. It occurs from the moment when the micro-organisms are able to adapt or proliferate in the root canal. These pathogens can access the root canal and adjacent tissues through dressing changes or after filling, due to the breakdown of the aseptic chain, lack or inappropriate use of absolute isolation, contaminated instruments, teeth kept open due to loss of filling material (SOUZA FILHO; 2015). Only one species of microorganism will be present, most often being facultative Gram-positive, involving *Pseudomonas aeruginosas, Staphylococcus species, Escherichia coli, Candida species and Enterococcus faecalis.* (LACERDA *et al*., 2016).

Research reports that the most common microorganism in cases of endodontic reinfection is *Enterococcus faecalis*. This microorganism has a high prevalence in cases of endodontic failure, where

calcium hydroxide has shown limited effects against this type of species because it is resistant to environments with high pH. (ZANDONÁ, J.; SOUZA, 2015).

A large load of aerobic bacteria is installed at the beginning of the infection of pulp pathologies and in more advanced cases gram-negative anaerobic bacteria will predominate. Endodontic treatment should not be postponed, and biomechanical preparation, irrigation, and intracanal medication should be performed. This approach aims to combat or eliminate as much as possible the microbial load existing in the infection. (SIQUEIRA JUNIOR *et al.*, 2012).

The chemical characteristics of calcium hydroxide have made it the drug of choice in endodontic treatments, such as: antibacterial action (bactericidal and bacteriostatic), anti-inflammatory action, promoting mineralizing effect, biocompatibility, dissolution of organic remains, neutralizing of toxic substances, inhibition of inflammatory resorptions and function of physical barriers. (RODRIGUES *et al*., 2013).

In endodontics, in addition to being used as an intracanal medication, calcium hydroxide can be used as a lime water solution, helping in the irrigation of root canals, having a neutralizing action of toxic products and hemostatic. In some situations, it can also be used as a shutter paste. (SOARES AND GOLBERG, 2011). In deciduous teeth, calcium hydroxide can be used as an intracanal medication and obturator paste, while in permanent dentition its effects stood out as an intracanal medication. (MASSARA *et al*.; 2012)

In order for root canal decontamination to be carried out, it is necessary that the calcium hydroxide remains in the medium for some time and the ideal time is controversial. However, its antimicrobial action can be clinically evaluated by the absence of exudate in the root canal system and the absence of painful symptoms. However, it is known that in order to exert its antimicrobial activity inside the dentin tubules, calcium hydroxide needs a long time of action. (LOPES; SIQUEIRA JR, 2004)

In a study to evaluate the susceptibility of microorganisms to calcium hydroxide, its combination with some vehicles was carried out. Stainless steel cylinders were placed on the inoculated agar plates. The tested drugs and their controls were placed inside the cylinders. Growth inhibition zones were measured for each cylinder and recorded after the incubation period. *Enterococcus faecalis* was the most resistant microorganism to calcium hydroxide, while *Porphyromonas endodontalis was more susceptible to all drugs, followed by* Porphyromonas gingivalis *and* Prevotella intermedia. The association between calcium hydroxide and paramonochlorophenol and glycerin showed greater inhibition zones when compared to the other drugs tested. Through this study it was concluded that Gram-negative anaerobic bacteria are more susceptible to calcium hydroxide pastes than Gram-negative ones. (GOMES *et al*., 2002).

The use of intracanal medication can interfere with the nutritional interrelationships already established, and some microorganisms that could be essential for the growth of others can be eliminated or maintained. The optimal time for calcium hydroxide to exert its antimicrobial action effectively in the root canal system has not yet been determined. The presence or absence of exudate in the root canal, presence or absence of *smear layer*, type of microorganism involved and its location in the root canal system will influence this time (GOMES *et al*., 2002). However, an in *vitro* study demonstrated that many microorganisms that are commonly found in the microbiota of the root canal system were rapidly eliminated when exposed to calcium hydroxide in a 7-day application. (ROSENBERG *et al*., 2007).

Calcium hydroxide is a fine white powder, odorless, chemically strong and with an extremely alkaline pH. Its properties are released by the dissociation of calcium and hydroxyl ions. Its molecular weight (74.08g) should be highlighted, containing 45.89% hydroxyl ions and 54.11% calcium ions. When ionic dissociation occurs, its antimicrobial action is released, stimulating the formation of hard tissue and presenting good biocompatibility to the root canal and adjacent tissues. (ESTRELA, 2013).

In order for the ionic dissociation of calcium hydroxide to occur, it is necessary that it be associated with other substances in order to make it a paste, providing viscosity and greater radiopacity, improving its clinical properties. (SOARES; GOLDBERG, 2011).

A very important issue for the antimicrobial action of calcium hydroxide is the choice of the vehicle used in conjunction with the medication, as it will be decisive to maintain the properties of calcium hydroxide or potentiate it. Research has shown that the type of vehicle associated with calcium hydroxide is directly related to the concentration and release rate of hydroxyl ions, favoring the antimicrobial action of the paste and clinical handling. (SOARES; GOLDBERG, 2011) (NERY *et al*., 2012).

Vehicles can be classified under antibacterial effect or in relation to chemical properties. According to their physicochemical properties, they are classified as oily or water-soluble. As for their antibacterial effects, vehicles can be inert and biologically active. (LAUREL *et al*, 2018).

In the vast majority of situations, inert vehicles are characterized by being biocompatible and not influencing the antimicrobial properties of calcium hydroxide. Among them, the following stand out: distilled water, anesthetic solution, saline solution, methylcellulose solution, olive oil, polyethylene glycol, glycerin and propylene glycol. (LOPES; SIQUEIRA JR, 2004).

Aqueous inert vehicles promote rapid therapeutic action due to rapid ionic dissociation and rapid diffusion of hydroxyl ions and calcium ions. However, the loss of its effect occurs more quickly, requiring a more frequent change of medication. In the event of a breakdown of the aseptic chain or suspected infectious processes, active vehicles should be elected. (LAUREL *et al*, 2018).

Inert vehicles are biocompatible substances and do not influence the antimicrobial properties of calcium hydroxide, so its association with calcium hydroxide is indicated in cases of live pulp or biopulpectomy.

Additional effects Calcium hydroxide paste is provided by its association with biologically active vehicles, such as Paramonochloroconforate (PMCC), potassium iodide and chlorhexidine. (NERY *et al.*, 2012).

The aqueous vehicles provide an extremely fast ionic dissociation to the calcium hydroxide, resulting in greater diffusion and consequently greater action by contact of calcium and hydroxyl ions with microorganisms and tissues. When applied inside the root canal, the paste is quickly diluted, requiring successive changes so that the desired results are achieved. Distilled water, saline, anesthetic solutions, and methylcellulose solutions are examples of aqueous vehicles. Some examples of trademarks that employ watery vehicles are: Calxyl (Otto & Co. Frankfut, Germany), Pulpdent (Pulpdent Co. Brookline, MA, United States).

Viscous vehicles are soluble in water, but make the dissociation of calcium hydroxide slower due to their high molecular weight. Glycerin, polyethylene glycol, and propylene glycol are examples of viscous vehicles. Calen and Calen PMCC (SS White, RJ, Brazil) are trademarks that use polyethylene glycol as a vehicle. (LOPES; SIQUEIRA, 2015).

Soares and Goldberg (2011) report that calcium hydroxide expresses its antimicrobial effect in a safe way, and its time of action must be respected. The authors mention that if there is a need for the medication to be maintained for 30 days, changes should be made every 15 days, remembering that the clinical condition of the canal is a determining factor for changing the medication. The authors recommend the use of intracanal medication for a minimum period of 15 days, justifying that during this period of time, calcium hydroxide produces antibacterial action effectively and safely. However, in more severe cases, such as periapical lesions and apical resorptions, calcium hydroxide should remain for a period of 30 days. However, it is still unclear when the timing calcium hydroxide needs to develop antimicrobial action.

In order to improve the physicochemical properties, additional chemical substances have been added to calcium hydroxide to favor its clinical use, such as radiopacity itself. Usually, these substances are: bismuth carbonate, barium sulfate, iodoform, and zinc oxide. (LOPES; SIQUEIRA, 2015).

3.5 ROOT CANAL FILLING WITH CALCIUM HYDROXIDE PASTE

Several techniques for placing the calcium hydroxide paste inside the root canal have been used, especially endodontic instruments, amalgam holders, special syringes, paper or gutta-percha cones, EndoActivator (sonic appliance, Dentsply Tulsa Dental, Tulsa, OK, USA) and the Lentulo spiral.

In addition to the anatomy and chemical-mechanical preparation, the efficiency of inserting calcium hydroxide paste into the root canal depends on its chemical composition, the nature of the vehicle and its consistency at the time of use. Viscous and oily vehicles, because they act as lubricants, favor the placement of the paste inside the channel. Despite the various application techniques proposed, when the medication is prepared at the time of its use, the most recommended are those that use manual endodontic instruments or Lentulo aspirations. (LOPES; SIQUEIRA, 2015).

3.5.1 Manual endodontic instruments

A type K file with a diameter immediately below is used, and the last file used to make the apical preparation (memory file) must be selected for the insertion of the calcium hydroxide paste into the root canal. The instrument should be loaded with the paste into its spirals, slowly introduced to working length, brushed against the walls of the channel, and rotated counterclockwise for two or three times. Removal of the instrument should be performed slowly, without interrupting the counterclockwise rotation movement. This process should be repeated up to three times so that the entire channel is completely filled with the paste.

Subsequently, a radiographic examination should be performed. Once this is done, the paste is compacted with a sterile cotton wick of appropriate size, placed at the mouth of the canal and compressed with the tips of a clinical forceps or Paiva presser foot, to ensure the filling of the canal along its entire length. (LOPES; SIQUEIRA, 2015).

Figure 01: Representative image of a type K maual file that can be used for insertion of Calcium Hydroxide paste inside the root canal

SOURCE: https://www.dentalunic.com.br/produto/453/lima-k-file-n-10-25mm-dentsply-maillefer /

3.5.2 Lentulus Spiral

Lentulo coils are instruments that allow better application of calcium hydroxide paste inside the root canal. A study by Sigurdsson et al. He demonstrated the efficacy of the Lentulo spiral, endodontic files and syringe with needle in the placement of calcium hydroxide paste inside the mesiobuccal canals of maxillary first molars instrumented up to the K #25 file. It was concluded that the Lentulo spiral

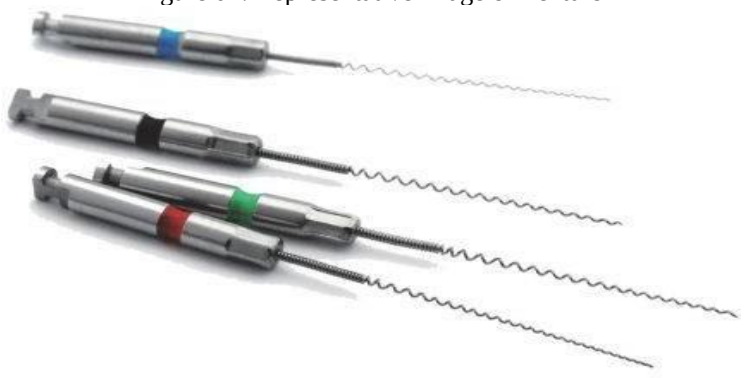
was more efficient in relation to the filling and compaction limit of the paste inside the root canals than to the filling and compaction limit of the paste inside the root canals. Lopes *et al*. In an in vitro study showed that the Lentulo spiral was more efficient than the McSpadden compactor in filling root canals with calcium hydroxide paste, probably due to the geometric shape of the instrument; McSpadden's compactor, has a larger straight section than the When the spiral of Lentulo is removed from the root canal, it shifts the paste to the side, thus leaving a higher percentage of voids.

To insert the calcium hydroxide paste into the root canal, the Lentulo spiral must have a diameter smaller than that at the end of the preparation, be placed to a depth of 2 to 3 mm below the working length and driven by a micromotor, at constant speed and with rotation to the right, for approximately 10 seconds.

Once the paste has been handled, spatulated presser feet will take small portions to the pulp chamber. Then the rotary instrument is loaded into its spirals with a small amount of paste and slowly introduced into the channel. Simultaneously, the Lentulo spiral is triggered to rotate to the right, with gentle and slow movements of penetration and removal, the root canal is filled. It is important that the instrument is removed from the channel while it is still rotating.

Next, the radiographic examination should be performed, and this procedure can be repeated until the canal is completely filled. As mentioned above, the paste must be compacted at the level of the inlet. (LOPES; SIQUEIRA, 2015).

Figure 02: Representative image of Lentulo



SOURCE: https://www.endovita.com.br/fabricante/tdk/).

3.5.3 Endoactivator

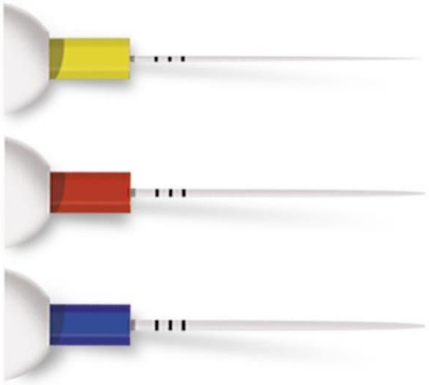
The device uses subsonic vibration and can be used as an auxiliary resource for filling the canal with calcium hydroxide-based medication (RUDDLE, 2009). The author states that the oscillation of the plastic tip of the Endoactivator pushes the medication against all the walls of the root canal system. In this technique, using a steel file (conventional technique), the paste is taken into the canal, where the Endoactivator is used. This association aims to eliminate blisters by having the medication fill all

the spaces in the root canal. This process can be repeated a few times, taking small amounts of the paste into the channel until it is completely filled.

Figure 03: Representative image of the Endoactivator instrument

SOURCE: http://endoactivator.com)

Figure 04: Representative image of Endoactivator Tips



SOURCE: http://endoactivator.com

4 CONCLUSION

One of the great challenges of endodontic treatment is to achieve asepsis of the root canal system through the elimination of pulp and periradicular pathogenic microorganisms.

Calcium hydroxide is the most widely used intracanal drug in the treatment of root canal infections, but it is not as efficient in eliminating *Enterecoccus faecalis*.

Although there are still divergences regarding the use of calcium hydroxide as an intracanal medication, studies point to its high efficacy in endodontic treatment, due to its high antimicrobial and antiseptic potential and in inducing periapical repair.

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SEVEN
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Dental care for patients with severe intellectual disabilities

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ABSTRACT
Objective: To present the conduction of a dental treatment case in a patient with severe Intellectual Disability (ID), detailing the procedures performed to demystify impossibilities. Case Details: A 48-year-old female patient, diagnosed with severe ID, ICD 10 F 72, sought dental treatment at a school clinic during the discipline of Supervised Internship for People with Disabilities. The patient needed surgical, endodontic, and restorative interventions. Final considerations: In patients with ID, due to the lack of oral health care skills, and/or inability to receive adequate personal and professional care, sometimes the condition of the oral cavity is complex, in addition, the presence of underlying congenital or developmental anomalies may be related. Tooth decay and periodontal disease are among the secondary conditions that most affect these individuals. The procedures performed on the patient were adapted according to her needs, aiming to deliver a better quality of life and comfort through the improvement of oral health.

Keywords: Intellectual Disability, Person with Disabilities, Oral Health.

1 INTRODUCTION

The term person with disabilities (PWD) refers to individuals who have intellectual, physical, or sensory limitations. Currently, in Brazil, 6.2% of the population has some kind of disability, be it hearing, intellectual, physical or visual. PWD may have limitations or inability to perform day-to-day activities, especially in the most severe cases (ARDUIM AS, et al., 2023). According to the demographic census conducted in 2010 by the Brazilian Institute of Geography and Statistics (IBGE), visual impairment was present in 3.4% of the Brazilian population, motor impairment in 2.3%, hearing impairment in 1.1%, and intellectual impairment in 1.4%. About 46 million Brazilians declare to have some type of disability (IBGE, 2010).

Intellectual disability (ID) is defined as a neurodevelopmental disorder, specifically intellectual developmental disorders, with heterogeneous etiology. Intellectual functioning refers to general mental capacity, related to learning, reasoning, problem solving, among others (AAIDD, 2010). The individual diagnosed with this condition has adaptive and comprehension difficulties, limitation in social skills

and daily practices. This disorder may be accompanied by other mental disorders, underlying congenital or developmental anomalies, or occur in isolation, with its onset before the age of 18 years as a standard characteristic (LUCKASSON R, et al., 2002).

Different terminologies can be found for its reference. The expression Mental Retardation (MR) is still used in some contexts, however, considered a pejorative term, the terminology was changed to ID; However, to date, it is still possible to observe research and studies with this reference. In light of this, the American MRI Association has been renamed the American Association on Intellectual and Developmental Disability (AAIDD), although it emphasizes that the definition of ID is exactly the same as for MRI (SHEA SE, 2012). Its prevalence is estimated to range from 1% to 3% worldwide (SÁ PKS, et al., 2022).

Regarding its classification, there is the Statistical Manual of Mental Disorders (DSM) that uses the term MR, in which it covers the best allusion, with a description of the mild, moderate, severe and profound degrees, and is based on the intelligence quotient (IQ) test for classification (DSM-5, 2014). By contrast, the AAIDD uses the term DI and is not based on DSM categorization (SHEA SE, 2012).

The etiology of ID is broad, and may be genetically-related, caused by environmental factors, or both. They are classified according to the causal epoch: periconceptional, intrauterine, perinatal, postnatal, and infancy. However, the diagnosis is complex and unknown in many cases (KATZ G and LAZCANO-PONCE E, 2008). It is estimated that it is not possible to verify the causal factor in 50% of the cases, and the probability of determining the etiological factor is greater in severe cases of the disorder. Some risk factors may be taken into account, such as: genetic syndromes; chromosomal abnormalities; problems during childbirth, such as choking; use of drugs or toxic products during pregnancy, among others (SCHWARTZMAN JS and LEDERMAN VRG, 2017).

The consequence of reduced IQ is accompanied by deficit in adaptive functions, i.e., lack of conceptual, social, and practical skills. In cases of severe ID, individuals may have difficulty understanding time, literacy, and communication, in addition, they have difficulty establishing social contact and developing interpersonal and social skills. On a day-to-day basis, they have limitations related to their ability to perform personal care and hygiene (SHEA SE, 2012). Therefore, the oral health of individuals with ID is complex due to the lack of oral hygiene care skills and/or inability to receive adequate personal and professional care. Tooth decay and periodontal disease are among the most common secondary conditions affecting people with ID (ANDERS PL, et al., 2010).

An aggravating factor to the above-mentioned scenario is the reality experienced by caregivers, who report lack of preparation to perform oral hygiene on these individuals, due to lack of skills and knowledge. In addition, socioeconomic status is a factor that must be taken into account when it comes to access to information and dental care. Thus, the search for a dental surgeon (DC) is late, therefore, the dentistry provided is not classified as preventive, but curative (JUNIOR ÊF, et al., 2020).

The dental practice in these patients is not at all different in technical-scientific matters, however, the management of the patient must respect their physical, psychological and emotional limitations (ANDERS PL, et al., 2010). It is important that during the consultation, the professional has knowledge to manage the individual's behavior, in order to ensure the safety and efficacy of the treatment. Therefore, behavioral management techniques are relevant tools in this context (PETROVIC BB, et al., 2016).

According to Lima AC (2022), the use of these techniques allows the emotional and behavioral control of the patient, and can be differentiated into three areas: pharmacological, physical, and linguistic. Thus, they can range from a simple verbalization and demonstration of procedures on objects, to the administration of general anesthetics in a hospital environment. The selection of the correct technique will vary according to the age and characteristics of each patient.

The present study aims to present the conduction of a dental treatment case in a patient with severe ID, detailing the procedures performed in order to demystify impossibilities.

2 CASE BREAKDOWN

The approval by the Research Ethics Committee (REC) preceded the publication and preparation of this case report, which presents CAAE No . 69725723.3.0000.5066. For this study, the patient's guardian signed the Free and Informed Consent Form (ICF). The ethical principles of resolution 466/12 were preserved, as well as the integrity and dignity of the patient. All dental care, from screening to procedures and subsequent follow-up, was carried out in a school clinic during the discipline of Supervised Internship for People with Disabilities.

The reported case is a 48-year-old female patient diagnosed with severe intellectual disability, presenting according to the International Classification of Diseases, ICD 10 F 72, referring to severe mental retardation. She routinely uses the antipsychotic drugs Olanzapine and Amplictil.

The caregiver reported difficulty in the oral hygiene process, and there was resistance to performing it. He had general characteristics such as difficulty in speech and communication, impaired cognition, impaired motor coordination, and slowness in perceiving commands. In addition, the patient was unable to keep her mouth open without the use of personalized mouth openers, which limited indirect vision with the use of mirrors on the elements used with the support of the opener.

The patient presented for treatment with a recent panoramic X-ray. Periapical radiographs were not requested due to limited mouth opening. Intraoral clinical examination revealed the following demands: Inadequate control of bacterial plaque; Presence of generalized dental calculus; Root remains; Tooth element with extensive carious lesion (21).

Figure 1 – Panoramic X-ray

Fonte: Kiill LKC, et al., 2023.

Based on the intraoral clinical examination and the anamnesis obtained, the treatment plan was prepared prioritizing the removal of the foci of infection. Initially, supragingival scaling was performed with manual curettes to remove the tartar present, and it was not possible to use ultrasound in view of the limitation of mouth opening and the gagging reflex.

Subsequently, the extractions of the root remnants were performed, with the surgical procedures completed in two sessions. The anesthetic of choice was lidocaine solution with epinephrine 1:100,000, and the surgical technique was conducted in the most atraumatic way possible, aiming at a better postoperative response.

After one week, the sutures were removed and the periapical radiograph of element 21 was taken to choose the appropriate treatment **(Figure 2).**

Figure 2 – radiographic status of element 21;

Fonte: Kiill LKC, et al., 2023.

Although the periapical radiographs did not present ideal quality and positioning, in view of the limitation of the patient compatible with her diagnosis, it was observed that dental element 21 had an extensive carious lesion, with pulp involvement, requiring endodontic treatment.

Based on the restrictions of the case, related to the mouth opening and the absence of the lower posterior elements after the extractions, making it impossible to use the mouth opener, conventional endodontics would not be possible. Other factors were associated with the choice of the modified treatment, such as: reduced visualization of the operative field, the need to reduce work time in order

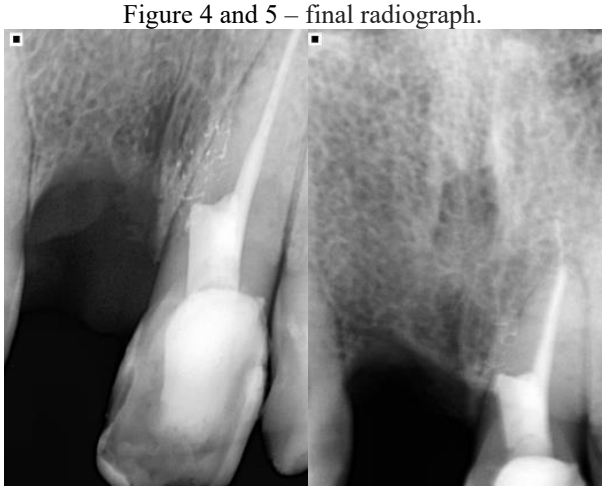
to improve the patient's comfort and conditioning, and the presence of a carious lesion on the buccal surface of the element with destruction of the structure.

Thus, the endodontic technique was adapted, modifying the procedure to a coronary opening performed through the buccal surface **(Figure 3).** In view of the above, aiming at a procedure that would bring greater agility, we opted for the use of a rotary instrument. After filling the root canal, the element was restored with composite resin. By means of the final radiograph, it was observed that there was a deviation in the root canal, and consequently, extravasation of the endodontic cement to the region **(Figures 4 and 5).** In view of the intercurrence, it is essential to follow up and control it later.

Figure 3 – coronary opening through the buccal surface;

Fonte: Kiill LKC, et al., 2023.

Figure 4 and 5 – final radiograph.



Fonte: Kiill LKC, et al., 2023.

Figure 6 – Follow-up X-ray 10 months after the procedure.

Fonte: Kiill LKC, et al., 2023.

3 DISCUSSION

According to Anders PL, et al. (2010), individuals with ID have limited manual dexterity, including oral hygiene, resulting in plaque accumulation. Therefore, they have high rates of caries and periodontal disease. The patient's oral health was precarious, with the presence of foul odor, root remains, carious lesions and dental calculus.

For these patients Camoin A, et al. (2018), attest to the complexity of simple dental procedures, precisely because of the difficulty in communicating and expressing feelings. As an aggravating factor, the fact that preventive practices are neglected is mentioned, that is, when they are taken to the dental office, the oral health picture is sometimes deficient; This was legitimized by the caregiver during the anamnesis, who pointed out the difficulty in performing oral hygiene, due to the fact that the patient presented an imperative and unfavorable behavior.

Usually, patients with special needs have difficulty expressing feelings and emotions, such as pain and fear. Despite this, it should be noted that the DC should be attentive to body language, facial expressions and movements, due to the possibility of being a way of transmitting sensations and disturbances (AMORIM CS, et al., 2020).

In this process, the inclusion of behavioral management techniques is integrated, which must be known by the professional, in order to reduce the stress that may be triggered during care (PUCCINELLI CM, et al., 2021). In this study, the fundamental deliberation of dental treatment was the removal of infectious foci and adequacy of the oral cavity, seeking to offer humanized care focused on the patient's needs.

Another important factor to be considered would be the behavioral aspects and other associated comorbidities; which corroborates when we also associate such characteristics with the use of medications, such as the antipsychotics used by the patient in this report, which validates the literary description, that ID is commonly accompanied by a psychiatric disorder (SÁ PKS, et al., 2022).

Amplictil and Olanzapine are drugs indicated for the treatment of psychiatric disorders (MACHADO FB, et al., 2009).

Accordingly, the continuous use of some medications induces alterations in the oral cavity, especially xerostomia and hyposalivation, favoring the development of periodontal disease and caries, which strongly corroborates the dental clinical picture exposed in this study (CARVALHO EMC and ARAÚJO RPC, 2004).

More complex dental treatments, such as surgeries, are commonly performed in a hospital environment, under general anesthesia, in order to ensure greater safety and comfort for the patient. The choice of this approach is chosen mainly in cases where the individual is not reassured through behavioral management techniques (SÁ PKS, et al., 2022). With regard to tooth extractions, despite the specificities of the case, they were performed without difficulties and quickly, and it was possible to perform them in the office, with no need to adapt the surgical technique. In addition, there were no postoperative complications.

Endo MS, et al. (2015) emphasize that endodontic treatment has success rates that can vary according to several factors, one of them being the number of sessions, and that in cases of pulp necrosis, the literature is controversial; however, Soares JA and César CAS (2001) note the advantages of performing endodontic treatment in just one session, with clinical success attested even in cases of pulp necrosis; therefore, it was decided to perform the procedure in a single session because the patient was a patient with ID.

Endodontic treatment encompasses several steps that are essential for the success of the procedure, and recommends pre-established points of choice for the beginning of coronary opening, and in incisors, the point traditionally described is the lingual or palatal surface (SHABBIR J, et al., 2021).

Nissan J, et al. In 2007, they conducted a study with maxillary incisors, alternating the coronary openings through the buccal or lingual surface. When the fracture strength was compared, they concluded that the different endodontic accesses did not affect the failure resistance of the maxillary incisors under simulated occlusal loading. Subsequently, Logani A, et al. (2009) emphasize that the use of the buccal face as a coronary opening has been studied as a way to save tooth structure, especially in cases of indication for dental veneers. In this report, the opening through the buccal surface was an adjustment chosen, due to the patient's conditions; aiming to be a more conservative method, but a subsequent follow-up is necessary, mainly due to the scarcity in the literature regarding the prognosis of modification of the conventional technique.

Regarding this fact, the final radiographic examination showed an image suggestive of a deviation in the root canal, possibly because of an accident during coronary opening, which may or may not be associated with changes in the conventional technique. Validating this justification, Miranda

EG, et al. (2012) confirm that the anatomy of root systems is complex and adverse events can occur in different circumstances in the dental context, making endodontic treatment difficult. For this reason, the importance of the basic care necessary for the success of the procedure is highlighted.

Even so, it is noteworthy that the complications were not enough to impair the success and prognosis of the case, considering that the patient remained without pathognomonic signs during the months after the procedure **(Figure 6).**

It may be considered that the care of patients with disabilities should be adequate and personalized according to their conditions and limitations, in addition, the ability to cooperate during treatment should be considered. Therefore,dentists must know the conditioning techniques, mainly because dental care for these patients is sometimes neglected. It is noteworthy that empathy is important to perform the procedures, which must be in conjunction with scientific knowledge and correct technical application, seeking to offer a humanized treatment. The procedures performed on the patient were adapted according to her needs, aiming to deliver a better quality of life and comfort through the improvement of oral health.

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Factors influencing the efficiency of intraoral *scanners* in dental prosthesis: Narrative review

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ABSTRACT
The objective of this literature review is to critically analyze the factors that influence the efficiency of intraoral scanners. Searches in electronic databases were performed using indexed keywords and free terms. The research was limited to full articles written in Portuguese and English and published in journals between 2011 and 2024. Intraoral scanning systems can be used reliably for diagnostic purposes and for short-span areas. However, for full-arc scanning, this system is more susceptible to distortion. Regarding the different scanner systems, the studies indicated variable results that do not allow a preference for the system to be realized. It is concluded that for the performance of prosthetic rehabilitation, the accuracy of the scanners is higher when the extension of the scan is reduced and when the scanned surfaces have minimal irregularities.

Keywords: Dental impression materials, Dental prosthesis, Computer-aided design.

1 INTRODUCTION

Dental impression is a routine procedure required in many areas of dentistry to copy oral tissues and reproduce them in models. These, whether physical or digital, are used for diagnostic purposes, planning or making prostheses, orthodontic appliances, etc. In order for the impression to fulfill its purpose, the patient's oral tissues must be copied appropriately, as the imprecision may cause maladaptation of the prosthetic piece, and consequently, a thick cementation line, infiltrations and secondary caries, in addition to excessive occlusal adjustments, which can generate fragility of the prosthetic piece, and impair the longevity of the treatment (Guth et al., 2013; Ender and Mehl, 2013).

The emergence of CAD/CAM technology in Dentistry in the late 1970s has led to several changes in dental clinics and prosthesis laboratories with the automation of processes and optimization

of the quality of final products, especially in the area of prosthesis. Compared to conventional impressions, intraoral scanning has advantages, such as not requiring printing materials, trays, disinfection, and pouring plaster models. In addition, once the professional is trained, it becomes a simplified and less sensitive technique, easy storage of patient data (Solaberrieta et al., 2019). The use of intraoral *scanners* is also reported to reduce clinical time, increase patient comfort, and allow impression visualization immediately (Akyalcin et al., 2013, Kim et al., 2016, Burzynski et al., 2017).

The use of *intraoral scanners* requires an expensive investment to obtain these devices and they rely on the skill of the professional to ensure an adequate scan. In order for intraoral scanning to be recommended for routine use, it is desirable that the accuracy be at least similar to conventional impressions (Persson et al., 2006). Accuracy and truthfulness are key aspects in determining the accuracy of systems. Veracity indicates how close the measurements obtained are to the actual dimensions of the object, while accuracy refers to the consistency of repeated measurements (Imburgia et al., 2017).

The accuracy of prosthetic specimens made from intraoral scanning can be comparable to conventional methods (Chochlidakis et al., 2016). However, several factors are not completely clarified in the literature and may affect the final veracity of these systems, such as operator skill, capture system, presence of implants, scanning pattern, digitized area, and type of prosthetic space (Renne et al., 2017). This literature review seeks to clarify these aspects, since it is essential that professionals have knowledge to minimize distortions, leading to maximum equipment efficiency.

2 OBJECTIVE

The objective of this literature review was to analyze the factors that influence the efficiency of *intraoral* scanners.

3 MATERIAL AND METHOD

The databases used for the elaboration of this narrative literature review were MEDLINE via Pubmed, Google Scholar and LILACS/BBO via VHL. The included articles were selected from a search with indexed descriptors (MeSH and DeCs) and free terms combined through Boolean operators in the English language: "intraoral scanners" OR "digital flow" OR "CAD/CAM technology" OR "accuracy and precision" and Portuguese: "intraoral scanners" OR "digital flow" OR "CAD/CAM technology" OR "accuracy and precision". The selected articles were published between 2011 and 2024 in English or Portuguese.

4 LITERATURE REVIEW

The quality of the virtual image obtained by intraoral scanning is influenced by several factors that were addressed in this study, namely: extension of the scanned site, morphology and surface of the object, and the type of scanning. In addition, characteristics specific to the *scanner* and the technique used were mentioned by the studies as factors that can influence the efficiency of the procedure.

4.1 PARTIAL ARC SCANNING

For years, the accuracy of *scanners* has been considerably lower than conventional printing methods. However, recent technological advances have allowed a significant improvement in the accuracy of this equipment to levels comparable to conventional molds in short-length single and multiple partial fixed dentures (PPF) in teeth and implants (Yang et al., 2015; Rudolph et al., 2016; Lee et al., 2017; de Oliveira et al., 2020), and this development allowed for a more efficient workflow in the clinical setting of Dentistry (Chiu et al., 2020).

De Oliveira et al. (2020) conducted a systematic review with meta-analysis to evaluate clinical parameters of single crowns on implants in which fingerprints and conventional printing were used. The use of the *scanner* showed better efficiency considering the clinical time and patient preference. The evaluation of the adjustment time of the prosthetic pieces showed different results, in which the digital flow varied between 1.96 and 14 minutes, while for the conventional one, it was between 3.02 and 12 minutes. Similarly, the studies included in the review by Afrashtehfar et al. (2022) indicated similar accuracy between the intraoral scanner and conventional impressions for fixed prostheses of less than 4 elements.

For 3-element PPF pillars, Ali's (2015) study shows that some of the different systems evaluated (iTero, USA and Lava C.O.S - 3M ESPE, Germany) did not have significant variation in accuracy compared to the scanning of models from the conventional technique using addition silicone. Other systems tested, however, were inferior to the impressions obtained by laboratory *scanner*. Regarding 4-element PPF, Guth et al. (2013) point out that intraoral scanning generated models with greater accuracy than molds produced by polyether impressions.

In the clinical study by Ender et al. (2016), the scanning of a quadrant had a similar level of accuracy to models produced from conventional molding with filler silicone. In addition, the accuracy of conventional impressions was lower in areas with greater detail, such as the occlusal surface. Thus, concluding that the scanning of single crowns and multiple prostheses, up to 4 elements, has comparable accuracy to conventional impressions.

4.2 FULL-ARC SCANNING

For full-arc scanning, four scanner systems *(Cerec Bluecam, Cerec Omnicam - Sirona, Germany, iTero and Lava C.O.S) were compared with molds made from filler silicone, polyether, alginate and laboratory scanner scanning*, the silicone *molds* showed higher accuracy. Alginate impressions produced molds with accuracy and precision comparable to Cerec Omnicam, iTero and Lava C.O.S, while Cerec Bluecam was more accurate. Molds using polyether suffered greater distortions, while silicone impressions scanned by laboratory *scanners* produced results inferior to conventional molds, but comparable to intraoral scanning systems (Ender and Mehl, 2015).

In a clinical study, Ender et al. (2016) compared the accuracy of intraoral *scanners* with conventional group scanners for full-arc scanning, similar to the previous study. All *scanners* were inferior to conventional impressions, except for alginate. The highest accuracy was obtained by mold and addition silicone printing performed by laboratory *scanner*, followed by polyether printing. The performance of the evaluated systems (Cerec Bluecam, Cerec Omnicam, iTero, Lava C.O.S, Lava True Definition, TRIOS and TRIOS Color) were similar, except for the Lava C.O.S which had lower accuracy.

The qualitative evaluation of the systematic review by Abduo and Elseyoufi (2018) revealed that different scanning techniques are associated with different distortion patterns. The most evident distortion pattern in totally edentulous rims was obtained in the most posterior region of the arch. The earlier segment had higher accuracy than the later segments for the scanner-generated digital models. The authors concluded that, in general, intraoral scanning systems are more vulnerable to distortions than conventional methods.

Another aspect to be considered in scanning, especially in fully edentulous arches, is the soft tissue ratio, depth of the palatal vault, and width of the arches. Gan et al. (2016), in an in vivo study comparing the influence of these factors on the veracity and accuracy of the scan, demonstrate that soft tissue fingerprints were better and without significant interference from the height of the palatal vault. However, there was an inversely proportional correlation between the width of the arch (narrow, medium and wide) and the accuracy of the intraoral scan, i.e., the greater the width of the arch, the lower the efficiency of the *scanner*.

In a review conducted by Afrashtehfar et al. (2022), the clinical recommendation based on the included studies is that for extensive permanent fixed prostheses (above 4 elements) or removable total dentures, the conventional approach is recommended over the use of intraoral scanning. However, they point out that more clinical trials are needed to determine the clinical efficacy of intraoral scanning for broader oral rehabilitations.

4.3 SUBSTRATE MORPHOLOGY AND SURFACE

Nedelcu et al. (2018) stated that scanning under conditions of subgingival preparations should be critically evaluated due to the technical limitations and variations of *scanner systems*. During these procedures, some clinical situations, such as the presence of saliva, limitation of mouth opening, and positioning of the teeth in the arch may contribute to the inaccuracy of the digital model, due to the difficulty of light reflection.

Park et al. (2018) evaluated the accuracy of the Identica Blue (MEDIT, Korea), TRIOS, and Carestream 3500 (Carestream Dental, USA) scanners in different intraoral environmental conditions such as temperature, relative humidity, and lighting. In the comparison between the *scanners*, the TRIOS had similar accuracy and reproducibility with the Identica Blue. Although there was a subtle difference in accuracy based on the type of *scanners*, no significant differences were shown in the different simulated environmental conditions and accuracy was maintained between the scanners used.

The systematic review with meta-analysis conducted by Hardan et al. (2023) investigated whether the accuracy of *intraoral scanners* is influenced by different scanning factors and conditions. The meta-analysis data demonstrated that fingerprint accuracy improved significantly in dry environments. In addition, precision and accuracy were improved when artificial landmarks were used and an S-shaped scanning pattern was followed. However, the type of light used did not have a significant impact on the accuracy of the equipment. Thus, aspects such as the use of landmarks and fingerprints in dry conditions could improve the accuracy of *intraoral* scanners.

Another aspect addressed in two clinical studies is the accuracy of *the scanners* being influenced by the morphology of the tooth. Acute angles and proximal areas negatively influenced the reproduction of details. On the other hand, the *laboratory scanner* was less affected by the location and morphology of the teeth. Filler silicone impressions showed minimal deviations, while alginate and polyether impressions had localized distortions (Flugge et al., 2013; Ender et al., 2016).

Carbajal Mejia et al. (2017) tested the accuracy of using the TRIOS scanner (3Shape, Denmark) compared to silicone addition molds in incisor samples prepared for single crowns and obtained favorable results for the use of intraoral scanning. However, Yang et al. (2015) highlight the sensitivity of the equipment in accurately capturing images in marginal areas, since intraoral *scanners* were more vulnerable to distortions than conventional impressions.

The study by Su and Sun (2015) points to another factor related to the preparation of anterior and posterior teeth, in which the scanning of molar preparations tended to be more accurate than that of incisors. Another study corroborated this finding, demonstrating that incisor preparations for single crowns had greater inaccuracy than molars, a fact attributed to the steeper surfaces of incisors compared to molars (Rudolph et al., 2016).

Carbajal Mejia et al. (2017) evaluated the effect of changing the occlusal angle of convergence of maxillary central incisor preparations. The intraoral scanner was efficient in accurately recording the prepared tooth, regardless of the angle, while the accuracy of the impression with addition silicone deteriorated at an angle of less than 8º. This result was attributed to the material's vulnerability to distortion and tearing in areas with great parallelism.

4.4 INTRAORAL SCANNING SYSTEMS

Nedelcu and Persson (2014) evaluated the accuracy of four *scanners* (Cerec Bluecam, Cerec Omnicam, iTero and E4D - D4D Technologies, USA) for scanning unit crowns and there was variation in the results, in which a similar accuracy was found for the Lava C.O.S, Cerec Bluecam and iTero systems, with the E4D scanner being inferior to the others.

For scanning 3-element PPF pillars, Ali (2015) observed differences in veracity between the different *scanners* (Cerec Bluecam, iTero, Lava C.O.S, and E4D). The most accurate systems were iTero and Lava C.O.S, and the lowest accuracy was reported for E4D followed by Cerec Bluecam. For scanning 4-unit PPF metal abutments, Guth et al. (2017) obtained the best accuracy associated with Lava True Definition (3M ESPE, Germany) followed by Carestream 3500, Cerec Bluecam, Cerec Omnicam, and ZFX intrascan (Zfx GmbH, Germany), respectively. In addition, the authors attributed the results to the positive effect of powder coating for metal scanning.

Uhm et al. (2017) evaluated the accuracy of four systems (Cerec Bluecam, Cerec Omnicam, TRIOS, and Carestream 3500) for 4-element PPF inlay and abutments. For *inlay* scanning, while all systems had similar accuracy, the TRIOS and Carestream 3500 had the highest accuracy. On the other hand, for 4-element PPF, Cerec Omnicam and Carestream 3500 performed the best in the accuracy of the images obtained.

In general, as mentioned earlier, there is a pattern of reduced accuracy as the scanning range increases. The result of Mehl et al. (2009) for the scanning of unitaries using Cerec Bluecam was more accurate than that of a quadrant. Similarly, Su and Sun (2015) using the TRIOS scanner reported that there was a reduction in scanning accuracy as the amplitude increased. The authors concluded that regardless of the system performed, the intraoral scanner has an acceptable accuracy if the scanning site is smaller than a hemiarch.

Wang et al. (2024) compared the accuracy of five *intraoral scanners* by a coordinate-based method in fully toothed and partially edentulous models. Control images were obtained using a laboratory *scanner* (Ceramill Map 600) and the intraoral scanners were TRIOS 3 (3Shape), Planmeca Emerald, iTero Element 5D, Medit i500 and Shining A Oralscan 3. For the fully toothed mold, Element 5D demonstrated the highest accuracy in most of the measured parameters. In the partially edentulous

mold, Element 5D and Emerald exhibited higher accuracy in most of the measured parameters. In this way, the Element 5D scanner offered a high level of accuracy and was suitable for both situations.

Le Texier et al. (2024) conducted an in vitro study to evaluate the accuracy and precision of three *intraoral scanners* to scan a maxillary and mandibular total prosthesis. The purpose of this study was to test methods to facilitate duplication and replacement of total prostheses, since the stored file would allow its rapid replacement in case of loss, damage and need for repairs. For this, the total dentures were scanned with a flatbed scanner (D2000) to obtain the reference model and the *intraoral scanners* tested were TRIOS 4, Primescan and IS3800. The TRIOS 4 and Primescan showed comparable accuracy to the reference model, the latter having the lowest sagittal and transverse deformation. Although the equipment does not have the same precision, it has sufficient properties to perform the proposed procedure.

Another aspect described by Chiu et al. (2020) refers to the accuracy of scanning at the preparation margin of total crowns using different resolution parameters of an intraoral scanner (TRIOS 3, 3Shape). The authors observed significant differences in imaging between tooth surfaces, with the distal surface showing the largest discrepancies, and concluded that adjusting the *software* to a high-resolution mode, which obtains more data over a period of time, may not necessarily benefit the accuracy of the scan, while tooth preparation and surface parameters affect accuracy.

4.5 SCANNING TECHNIQUES

Ender and Mehl (2013) investigated the effect of different scanning strategies for Cerec Bluecam and Lava C.O.S. For Cerec Bluecam, the diagonal and rotational orientations of the *scanner* camera were superior to the occlusal orientation. For the Lava C.O.S., the accuracy was the same for occlusal, buccal and lingual orientation and rotational orientation around each tooth. However, direct guidance had superior accuracy.

Anh et al. (2016) evaluated different scan sequences for iTero and TRIOS. For each *scanner*, one scan sequence started on the right and the other sequence started on the left. Although the difference between the orientation sequences was statistically significant, in terms of precision, the difference was minimal, and the iTero showed greater sensitivity to sequence alterations.

The study by Muller et al. (2016) compared the veracity and accuracy of three scanning strategies for TRIOS: occlusal-buccal surface of the entire arch followed by the palatine surface, occlusal-palatine surface of the entire arch followed by the buccal surface, and alternation or rotation between the vestibular and palatal surface. The authors concluded that the second strategy had greater precision and accuracy. However, the significant difference was observed only for precision, and regardless of the strategy adopted, the more posterior region suffered greater distortion.

5 DISCUSSION

In unitary cases, the available evidence indicates similarity in the accuracy of intraoral scanning and addition silicone printing (Yang et al., 2015; Lee et al., 2017) and polyether printing (Rudolph et al., 2016). In impressions of PPF abutments, intraoral scanning is comparable to impressions using filler silicone and polyether (Guth et al., 2013; Ali, 2015). In cases of full-arc scanning, studies have consistently revealed the superiority of addition silicone printing over intraoral *scanners* (Ender and Mehl, 2013; Ender and Mehl, 2015; Ender et al., 2016). However, although statistical differences have been observed between the use of intraoral *scanners* and conventional impressions, the clinical significance of this difference in precision has not yet been determined.

The inaccuracy associated with intraoral scanning may be related to excessive reflection in the image capture processes, due to metallic restoration or excess saliva, or hard-to-reach areas, which can influence the quality and sharpness of the image (Kravitz et al., 2014; Nedelcu and Persson, 2014). Steep surfaces, acute angles, proximal areas, and subgingival margins often cause shading and are more likely to suffer greater discrepancies (Flugge et al., 2013; Rudolph et al., 2016; Ender et al., 2016).

Because scanning is not able to capture the entire arc with a single scan, multiple overlapping images must be taken and combined through an algorithm. As a consequence, each process may have additional discrepancies. Eventually, the error can be propagated to all processes (Flugge et al., 2013). This explains the observation of most of the included studies, in which the inaccuracy increases directly proportional to the measurement of the amplitude of the digitization (Ender and Mehl, 2013, 2015; Muller et al., 2016; Kuhr et al., 2016).

Conventional printing and laboratory scanning do not require numerous overlaps, unlike intraoral scanning; therefore, they can potentially be more accurate. In addition, each image taken from the laboratory scanner spans the entire arc, which means recording the entire dimension of the arc in each shot of the image (Su and Sun, 2015; Renne et al., 2017).

In the analysis of the efficiency of *intraoral scanners*, although all equipment is capable of generating virtual models of acceptable accuracy in certain applications, they share similar limitations. From the studies included in the review, no recommendation can be made as to which system has superiority. This difference can be attributed to the methodology of the studies, the operator's familiarity with the system, the learning curve associated with the use of these systems, and the ergonomic design and calibration of the *scanners* (Kim et al., 2016; Rudolph et al., 2016; Muller et al., 2016; Wang et al., 2024). Part of the differences in results may also be related to systems continually undergoing updates to improve performance.

For metal pillar scanning, some studies have indicated that systems using powder coating provided more accurate and consistent results on different substrates (Nedelcu and Persson, 2014; Guth

et al., 2017). This is due to the increased reflection of light emitted by the scanned surface. On the other hand, the superiority of scanning over the use of powder has not been reported by several studies (Ali, 2015; Ender and Mehl, 2015; Renne et al., 2017; Lee et al., 2017). Therefore, the positive effect of applying the powder to the surface of the pillars does not seem to be clear.

The scan sequence and camera movement can influence the accuracy of the virtual model. Diagonal orientations or rotation of the *scanner* were found to be more accurate than occlusal orientation, which can be attributed to a greater record of overlapping areas and prominent features (Ender and Mehl, 2013; Muller et al., 2016). Therefore, from the limited evidence, it can be speculated that scanning accuracy can be improved by reducing the reliance on software stitching of multiple scanned images. This can be achieved by increasing the number of overlapping areas, recording the amplitude of the arch in the early stages of scanning, and starting at surfaces with more defined anatomical morphology.

5.1 CLINICAL RECOMMENDATIONS BASED ON THE FACTORS THAT CAN INFLUENCE THE EFFICIENCY OF INTRAORAL SCANNERS

The included studies revealed several factors that may influence the accuracy of intraoral scanning systems, such as length of the edentulous space, scanning sequence, and morphology of the scanned surface. While intraoral scanning can be safely used to acquire diagnostic models and for treatment planning purposes, some recommendations are necessary for performing final prosthetic rehabilitations.

According to the current level of evidence, scanning the maxillary and mandibular arches at maximum intercuspation yields more accurate rehabilitations. This recommendation is supported by clinical studies that indicate that 3- or 4-element prostheses made using fingerprints exhibit similar accuracy to prostheses made by conventional techniques (Guth et al., 2013; Ahrberg et al., 2016). For larger rehabilitations, in addition to accurately recording the tooth surface, the occlusal relationship must be recorded, which is made more difficult after the preparation of several teeth.

There is some evidence that smooth surfaces are easier to pick up by *scanners* compared to uneven and wavy surfaces (Flugge et al., 2013; Ender et al., 2016). Thus, the professional should pay attention to these recommendations in the process of preparing the teeth. In addition, areas of sudden change in curvature may suffer greater distortions (Rudolph et al., 2007). Therefore, it is recommended to avoid sharp angles, "boxes" and gutters.

One of the limitations often encountered in digital imaging systems is the accuracy of the marginal area (Yang et al., 2015). Studies indicate that the margins of the prosthesis are vulnerable to inaccuracy, and this can be attributed to the difficulty of virtually copying the margin of the preparation (Aboushelib et al., 2012). However, further studies are needed to provide recommendations to

practitioners on the design of the preparation margin, saliva control, cost efficiency and clinical time, and long-term outcomes.

6 CONCLUSION

With the limitations of the review, it was possible to conclude that:

The accuracy of *intraoral scanners* is comparable to conventional impressions when used for diagnostic purposes and in cases of short-term scanning;

Smooth surfaces and dry environments produced scan results with greater accuracy;

The different intraoral *scanners* available on the market showed similar accuracy, however, there were limitations due to the lack of standardization of the evaluations.

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SEVEN
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Study of the relationship between the presence of musculoskeletal disorders and length of work in dental surgeons

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ABSTRACT
Introduction: Dentists are among the professional classes with the highest frequency of musculoskeletal pain and discomfort, justified by the characteristics of work in a restricted area that is the mouth and aggravated by postural adaptations maintained for a long period of stay, usually without breaks or breaks. These complaints accompany the increase in pain, demotivation, stress and finally incapacitation and withdrawal from professional practice. Whether years of work potentiate or mitigate these complaints is not yet defined, since there are numerous factors associated with these disorders. Objective: To investigate the possible relationship between the presence of musculoskeletal disorders and length of time working in dental surgeons. Materials and method: exploratory descriptive cross-sectional study with a quantitative approach to the data carried out through a questionnaire applied to 108 dental professionals in the State of Maranhão, collecting information on pain, location, intensity and duration of work. Results: The results showed that pain was more prevalent in professionals with 1 to 3 years of work, with the most affected regions being back (lower), back (upper), shoulders, wrists and hands. Conclusion: Through the study, we found that there is no relationship between musculoskeletal disorders and the time of work of these professionals.

Keywords: Musculoskeletal Disorders, Working Time, Dentists.

1 INTRODUCTION

Musculoskeletal diseases and pain (MSD) are described as a set of diseases and complaints that have impacts on various structures of the musculoskeletal system of the human being. These include, for example, joints, muscles, bones, nerves, blood vessels, ligaments, tendons, and supporting structures such as intervertebral discs (LIETZ, ULUSOY, NIENHAUS, 2020).

MSDs can arise from one or multiple injuries and result in pain or sensory disturbances in various regions of the body. They can become a temporary or chronic disease – the latter is more common, accounting for 40% of all chronic diseases (LIETZ, ULUSOY, NIENHAUS, 2020).

Several studies have found that MSDs often lead to increasing incapacity for work, sick leave, poorer quality of work, decreased job satisfaction, work-related accidents, and premature abandonment of occupation (LIETZ, ULUSOY, NIENHAUS, 2020).

In addition, there is greater awareness and concern in distinguishing the effects of physical inactivity and sedentary lifestyle, since an individual can be classified as active according to the definition standardized by the World Health Organization (WHO) and, at the same time, have a sedentary lifestyle, as is the case of those who sit for a long time according to Lopes et al (2021).

Knowledge about ergonomics has advanced a lot. Studies have revealed its importance for the quality of life of dentists. However, there is a great lack of application of its concepts and principles in dental practice, according to Castilho et al., (2021).

Scientific evidence indicates the high prevalence of joint, muscular, lumbar problems and other work-related musculoskeletal disorders (WMSD), mainly due to poor posture, lack of ergonomic planning of equipment, work environment, work systems, among others according to Castilho et al (2021).

Also according to Castilho et al., (2021), this has caused many dentists to work with low productivity, low comfort and, above all, no quality of life, which, in many cases, can leave them temporarily unemployed or even condemn them to abandon their careers early.

Work-related musculoskeletal disorders (WMSD) are highly prevalent, and it is essential to recognize the factors associated with them and their determinants Lopes et al (2021).

According to Castilho et al., (2021), among the main causes of the development of WMSD in dentistry are poor posture at work. In view of the above, and due to the existing gap in the area, this study aims to identify the regions of the dental professional's body that present musculoskeletal dysfunctions, and to relate these pain complaints and their intensity to the time and specialty of practice.

2 MATERIALS AND METHODS

2.1 STUDY DESIGN, SAMPLE AND EVALUATION SITE

This is an analytical cross-sectional study that aimed to identify the presence of musculoskeletal disorders in dentists in the state of Maranhão, Brazil, throughout their professional lives. Academics in the first and last period of internship and dentists of any specialty who had been working for at least 1 year and practiced for at least four hours/day were included, whether in the public or private sector. Patients with systemic pain diseases, such as fibromyalgia, rheumatoid arthritis, among others, and

those with temporary interruption of working time, as well as those who did not fully answer the questionnaires, were excluded.

2.2 ASSESSMENT OF MUSCULOSKELETAL PROFILE AND SYMPTOMS

Initially, we were provided, through the CRO, with a list with e-mail and telephone contact, as well as the number of dental professionals in the state of Maranhão. Subsequently, we contacted the professionals by e-mail, sending a letter for the explanation and invitation to participate in the study, along with the link to the questionnaire built through the *Google Forms tool.* The signature of the informed consent form was a basic and mandatory condition for the rest of the questions to be viewed and answered.

The questionnaire constructed through the *Google forms* tool for data collection contained questions to explore sociodemographic data and work characteristics, as well as personal and health habits such as: smoking habits, physical activity, information on working hours, health history, prepared by the researchers and which subsidized data on factors associated with musculoskeletal disorders. Musculoskeletal symptoms and their respective areas of affection were assessed using the Self-Estimated Functional Inability because of Pain *Questionnaire* for Brazilian workers**.** PINHEIRO (2020).

This instrument was chosen because it allows not only the assessment of muscle pain or discomfort, but also to what extent it affects the professional activity and is divided into 5 levels: (0) No pain, (1) Some pain, but not many problems, (2) A lot of pain, but I can bear it, (3) A lot of pain, I avoid certain movements and (4) I can't work because of the pain. They were also asked if they were prevented from carrying out their work, daily living or leisure activities; and/or sought health services such as physicians or physiotherapists due to these symptoms in the last 12 months.

For those who already have painful symptoms and functional discomfort due to pain, an invitation was made to come to the school clinic of Ceuma University, at the orofacial pain outpatient clinic, for a more detailed evaluation and physical therapy aimed at minimizing the pain, rehabilitation protocol and ergonomic guidance, free of charge. Of the 550 questionnaires sent, only 125 answered them in full, 50 of which were dental students and 100 professionals.

The collected data were presented as means, standard deviations (SD), differences between means and 95% confidence intervals (CI) of differences, and significance level was set at 5%.

This study was based on Resolution 466/12 of the National Health Council that regulates research involving human beings, submitted to the Human Research Ethics Committee of CEUMA University and approved by opinion No. 4,055,586.

3 RESULTS AND DISCUSSION

Working in a dental practice predisposes dentists to biological, chemical, psychological, and ergonomic hazards. These occupational hazards are associated with the occurrence of musculoskeletal disorders (MSD). MSDs constitute a group of serious occupational diseases characterized by pain and dysfunction that affect the musculoskeletal system that includes nerves, tendons, muscles, and intervertebral discs. ALSHOUIBI et al., (2020).

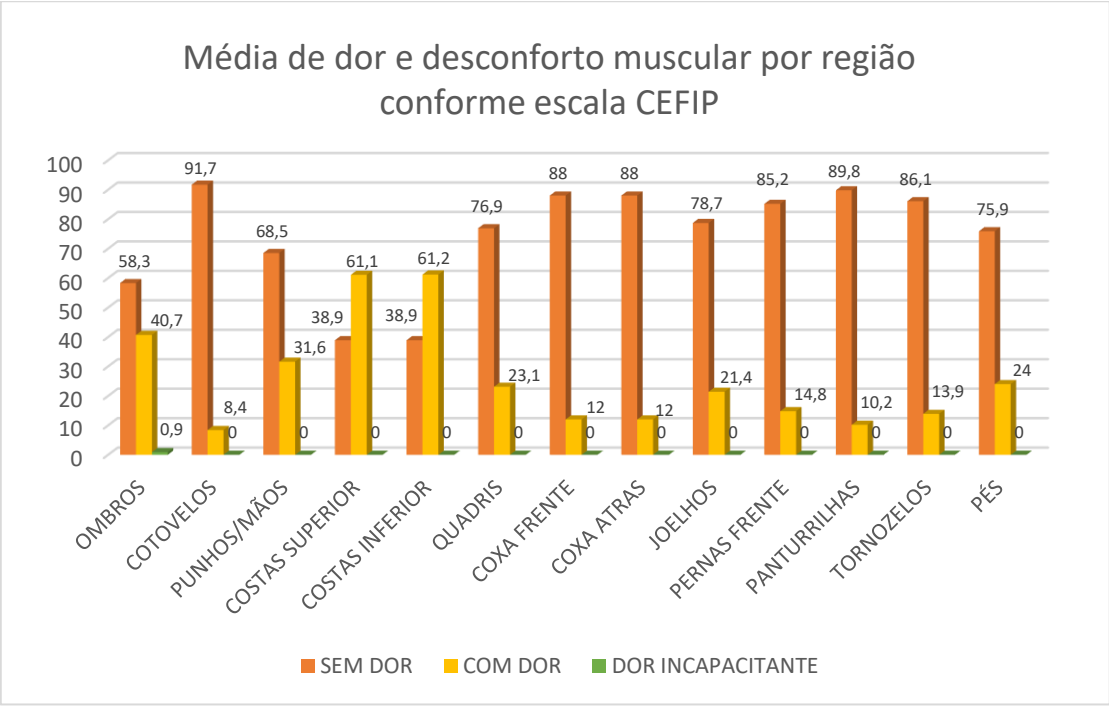
A study conducted with 1,250 dentists from Belgium, Luxembourg and the Netherlands showed that 64% of the professionals evaluated had disorders in the neck, shoulders and spine; 42% suffered from headaches; there was a higher occurrence of postural disorders in women; higher occurrence of disorders in dentists over 1.80 m tall; higher occurrence of neck and shoulder disorders among dentists who worked with direct vision of the maxilla; and 1/3 of the dentists had muscle fatigue.

It was also shown that the more difficult the treatment, the worse the posture, and also that the neck muscles were the ones that most contributed to the occurrence of fatigue and disorders according to Castilho et al., (2021).

Several studies show that dentists work in the same posture for many hours at a time and are exposed to static body posture. In addition, they use equipment with inadequate lighting and color combinations and are exposed to an annoying sound load, which affects both mental and physical health. CASTILHO et al., (2021).

In addition, it is known that while working, dental professionals need to perform precise hand movements, adopt awkward working postures, use vibrating dental instruments, and perform administrative work and repetitive monotonous tasks for a long time. (LIETZ, ULUSOY, NIENHAUS, 2020).

In view of this need for action, one of the points of this study was to observe the average of the reports of musculoskeletal pain and discomfort segmented by body regions, from the sample of 108 professionals, following the criteria of the CEFIP scale, as shown in the graph below.



Above, among all the regions of the body, we found that the ones with the most reports of musculoskeletal pain and discomfort are the lower back, i.e., lumbar region, with 61.2%, followed by the upper back with 61.1%, shoulders with 40.7% and wrists and hands with 31.6%.

The regions that signaled a higher incidence of pain are not surprising, since dental practice involves prolonged static postures, postures with forward flexion and repeated rotation of the head, neck and trunk to one side, overloading certain muscle groups, until it leads to stress.

This postural tendency is explained by Neves et al., (2022), who explain that as the posture deviates more from the neutral, the muscles responsible for the main side of rotation or flexion become stronger and the corresponding antagonist muscles become weakened, creating a muscle imbalance.

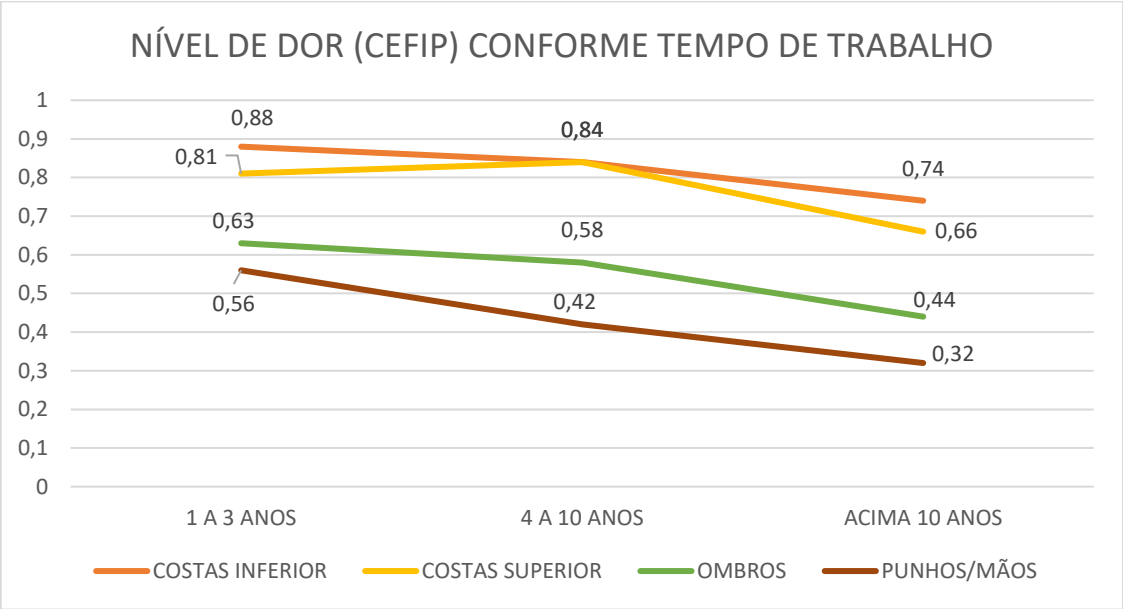
In the clinical practice of these professionals, due to short and insufficient rest periods, the damage rate is higher than the repair rate. The body, in order to protect the stressed area from further pain or injury, compensates by using another part of the muscle to maintain posture. This is known as muscle replacement. This is a cycle that perpetuates itself, and can result in the development of a whole range of musculoskeletal disorders. NEVES et al., (2022).

In the study conducted by Meisha DE et al., (2019), the prevalence of WMSD was 70% among dentists, with the most common location of WMSD pain being in the lumbar region (85%) and neck (84.6%). Recent research indicates that dentists have a higher risk of developing Carpal Tunnel Syndrome (CTS) due to frequent pressure from wrist movements, causing inflammation of the flexion tendons and compression of the median nerve.

Among other most commonly observed disorders are: muscle pain, headache, visual disturbances, poor circulation and varicose veins, bursitis of the shoulders and elbows, tendinitis, back

problems such as kyphoscoliosis, cervical, dorsal, lumbar changes and inequality in shoulder height. Santos et al., (2017); Meisha DE et al., (2019); Fernandez de Grado et al., (2019); Pejčić et al., (2020).

When we relate the pain complaints of these most mentioned regions with the time of work of these professionals, we found that they are not related, as shown in the graph below.



Above, among the regions of the body that had greater relevance in the level of pain according to the CEFIP scale, we found a decrease in the report of pain during the increase in the time of work of these professionals. In which we obtained an average fall of 15% for the back in the lower part, 18% fall for the back in the upper part, 30% fall in the report of pain for the shoulder region and 42% for wrists and hands.

The study also shows that 71.4% of the professionals interviewed perform some type of preventive practice or treatment to minimize pain that may be related to work.

Preventive actions, such as regular physical activity, stretching, maintaining a balanced posture, or alternating between different positions, are also very important in preventing musculoskeletal disorders and reducing pain caused by these disorders. Meisha DE et al., demonstrated that dentists who practice any sport or exercise were 50% less likely to report musculoskeletal disorders (MSD).

In addition, being regular in exercise decreased the chances of MSD even more by 10%. Working in chairs with adequate lumbar support also positively influences the reduction of pain related to MSDs, as they are beneficial in correcting the dentist's posture, facilitating a neutral posture of the lumbar spine that is considered favorable to musculoskeletal health and prevents back pain. In the same way, the use of magnifying loupes improves working posture and reduces shoulder pain. Neves et al., (2022).

Some initiatives would be of great value to the health of these professionals, such as training workshops on ergonomic practices for dentists, which would increase awareness about ergonomic practices and, consequently, reduce the negative consequences on musculoskeletal health. Other evidence-based health promotion activities include the promotion of exercises for low back pain. Meisha DE et al., (2019).

Stretching is also recommended to obtain elasticity in tissues injured by occupational diseases and to combat a sedentary lifestyle. It has a preventive and complementary character to the professional's relaxation and ergonomics. They are the exercises of first choice in cases of injuries caused by RSI/WMSD. The way they are performed allows a certain range of motion to be obtained and has prophylactic value. SANTOS et al., (2017).

4 CONCLUSION

Through the results obtained in the present study, it was possible to verify that there was no relationship between musculoskeletal disorders and time of work of these professionals, since the results obtained pointed to the presence of pain mainly in professionals with 1 to 3 years of work, highlighting as the most affected regions back (lower), back (upper), shoulders, wrists and hands.

Our results draw attention to the multifactorial causes of pain in these professionals, reinforcing the importance of a closer exploration of possible factors associated with these pains, as well as what can lead to the appearance and aggravation of these pains, so that we can suggest strategies to minimize and, if possible, elucidate and solve this problem, which is a problem for a large number of professionals and can even culminate in permanent absence from work.

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Environmental education in dentistry: Perceptions about mercury in dental amalgam and its harmful effects

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ABSTRACT
This scientific research deals with the harms and risks of Mercury, found in amalgam dental restorations made in dental activities. It aimed to answer the guiding question: what are the harms of the Mercury component in dental amalgam with a view to the academic-work environment and the natural environment? The general objective was to analyze, together with Dentistry students, the perceptions they have about the environmental theme and their actions in the environments. From the qualitative interpretative approach, the methodology used was the search for publications on the following platforms: Brazilian Digital Library of Theses and Dissertations (BDTD), Google Scholar, Scielo Platforms, etc., without obeying a specific period of time. In addition, the Likert Scale, Free Word Association Techniques and Content Analysis were also used in the Google Forms for students who are in the 2nd period or higher. There were some inconsistencies in the students' answers, such as: they did not know how to work with dental amalgam without polluting. We conclude that there are challenges for students and teachers, in the sense that the methodology used in the classroom is aimed as innovative, as a parameter of Environmental Education. In addition, it is necessary for the community of the school institution to think of ecosystems that involve entrepreneurial actions that meet the awareness of professionals who teach and those who learn, so that it is possible to dialogue between teaching and learning and the development of creating a "pleasant environment".

Keywords: Amalgam, Environmental Education, Harm, Mercury, Dentistry.

1 INTRODUCTION

This article deals with the harms and risks of Mercury (Hg), a component found in silver amalgam (or metallic amalgam) for dental restorations and widely used in laboratory activities in educational institutions, by Dentistry students, in the field of teaching and learning. In this sense, this article aims to answer the guiding question: what are the harms of the Mercury component in dental amalgam in the academic, professional and environmental environments? And whose intention is to reflect on the risks that Mercury (Hg) can cause to individuals, such as: Dentistry students, teachers, patients and the environment and what implies actions that may lead to the acquisition of knowledge of Dentistry students in the scope of laboratories and dental clinics of universities and the minimization of possible damage to the health of these subjects and their patients.

Grigoletto *et al* (2008) address that the high production of this component, for years, has caused environmental contamination and problems related to various health problems for human beings, and not unlike the inadequate disposal in the environment. These events will be discussed in the following sections. Also, in Grigoletto *et al* (2008) report that environmental contamination by Hg happens due to its exploitation, for many years, by society, in various areas, whether in industry, mining, dentistry, etc. The latter, occurring for more than 190 years for various purposes in labor practices, recalled by Costa, (2017).

In view of the concern with Education and, as a result, with the training of future Dentistry professionals and the working conditions of dentists and patients and the environment in which the subjects live, it appears as an important issue in society, in the light of contemporary demands, such as: environmental and occupational that occupy a space of great speed, This study was based on the presence of the substance mentioned above, Hg as toxic to humans and the environment, and that this research was motivated. In this societal context, the question arises: can Environmental Education (AE) in the contexts of future academics and dental professionals subsidize changes that minimize the consequences of the unfortunate use of amalgam in dental environments? Because, AE represents life: human, fauna, flora, aquatic and in order for it to be sustained, some actions are pronounced in the impetus to preserve and sustain the environment, being a dimension of Education, which aims to form ethical citizens in relationships, whether in relation to nature and between men or in the professional; promote reflection on their behaviors, attitudes, values and beliefs, as listed by Reigada and Reis (2004); in addition to inducing social dynamics at first in the local community, i.e., at work, and later, in broader networks in which there should be. (SAUVÉ, 2005). In this way, EE will be able to contribute to critical education and with its enactment, Law 9.795, of April 27, 1999, it was possible to make it mandatory in all Brazilian educational establishments (BRASIL, 1999).

It is in this context that it (EE) has as one of its objectives the participation of subjects in discussions, proposals and decisions on environmental issues, as well as in the impetus of dental teaching and learning within academic institutions. Thus, the relationship and participation of the subjects become important to seek solutions to the harms of environmental and social problems. (REIGOTA, 1994). The following is a look at the methodology and procedures.

2 METHODOLOGY (OR MATERIALS AND METHODS)

The methodology used was the search for articles, in the year 2022, on the following platforms: Brazilian Digital Library of Theses and Dissertations (BDTD), Google Scholar, Scielo Platforms, etc. The research did not follow a period, that is, a period of years.

Initially, it was proposed to carry out a research only with students of the 2nd period of the Dentistry Course. However, when thinking about the questions, the periods of choices were from the

2nd year onwards, since in colleges in Brazil there is no standardization of the beginning of classes in laboratories and dental clinics, practices that are part of the school curriculum. Based on this, the Free and Informed Consent Form (ICF) was presented[1] and two questionnaires were created, on the *Google Forms*[2] platform, for Dentistry students from all over Brazil: research on the knowledge of Dental Students about the harm of Dental Amalgam and Free Word Association Technique (TALP), the latter being "a strategy for collecting material that requests, to the students, the choice of words evoked and classified within a category". (SOUZA, 2020, p. 151). There were no responses referring to the data collection instrument, the Liket Scale. Therefore, the researcher preferred to continue with the research, using only the instruments mentioned above. It is alleged that this action did not prejudice the answer to the guiding question of the research.

Regarding the number of participants, 22 (twenty-two students) answered the form "Survey on the knowledge of Dental Students about the harm of Dental Amalgam" and 7 (seven students) answered the form "Technique of Free Association of Words" – evoked words. Regarding the choice of the target audience, it is thought that there has probably already been some theoretical and practical knowledge about the use of Dental Amalgam, whether in laboratories or dental clinics. As well as the criteria for choosing the educational institutions, that is, there was no criterion for the choice of the faculties, allowing many students to reach and answer the questionnaires with open and closed questions more quickly, given the distance of the subjects. Thus, planning to collect through *Google Forms* made the process easier. In addition, the Content Analysis Technique (CAT) was used for the treatment and analysis, whose objective is to adequately describe, systematize, inferentiate and interpret qualitative and quantitative studies (BARDIN, 2007).

From the qualitative interpretative approach, other questions arose: can Environmental Education in academic and professional dental contexts support changes that minimize consequences in the use of amalgam in dental environments? Are future professionals aware to act in an innovative way, minimizing environmental pollution and health hazards? In this way, we processed the data produced for future analysis, which was carried out in two stages. These can be enlivened in the results.

[1] - It was delivered in advance to all participants and 100% accepted the document.
[2] - Free tool for creating online forms available to any user who has a Google account for the purpose of conducting field research, also aiming to facilitate the process of data collection and analysis of results. DA SILVA MOTA, Janine. Use of *Google Forms* in academic research. Humanities & Innovation, v. 6, n. 12, p. 371-373. (2019, p. 1).

3 THEORETICAL FRAMEWORK

3.1 DENTAL AMALGAM: CONCEPT, ADVANTAGES AND DISADVANTAGES

A low-cost, easy-to-handle, long-lasting, high-strength material, dental amalgam has been used in the field of dentistry for more than 150 years (De Oliveira *et al., 2022) for direct restorations*[3]. As components, it has silver, tin, copper, zinc, indium, palladium and mercury. (REIS *et al*, 2006). However, it has the following disadvantages that help to minimize its current use (Moura, 2021): the anti-aesthetic, "does not reinforce the weakened tooth structure and subject to corrosion"[4] Reis *et al* (2006, p. 321) and its mercury component, which is a substance of great risk, both for the Dental Surgeon (DC), Dental Students, Patient and for the Environment, There is a possibility that there is a lack of knowledge about the proper handling and disposal of amalgam waste.

3.2 MERCURY IN DENTISTRY: ITS HARM TO INDIVIDUALS AND THE ENVIRONMENT

Mercury is classified into three forms: Organic and Inorganic Mercury and Metallic Mercury, the latter being the one of choice in private and public practices and in universities with dental clinics. (PÉCORA, 2003).

The concern with this component of amalgam is so great because, according to reports by Aciole (2022), it is painless, odorless, can be present in the environment for up to a year and even if it is in low concentrations, mercury can cause toxicity to humans. And depending on its concentration and quantity, systemic signs and symptoms may appear: tremors, altered personality, agitation, anxiety, sleep disorders, memory loss, dementia, attention deficit, depression and hearing and vision impairment, which can cause irreversible effects and, in more severe cases, even death. Pécora (2003, p. 2) argues that in relation to local signs and symptoms (oral cavity), there are "gingival bleeding, loss of alveolar bone, loss of teeth, excess salivation, bad breath, metallic taste, oral leukoplakia[5], stomatitis[6] and tissue pigmentation".

3.3 SUGGESTIONS FOR THE CORRECT DISPOSAL OF AMALGAM AND FOR THE REDUCTION OF ITS USE

Also in Aciole (2022), unnecessary exchanges of old amalgam restorations for aesthetic restorations of composite resin, ceramics, etc., improper disposal of amalgam in the garbage, incorrect handling of the material, and the presence of Hg residues in the sewage system because of suckers and

[3] - Procedures done in a single dental visit.
[4] - It is the degradation of materials.
[5] - Potentially malignant disorder of the oral cavity. RAMOS, Ruth Tramontani *et al*. Oral leukoplakia: concepts and clinical repercussions. Brazilian Journal of Dentistry, v. 74, n. 1, p. 51, 2017.
[6] Inflammation in the stomatognathic system (in the lining of the mouth)

spittoons in an office without sieves are the causes of amalgam toxicity by humans and the environment, as listed below.

> Mercury settles into methylmercury, contaminating plankton, which serves as food for fish, thus contaminating the entire food chain, including humans. (ACIOLE, 2022, p. 15).

Therefore, it is important that students and their professors pay attention to the correct disposal of dental amalgam. It is essential to have, in the dental field, refrigeration during handling, finishing and polishing of the restoration and a cool environment during its storage, because heat sources, such as autoclaves and ovens, increase mercury toxicity. In addition, storing used amalgam capsules and sending them to a chemical waste laboratory provides a minimized contamination environment. Well, these capsules have traces of mercury, use mechanical amalgamators during their handling, use new drills and a high-speed pen with refrigeration to avoid the appearance of heat, always use PPE (Personal Protective Equipment) to protect, mainly, the skin, mouth and eyes and acquire spittoons with sieves to prevent amalgam residues from going into the sewer, as discussed by researchers Reis *et al* (2006); Aciole (2022). These are actions that avoid or reduce harmful risks to humans and the environment. And also of great importance: professors delve deeper into theories about the use of amalgam in the faculty and thoroughly evaluate each case of patients and reach a correct diagnosis to observe if the choice of using amalgam is really necessary during restoration or if it can be replaced by composite resin.

4 RESULTS AND DISCUSSION

Bardin (2016, p. 135) argues that "making a thematic analysis consists of discovering the 'nuclei of meaning' that make up the communication and whose presence, or frequency of appearance, can mean something for the chosen analytical objective". For the classification of categories, the units were established in the context of the thematic investigation, in such a way that we seek to understand the textual indications of the undergraduates in their reports during the research. Therefore, they were grouped as follows.

The 1st Stage refers to the questionnaire with structured and semi-structured questions. Among them, the questions chosen are those that deal with the disposal of amalgam in activities(1), risks that harm human beings(2), risks that harm the environment(3) and discipline of environmental issues in dentistry – referencing environmental education(4). According to the testimonies of the participants, respectively, we can cite some textual records: 1- specific garbage and container with water; 2- toxicity and alteration in the gastrointestinal tract and nervous system; 3- environmental pollution and contamination of water and soil and 4- there is an awareness of our actions – prevention and insertion of content in various disciplines on socio-environmental impacts.

In view of some of the reports of the deponents, Grigoletto (2008) argues that there can be a control of this toxic material through preventive measures, regarding Mercury, its residues, the manipulation of amalgam and its disposal, such as a container with a lid, water and specialized collection, also presented in D17. To complement this, D2 states that a possible risk to humans is toxicity and, to avoid this, awareness of our actions is the solution to prevent the harm that Amalgam can cause.

As previously mentioned, Aciole (2022, p. 28) reports that mercury can "cause tremors, altered personality, agitation, anxiety, sleep disturbances, memory loss, dementia, attention deficit, depression and impairment of hearing and vision, irreversible effects, and even death." Pécora (2003) also addresses that there may be oral leukoplakias, stomatitis and other signs and symptoms. This is in line with the D19 report.

Therefore, below we find some of the testimonies of the participants.

> Toxicity to the body due to the presence of mercury. The more we are aware of the effects of our actions, the better prepared we will be to prevent and solve those that harm our environment (D2). Contamination of water and soil, which can lead to Minamata disease (D6). It is not used. However, we use it and it is placed in a container with a lid and water and the specialized collection comes to remove it (D17). Although it is important to know the social and environmental impacts caused by the use of materials in the dental area, I do not consider it necessary to have a discipline on the subject. However, inserting this topic with emphasis and revision in other subjects of the course can be interesting (D18). Intoxication, changes in the gastrointestinal tract and nervous system (D19).

In the 2nd stage, there is a questionnaire with unstructured questions using the Free Word Association Technique, TALP" – evoked words. The ones of choice address the text units and their categories, for example, Environmental Education in Dentistry - Environment and Individual Protection(1); Benefits of Amalgam – Advantages(2); Amalgam manipulation awareness - Education and Awareness(3). Regarding the reports, we obtained them in the following order: 1- health and environment; procedure and protective gloves; 2- durability and resistance; 3- Education, campaigning and responsibility.

From the words evoked from the participants, we can enliven the following statements.

> Endurance, as it also ensures longevity. [...] responsibility, because as professionals and conscientious citizens, we must do our part and contribute to the reduction of risks, toxicity and pollution to the environment (D6). Disposal ends up becoming more important when it comes to the execution of Environmental Education, because discarding (or not) is what will impact the environment (D7). [...] protection, as it will ensure the individual's health (D7).

In the report of Student 6, we witnessed the commitment to the benefits of amalgam in the treatment of patients, for example, it is remembered resistance, longevity of the material and minimization of risks due to the toxicity generated and harmful to the Environment. In addition, Student 7 also reports that it is important to protect the individual during the use of Amalgam. These

word choices are associated with the author Grigoletto (2008, p. 8), where she states that "mercury must then be handled in hermetically sealed systems and within hygiene standards". In this sense, student D7 corroborates when he lists that the issue of disposal is pertinent to minimize the damage to health.

These are some of the aspects said by researcher Aciole (2022, p.14) that in his speeches about Amalgam; "It has "excellent mechanical resistance, with durability of around 20 years of use in the oral cavity" are issues that have in relation to the scope of economic education as well. Sauvé (2005, p.3017) states that thinking about Environmental Education is part of a true economic education: it is not only about "environmental management", but rather about the "management" of our own individual and collective behaviors with respect to the resources extracted from the environment"; in a critical and innovative way.

5 FINAL THOUGHTS

We conclude that it requires challenges from students, in the sense that the methodology used in the classroom is objectified as innovative, as a parameter to Environmental Education. It is necessary for the community of the school institution to think of ecosystems that involve entrepreneurial actions that meet the awareness of the professionals who teach and those who learn, so that the dialogue between teaching and learning is possible and the development of creating a "pleasant environment". Even with its harms, many patients still have amalgam restorations and because it is a cheap material, it is still widely used, especially in public clinics. Based on the research done in this study, it was observed that students still do not have in-depth knowledge on the subject.

Therefore, it is concluded that it is of paramount importance that there is not only learning of Dentistry students about its use and correct disposal in chemical waste laboratories, but also lectures, courses and/or an extra discipline of Environmental Education in the curriculum of the Dentistry course, so that there are no consequences for future dentists. to the patient and to the environment.

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Perception of Dentistry graduates in relation to professional training with emphasis on interprofessional education

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ABSTRACT
The objective of this chapter was to reflect on training in Dentistry, including the perception of undergraduate graduates in Dentistry in Rio de Janeiro about the quality of professional training with emphasis on interprofessional education. We present a study where an online questionnaire was applied to graduates of three Dentistry courses, two public institutions and one private, to students graduated between 2016.2 and 2019.1. The structured questionnaire used contained 41 questions to analyze the quality of the academic activities offered during the training of these professionals. The questions involved four dimensions: (1) profile of the graduate, (2) orientation of health care, (3) teaching-service integration, and (4) pedagogical approach. In this study, the answers to 9 questions from the four dimensions were presented. The results show that graduates of the Dentistry courses evaluated are satisfied with the quality of the professional training achieved through the academic activities offered by their courses. Especially those related to the formation of the professional profile and health promotion. However, the perception of the graduates indicates that multiprofessional/interprofessional experiences and living in the SUS still need to be improved, encouraging students to participate in internships and extension projects, thus training professionals capable of working in the SUS and in the existing social context.

Keywords: Dental Education, Curriculum Guidelines, Health Promotion, Interprofessional Education, Alumni Profile, Questionnaires.

1 INTRODUCTION

This chapter aims to reflect on training in Dentistry, including the perception of undergraduate graduates in Dentistry in Rio de Janeiro about the quality of professional training with emphasis on interprofessional education.

In this sense, the maintenance of the traditional model of higher education still highlights the need for changes in the training of professionals in this area (NORO, 2019), as well as in other areas of health, including postgraduate training. Even after the publication of the National Curriculum

Guidelines for undergraduate courses in Dentistry (CNE/CES Resolution No. 3 of June 21, 2021), there is a demand to adapt professional training in a more interprofessional perspective. This issue encompasses different points, among them the new demands of the labor market, training considering multidisciplinary patient care, and the performance of the Brazilian public health service (Unified Health System - SUS) to meet the demands of the population and provide comprehensive treatment to the community. For these changes to be possible, the articulation between education and health policies is essential (ARAÚJO, 2006).

The SUS was created in 1988 by the Brazilian Federal Constitution, which determines that it is the duty of the State to guarantee health to the entire Brazilian population (COBAITO & COBAITO, 2020). The Brazilian public health system has fundamental characteristics, which are: to enable activities related to health promotion, prevention and care that are carried out in an equal, universal and integral way for the population, ranging from primary care to highly complex procedures (INTERNATIONAL CONFERENCE ON HEALTH PROMOTION, 1986). The integration between the public service and professional education is essential, so that there is the training of professionals able to work in this context, following the Family Health strategy (BRASIL, 2021; ARAÚJO & ROCHA, 2007).

Professional training in Dentistry should develop a generalist, humanistic, autonomous, critical and reflective profile, capable of understanding social reality, being some of the main objectives of undergraduate courses in Dentistry according to the DCN (BRASIL, 2021).

Multi- and interprofessional work in integrated patient care is very important for the promotion and maintenance of health and for the treatment of diseases, especially in the case of chronic non-communicable diseases (SIDDIQI *et al*, 2022). Multiprofessionality refers to the joint action between professions, but without interaction between them, fragmenting health care, while interprofessionality refers to the union between two or more professions in order to seek solutions to a problem, interacting in decision-making and building knowledge between health areas (ALVARENGA *et al*, 2013). Interprofessional education in health education courses has evolved, not only because it is a basic guideline of the public system, but also because it provides more complete care, in addition to encouraging exchanges of opinions and knowledge, the exercise of transformative practices and permanent dialogue (BATISTA, 2012).

The National Curriculum Guidelines (DCN) for undergraduate courses in Dentistry (BRASIL, 2021) define the principles, foundations, conditions, and procedures for the training of dentists, for application in curricula at the national level, in the organization, development, and evaluation of pedagogical projects of undergraduate courses in Dentistry at Higher Education Institutions (HEIs). Seeking to comply with the requirements of the DCNs, the courses changed their pedagogical projects, as well as several public policies were implemented in the country in the 2000s, such as the National

Program for Professional Reorientation in Health (Pró-Saúde) and the Program for Education through Work for Health (PET-Saúde; PET Interprofessionality; PET-Management & Assistance). All aimed at encouraging health promotion activities, multiprofessional/interprofessional education, and the comprehensiveness of actions, with the objective of bringing professional training closer to the needs of care in the public health service within the scope of the SUS (BATISTA et al, 2015; FREIRE FILHO *et al*, 2017).

These public policies aimed to offer students opportunities for internships and extension programs, in line with the DCN, enabling a greater experience in public service scenarios, expanding their performance in the SUS.

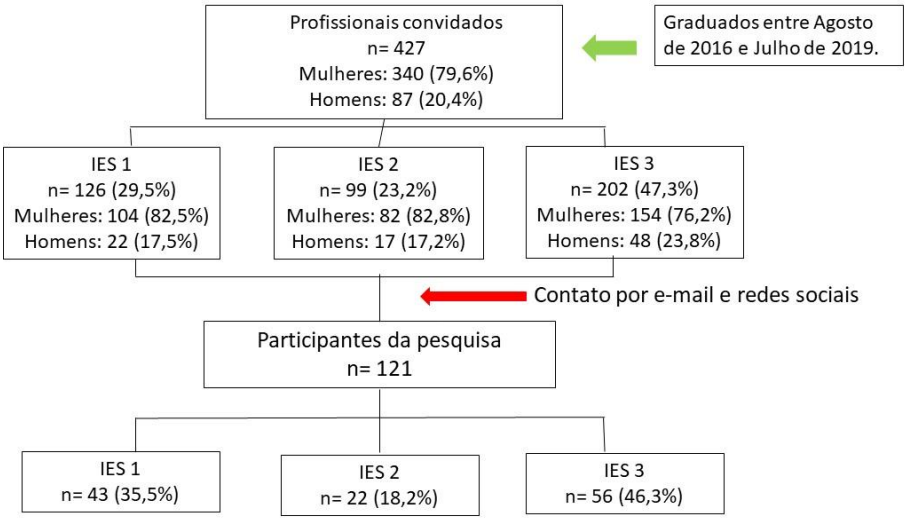
Expanding the discussion on these aspects mentioned above, some studies were carried out seeking to verify the perception of undergraduate graduates in Dentistry in Rio de Janeiro about the quality of professional training with emphasis on interprofessional education and experiences in the Unified Health System (SUS) such as internships and extension projects offered by the respective courses. Some results will be discussed below.

Menezes et al. (2022), in a survey with 121 graduates of three dentistry courses in Rio de Janeiro, two public and one private, (IES 1 - public; IES 2 - public); and IES 3-private), for students graduated between 2016.2 and 2019.1, an online questionnaire containing 41 questions was applied to analyze the quality of the academic activities offered during the training of these professionals, based on the study by Pessoa and Noro (2015). The questions involved four dimensions: profile of the graduate (generalist, humanist, autonomous, critical and reflective and capable of understanding social reality); orientation of health care (epidemiological focus, health promotion, diagnosis, dental treatment, oral health team and multi/interprofessional education); teaching-service integration (internship activities and experience in the SUS); and pedagogical approach (active methodologies, role of the teacher, practice scenarios, integrated curriculum, curricular flexibility and teaching-research-extension articulation). The following scale was used to guide the participants regarding the answer options: 1 - "none", 2-3 - "very little", 4-5 - "little", 6-7 - "moderate", 8-9 - "very good", 10 - "excellent".

Of a total of 427 graduates invited to participate in the research, 121 (28.34%) answered the questionnaire. Individually, HEI 1 had a response rate of 34.1%, HEI 2 of 22.2% and HEI 3 of 27.7%.

Figure 1 shows a flowchart with the number of invited graduates and effective participants in the research.

FIGURE 1: Flowchart with the number of invited graduates and effective participants of the research.



The results regarding the gender and year of graduation of the participants are presented in TABLE 1. The mean age of the participants was 26.94 (± 5.63) years. Two participants of HEI 3 did not answer adequately about the year of graduation and were excluded from the table.

TABLE 1: Relationship between graduation year and gender in each HEI.

Gender	Graduation year	IES 1 N= 43	IES 2 N= 22	IES 3 N= 54	Total N= 119
Female	2016	5 (11,6%)	0 (0%)	0 (0%)	5 (4,2%)
	2017	10 (23,3%)	5 (22,7%)	6 (11,1%)	21 (17,6%)
	2018	16 (37,2%)	9 (40,9%)	19 (35,2%)	44 (37%)
	2019	0 (0%)	2 (9,1%)	12 (22,2%)	14 (11.8%)
	All	31 (72,1%)	16 (72,7%)	37 (68,0%)	84 (70,6%)
Male	2016	2 (4,7%)	0 (0%)	0 (0%)	2 (1,7%)
	2017	4 (9,3%)	2 (9,1%)	6 (11,1%)	12 (10,1%)
	2018	5 11,6%)	1 (4,6%)	7 (13%)	13 (10,9%)
	2019	0 (0%)	3 (13,6%)	4 (7,4%)	7 (5,9%)
	All	11 (25,6%)	6 (27,3%)	17 (31,5%)	34 (28,6%)
Other	2018	1 (2,3%)	0 (0%)	0 (0%)	1 (0,8%)

Regarding the labor market, of the 121 participants in the study, 24.8% (n=30) were not yet working, 5% (n=6) worked in a public dental service and 70.2% (n= 85) in a private dental service, with the majority (63.6%) as General Practitioners.

The data referring to the sub-dimensions evaluated to verify the perception of the graduates regarding the quality of the academic activities offered aimed at the formation of the graduate's profile (generalist, humanist, ability to understand the social reality), health promotion, multi and/or interprofessional experiences, internship activity, experience in the SUS and on the practice scenarios used, are shown in TABLE 1 and TABLE 2. There was a statistically significant difference between the HEIs in relation to some variables.

CHART 1: Questions related to the sub-dimensions addressed.

Questions related to the Alumni Profile dimension
Generalist: In the individual field, have you carried out activities of prevention, diagnosis, planning and dental treatment of the main dental problems?
Humanist: Did the course offer quality care with welcome and qualified listening?
Humanist: Did the course offer a broader view of the subject and his/her care needs?
Ability to understand the social reality: Do you identify the social context in which you develop your professional practice, respecting the characteristics of the population and looking for appropriate solutions to this reality?
Questions related to the dimension Orientation of health care
Health promotion: Did the course offer you the ability to understand the social determination of the health-disease process and to develop comprehensive strategies for the expansion of healthy choices based on the living conditions of individuals and the population?
Multiprofessional/Interprofessional Education: Did the course provide you with the development of activities to guide multiprofessional and interdisciplinary care with students, technicians or professionals from the same area (dental prosthesis technicians) and/or from other health areas (doctors, nursing technicians, community agents, etc.) providing for the comprehensiveness of health actions?
Questions related to the dimension of teaching-service integration
Internship activity: Were individual clinical activities and collective actions developed in spaces outside the scope of the Faculty, articulated with the SUS (linked to your Faculty of Dentistry)?
Experience in the SUS: During the course, did you carry out activities developed at all levels of care in the health system (low, medium and high complexity), understanding the flow of the network, the planning and evaluation of services and the professional competencies at each level, enabling the understanding of the breadth and complexity of the SUS?
Question regarding the Pedagogical Approach dimension
Learning scenarios: Was your learning based on multiple sources of knowledge such as libraries, virtual environments, the community, planning, management and surveillance agencies, schools, daycare centers, social spaces, and health units?

TABLE 2: Graduates' perception of the quality of the development of activities aimed at health promotion, multiprofessionality, internship activity and experience in the SUS.

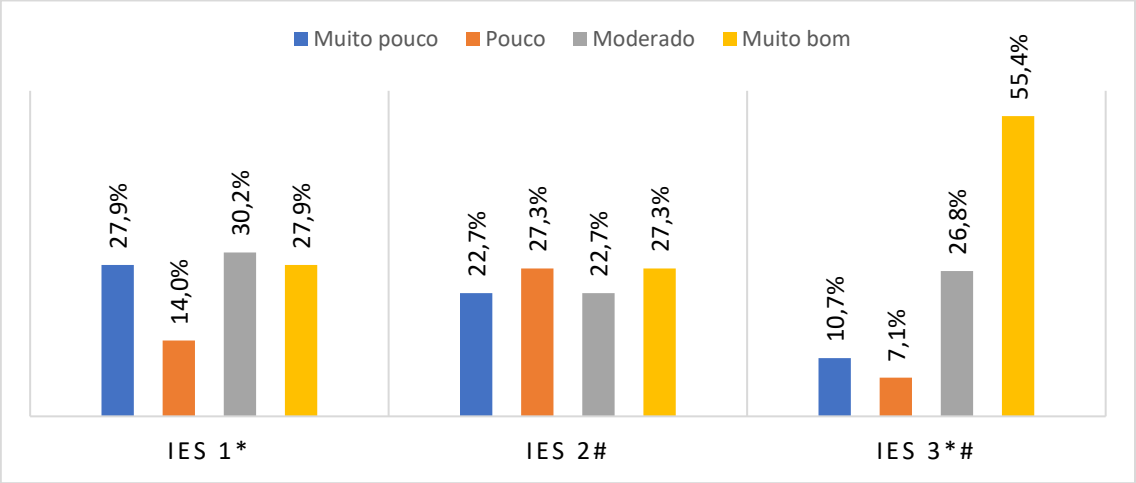
	IES 1	IES 2	IES 3	Total	p-value*
	Mean(SD)	Mean(SD)	Mean (SD)	Mean(SD)	
Generalist	8.12 (±1.9)	7.1 (±2.6)	6.7 (±2.7)	8.34 (±1.6)	0,199
Humanist (welcoming and qualified listening)	6,49 (±2,4)[a]	6.2 (±2.6)	6,6 (±2,5)[a]	7.6 (±2.0)	0,000
Humanist (enlarged view of the subject)	6,8 (±2,5)[a]	6.4 (±2.5)	6,6 (±2,5)[a]	7.7 (±2.0)	0,007
Ability to understand social reality	8.9 (±1.1)	7.0 (±2.6)	6.9 (±2.5)	8.7 (±1.2)	0,036
Health Promotion	6,8 (±2,5)[a]	8.1 (±1.7)	8,5 (±1,3)[a]	7.8 (±2.0)	0,002
Multi-professionality	4,7 (±2,8)[a]	6.2 (±2.6)	7,2 (±2,0)[a]	6.1 (±2.7)	0,000
Outreach Activities	5,9 (±2,5)[a]	7.2 (±2.4)	7,2 (±2,8)[a]	6.7 (±2.7)	0.010
Experience in the SUS	5,7 (±2,7)[a]	5,7 (±2,8)[b]	7,3 (±2,5)[ab]	6.4 (±2.7)	0.004
Practice Scenarios	6,9 (±2,5)[a]	6.14 (±2.6)	6,8 (±2,7)[a]	7.7 (±2.1)	0.004

Note: * Scale used: 1 - "none", 2-3 - "very little", 4-5 - "little", 6-7 - "moderate", 8-9 - "very good", 10 - "excellent"
*Kruskal-Wallis
Mann-Whitney with Bonferroni correction
[a] Comparison between IES 1 and 3. P-value≤0.05
[b] Comparison between IES 2 and 3. P-value≤0.05

The graduates considered as very good the quality of the activities to form the profile of the generalist, humanist graduate and the ability to understand the social reality, health promotion activities and the practice scenarios used. They considered the quality of multi/interprofessional education and extension activities to be moderate. Regarding the experience in the SUS, the answers varied greatly

among the graduates of each HEI, as observed in GRAPH 1. When comparing the institutions, a statistically significant difference was observed between HEIs 1 and 3 in the sub-dimensions humanist – welcoming and qualified listening ($p \leq 0.001$), humanist – expanded view of the subject ($p \leq 0.003$), health promotion ($p \leq 0.001$), multi/interprofessional education ($p \leq 0.001$), extension activities ($p \leq 0.001$), experiences in the SUS ($p \leq 0.003$) and practice scenarios ($p \leq 0.001$). Between HEIs 2 and 3, there was a statistically significant difference in the variable experience in the SUS ($p \leq 0.001$).

GRAPH 1 - Responses of the graduates related to their experience in the SUS during their training.



Teste Kruskal-Wallis e Mann-Whitney *# p<0,01

In this study, the perception of graduates of the evaluated courses showed that, in relation to the formation of the profile of the generalist graduate, there was similarity between the answers, and the activities for this training were considered very good. On the other hand, the humanistic and ethical aspect, attentive to the dignity of the human person and to individual and collective needs, promoting integral health and transforming reality for the benefit of society, showed a significant difference between the HEIs. HEI 1 showed that the graduates perceived the reception and qualified listening as little to moderate, differing significantly from HEI 3. Humanization is a fundamental aspect of health care to be carried out through empathy, communication skills, and perception of signals, verbal or not, skills to be developed by health professionals in training (BARELLI *et al*, 2021). Regarding the expanded view of care, there was also a significant difference between HEI 1 and HEI 3, demonstrating that there is a need to approach the patient in a broader and more comprehensive way (BRASIL, 2021).

TABLE 3 shows the number of graduates who worked in public health service settings during the course, in relation to the number of graduates per HEI. The percentage value refers to the number of graduates in relation to the total number of HEIs. Several graduates reported having worked in more than one scenario. There is a greater participation of the egressed in basic health units such as family clinics, followed by emergency care and in hospitals, and social spaces such as schools, daycare centers, community associations, among others. In the other option, the graduates reported having

worked at the Galeão Air Force Hospital (HFAG) and the Rondon Project, a social action project of the Brazilian federal government.

TABLE 3: Number of graduates who worked in SUS settings during the undergraduate course in relation to the total number of individuals from each HEI.

Scenarios	IES 1 (n:43)	IES 2 (n:22)	IES 3 (n: 56)	Total (n: 121)
1	31 (72,1%)	21 (95,5%)	39 (69,6%)	91 (75,2%)
2	8 (18,6%)	8 (36,4%)	13 (23,2%)	29 (24%)
3	7 (16,3%)	1 (4,5%)	3 (5,4%)	11 (9,1%)
4	10 (23,3%)	3 (13,6%)	39 (69,6%)	52 (43%)
5	0 (0%)	0 (0%)	2 (3,6%)	2 (1,7%)
6	28 (65,1%)	11 (50%)	12 (21,4%)	51 (42,1%)
7	2 (4,7%)	0 (0%)	2 (3,6%)	4 (3,3%)
8	3 (7%)	0 (0%)	0 (0%)	3 (2,5%)

Legend of the scenarios used by the graduates: 1: Basic Health Unit/Family Clinic; 2: Dental Specialty Center/Outpatient Clinics; 3: Itinerant dental offices; 4: Emergency Care Unit/ Hospitals; 5: Health surveillance agencies; 6: Social spaces; 7: Others; 8: Did not participate

Another important result in relation to the profile of the graduates in this study was the very good perception of the graduates about the ability to understand the social reality, identifying the social context in which they develop their professional practice, respecting the characteristics of the population and seeking appropriate solutions to this reality. The experience in the SUS is essential for these future professionals to know the reality of the community. And currently, in the current curricula, this experience is primarily provided through supervised internships or extension activities. It should be noted that, recently, the new DCN already make the inclusion of Dentistry students in the SUS mandatory, and that Supervised Internships must correspond to 20% of the total hours of the course (BRASIL, 2021).

It was also observed that from the first periods, the students had the opportunity to work in the SUS network, but there was a greater insertion between the fifth and eighth periods (Table 4).

TABLE 4: Period of insertion of graduates in practice scenarios linked to the Public Health Service (SUS).

Period of insertion in the SUS	IES 1 (N=43)	IES 2 (N=22)	IES 3 (N=56)	Total (N=121)
First period	23 (53,5%)	2 (9,1%)	6 (10,7%)	31 (25,6%)
Second Period	8 (18,6%)	4 (18,2%)	9 (16,1%)	21 (17,4%)
Third Period	5 (11,6%)	4 (18,2%)	12 (21,4%)	21 (17,4%)
Fourth period	10 (23,3%)	3 (13,6%)	20 (35,7%)	33 (27,3%0
Fifth period	19 (44,2%)	2 (9,1%)	24 (42,9%)	45 (37,2%)
Sixth period	6 (14%)	5 (22,7%)	35 (62,5%)	46 (38%)
Seventh Period	14 (32,6%)	3 (13,6%)	35 (62,5%)	52 (43%)
Eighth Period	15 (34,8%)	15 (68,2%)	25 (44,6%)	55 (45,5%)
Ninth period	3 (7%)	0 (0%)	6 (10,7%)	9 (7,4%)
Tenth period	2 (4,7%)	1 (4,5%)	5 (8,9%)	8 (6,6%)

Only 2.5% (3) of the graduates, all from HEI 1, reported experience in PET-Saúde activities.

For the research participants, in relation to the dimension Orientation of health care, the respective courses offered the ability to understand the social determination of the health-disease

process and the development of comprehensive strategies for the expansion of healthy choices based on the living conditions of individuals and the population. Fadel and Baldani (2013) observed that 94.5% of the students interviewed in their study consider themselves able to develop health prevention, promotion, protection and rehabilitation actions. On the other hand, Badan *et al*, 2010 observed that 100% of the graduates remembered what was taught during the undergraduate course on health promotion, but only 68.7% reported putting such teachings into practice. Often, only vertical transmission may occur, with the teacher passing on the teachings, without a practice that contextualizes the subject and connects the student with the content15. Therefore, the student experience in the SUS is important for this contextualization and understanding of the service (BULGARELLI et al, 2014).

There is a large amount of evidence evaluating the effectiveness and cost-effectiveness of the use of health promotion in relation to chronic diseases, particularly non-communicable diseases and their risk factors (JACKSON et al, 2006). This shows how important it is to address these diseases in conjunction with health promotion strategies through work teams (SIDDIQI et al, 2022), where future professionals can be inserted and trained to work in this context.

Also considering the dimension Orientation of health care, the results showed that the perception of the participants of HEI 1 was worse with regard to the fact that the course provided the development of activities to guide multiprofessional and interdisciplinary care with students, technicians or professionals from the same area (dental prosthesis technicians) and/or from other areas of health (physicians, nursing technicians, community agents, etc.), showing the need for changes in this issue, providing for the comprehensiveness of health actions. There was a statistically significant difference between HEIs 1 and 3. In the study by Fadel and Baldani (2013), 56% of the students felt able to work in multidisciplinary teams, and only 4.4% reported not feeling able to establish a professional support network. Interprofessional education is usually addressed in undergraduate courses in Dentistry in elective courses, or even as a topic within some mandatory course. The experience of working in a multidisciplinary team should not be isolated during the undergraduate course, but throughout the Dentistry student's education, ensuring interaction with students and professionals from other areas of health, developing an interprofessional collaborative practice (TOMPSEN et al, 2018).

The concepts of multiprofessionality and interprofessionality are not yet well used in higher education institutions, and there is confusion in their application. Although there are public policies aimed at the development of interprofessional activities and practices, Dentistry is still lagging behind in this regard. However, all three HEIs pointed out the need to offer more interprofessional education activities in their pedagogical projects.

In Brazil, the Program of Education through Work for Health (PET-Saúde) is a National Policy for Permanent Education in Health, which aims to reinforce the commitment of the Brazilian State to the public health system, ensuring the principles of integrality, universality and equity, aimed at the promotion, protection and recovery of health. The PET-Health/Interprofessionality seeks to implement Interprofessional Education as a way to strengthen the care of the population in an integrative and universal way, aiming to train health professionals capable of working in multidisciplinary teams, identifying the needs experienced in the health service, and carrying out proposals for continuous intervention (ALMEIDA *et al*, 2019).

Interprofessional education has been more widely addressed in the current DCN (BRASIL, 2021). However, the participants in this study graduated before the publication of these studies, which may partly explain the low quality of the offer of activities related to interprofessionality. The expectation is that future professionals, trained under curricula adapted to this new resolution, will have better training in this aspect.

IPE initiatives have shown benefits for the community and satisfaction for students for the experience, in addition to positive results in the training of health professionals (TOMPSEN *et al*, 2018). In general, collaborative practice initiatives among undergraduate students are individual efforts of professors or teams, offering elective courses, extension programs, or extramural activities, such as PET-Interprofessional Health. Institutions need to train their future professionals to work as a team, understanding the social determinants and the reality of the population served (SILVEIRA & GARCIA, 2015).

The curricular structure presented by undergraduate courses in Dentistry in Brazil, despite the DCN of 2002 and 2021, is still an obstacle to the implementation of IPE, due to its segmentation and uniprofessional format (TOMPSEN *et al*, 2018). Currently, IPE is experienced in undergraduate courses in Dentistry on a mandatory basis in supervised internships, which make up 20% of the total workload of Dentistry courses (BRASIL, 2021).

The demand for professional training with an emphasis on interprofessional education is already a reality, including being part of guides/documents used in the public health network (OLIVEIRA *et al*, 2022).

In relation to the dimension of teaching-service integration (internship and experience in the SUS), responding to the performance of activities developed at all levels of care of the health system (low, medium and high complexity), understanding the flow of the network, the planning and evaluation of services and the professional competencies at each level, enabling the understanding of the breadth and complexity of the SUS, the results were quite variable (GRAPH 1). It was observed that, in the educational institutions evaluated, the graduates worked more in basic health units (75.2%), emergency rooms and hospitals (43%), and social spaces (42.1%). In a study carried out by the

Ministries of Education and Health (BRASIL, 2006) to evaluate the adherence of health courses to the DCN, it was observed that the institutions with less adherence to the guidelines presented incipient teaching-service integration, unlike those that adhered to it, where diversification of the scenarios of practice and insertion of students in the SUS was observed. Fadel and Baldani (2013) observed that 50% of the students interviewed considered it important to carry out internships in public family health units. Silveira and Garcia (2015) observed that students recognized the importance and valued extramural experiences, especially in the SUS. However, according to Werneck *et al* (2010), supervised internships in schools, daycare centers, nursing homes, hospitals, collective health internships or rural internships, although they may be very valid, do not allow the achievement of the objectives of the DCN when carried out in a punctual manner, isolated in the curriculum and of short duration, because they do not establish a social commitment.

The diversification of learning scenarios and environments focuses on the practice and early insertion of students in the current public health system, at the beginning of their training (JACKSON *et al*, 2006). In this study, it was observed that there was an opportunity for the graduates to be included in scenarios from the first periods, but that the highest prevalence of activities was between the fifth and eighth periods of the course, probably because it is when the students work in the clinic and begin to have the ability to care for patients. This insertion in the SUS needs to be understood as essential in the formulation and implementation of pedagogical projects for professional training and not a mere field of internship or practical learning. This articulation is explicit in the objectives of the DCN (BRASIL, 2002). The active interaction of the student with the population and with the professionals must occur from real problems, assuming increasing responsibilities. Therefore, it is also questionable whether these insertions are carried out only at the end of the course, when the student's entire education has prepared him for a performance directed to specialized and technical care, without involvement with the demands of the public service (FINKLER et al, 2013).

A transformation in the market, bringing dental professionals to the public service, seems to be a consequence of public oral health policies such as the expansion of Dentistry in the Family Health Program (2000), with the implementation of oral health teams, approval of the DCN for Dentistry Courses (2002) and the Smiling Brazil Program (2004), in addition to Pró-saúde and PET-saúde. These policies promoted changes in the care model and in the training of the workforce, aiming at their insertion in the health system in force in the country (BRASIL, 2000, 2004). However, in our results, it was observed that the majority of graduates work in clinics or private offices, which is in agreement with the literature that shows that private practice predominates in the profession, corroborated by studies that found a predominance of 61% of DCs in private practices compared to 20% in the public service (NUNES *et al*, 2010). It should be noted that there is substantial variability in the labor market

influenced by several factors, including the number of professionals in the market loco regional and the availability of vacancies within the public service in that geographical area.

Another point that draws attention in the results of the present study is the large number of graduates who are not working in the field of Dentistry (24.8%). This may be related to the high number of dentists in the Brazilian labor market, with about 338,970 professionals according to the Federal Council of Dentistry (CFO), and to the working conditions and salaries offered by private clinics. According to San Martin *et al* (208), the rate of one dentist per 1,500 inhabitants would be sufficient to meet the demand of the local population, but in Brazil, the rate is 735 inhabitants/dentist. This fact is also a reflection of the excessive number of undergraduate courses in Dentistry in Brazil (MAIA & DAL POZ, 2020; MORITA *et al*, 2021).

The largest number of graduates who received the *link* to the questionnaire were female and graduated in 2018, as well as those who answered it, as shown in Table 1. This demonstrates that the sample collected is similar in terms of gender distribution and year of graduation in relation to the population invited to participate in the study. The results regarding gender corroborate studies since 1980, which point to an increase in the number of women in the profession (SILVA *et al*, 2012), as well as the proportion of women dentists in Brazil, which is around 60% (CFO). The mean age of the graduates studied was 26.94 (± 5.63) years, which is consistent with the expected time of completion of the course and beginning of the professional career.

The response rate was much lower than expected. Only 28.3% of the graduates contacted answered the questionnaire, however this seems to be a common finding. In their systematic review, Cho *et al* (2013) noted that the response rate for online questionnaires is around 38%. Several reasons can contribute to this result: typo of the e-mail address, outdated e-mail, retention of the message in the spam folder, impersonality, lack of ability of some respondents, low frequency of access to e-mail, eventual difficulty in accessing the internet, among others (VIEIRA *et al*, 2010).

The results presented in this chapter involved 9 questions from the four dimensions. According to the research participants, the quality and supply of activities related to the formation of the generalist, humanist profile and the ability to understand the social reality was very good, as well as the health promotion activities and the use of practice scenarios. On the other hand, activities related to multiprofessional/interprofessional education and living in the Unified Health System (SUS) were considered moderate.

The results show that graduates of the Dentistry courses evaluated are satisfied with the quality of the professional training achieved through the academic activities offered by their courses. Especially those related to the formation of the professional profile and health promotion. However, the perception of the graduates indicates that multiprofessional/interprofessional experiences and living in the SUS still need to be improved, encouraging students to participate in internships and

extension projects, thus training professionals capable of working in the SUS and in the existing social context.

Thus, based on the perception of the graduates, this work provided an analysis of the weaknesses and potentialities of professional training in Dentistry, thus seeking to contribute to the improvement of activities aimed at training based on the DCN of undergraduate courses in Dentistry.

2 CONCLUSION

Through this chapter, we were able to start a reflection on training in Dentistry, including the perception of graduates of undergraduate courses in Dentistry in Rio de Janeiro regarding the quality of professional training with emphasis on interprofessional education. Among the few studies developed on the subject, the majority of undergraduate graduates in Dentistry are satisfied with the quality of the professional training achieved through the academic activities offered by their respective courses. Especially those related to the formation of the professional profile and health promotion. However, the perception of the graduates indicates that multiprofessional/interprofessional experiences and experience in the Unified Health System (SUS) still need to be improved, encouraging students to participate in internships and extension projects, thus seeking the training of professionals qualified to work in the public health service, and in the existing social context.

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Decoronation: A treatment option for teeth avulsed - Case report

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ABSTRACT
Dental replantation is the first treatment option after dental avulsion. However, avulsed teeth often develop root resorption or ankylosis after replantation caused by the absence of the vital periodontal ligament on the root surface and inadequate tooth storage for the first 60 minutes. Trauma patients may have associated a history of malocclusion requiring treatment. When dealing with young patients, one option is the decoronation technique, where the tooth is sectioned at the level of the neck (the crown is removed and the root is left in the sockets) with the aim of supporting the bone, avoiding bone grafting in the future for the placement of dental implants. Thus, this study aims to review the literature on the subject and report a clinical case involving dental avulsion and decoronation and orthodontic and prosthetic treatment.

Keywords: Dental avulsion, Dental replantation, Root resorption, Dental ankylosis, Decoronation.

1 INTRODUCTION

Dental trauma is an emergency that must be treated promptly and correctly to reduce suffering, costs, and time for patients (1). There are several clinical protocols that aim to preserve dental structures in situations of dental trauma. Specifically for avulsed teeth, dental replantation is considered the first choice of treatment, although its success depends on many factors and the long-term prognosis is uncertain (2,3). Conservation of the periodontal ligament is essential for successful treatment (4). When the tooth is kept in the extraoral environment for more than 60 minutes, resorption or ankylosis often occurs after replantation, due to the loss of vitality of the periodontal ligament (5,6). After replantation, the patient is submitted to a therapy that involves endodontic treatment, restorations, and clinical follow-up with radiographs (3).

Treatment with dental replantation is very sensitive and susceptible to the time exposed to the extraoral environment and to the storage mode(7,8). Therefore, cases of dental replantation after trauma should be preserved. This monitoring is used in order to evaluate the occasional occurrences of root resorption and ankylosis that may hinder the procedure(5). Root resorption is progressive and

depends on the patient's age (9) and root size (10). Ankylosis is considered a very serious sequelae that leads to infraocclusion and defects in bone tissue that are difficult to correct, which is a concern, especially in children and adolescents who are in a phase of maxillomandibular bone growth (11). In these cases, the consequence is the loss of reimplanted teeth. Thus, it is important to consider other alternatives that preserve aesthetics, chewing, speech and promote the maintenance of space.

The decoronarization process is a viable alternative to avoid tooth extraction, with the advantages of avoiding resorption of the alveolar bone and, consequently, avoiding the need for future bone grafts. Decoronarization is indicated for ankylosed and infrapositioned permanent teeth. The procedure is characterized by the section of the tooth at the cervical level, with the crown being removed and the root left in the alveoli in order to minimize bone resorption. The mucoperiosteal flap is sutured after the root is buried(11,6).

The manufacture of removable orthodontic prostheses or appliances with provisional acrylic anterior teeth is preferred for the rehabilitation of young patients who have lost anterior teeth, as implants are contraindicated in growing patients.

The objective of this study is to review the literature on the subject, as well as to report a clinical case of decoronation.

2 CASE REPORT

A 17-year-old female patient was referred by her general dentist for orthodontic treatment.

In his dental history it was reported that at the age of 12 he suffered dental trauma with avulsion of elements 11, 21,22 and 23 after a fall from a bicycle. In less than an hour after the trauma, the patient was taken to a dental office where a dental surgeon reimplanted the avulsed teeth, splinting with polycarbonate and resin wire, and suturing the macerated soft tissues was performed by a dental surgeon.

The splint was removed after one month of restraint with prescription mouthwash with 0.2% chlorhexidine digluconate every 6 hours for 2 weeks. Endodontic treatment of the avulsed teeth was performed.

Follow-up was performed every eight months with clinical examinations and periapical radiographs of the traumatized region. However, after one year of follow-up of the case, infraocclusion of element 23 was noted, suggesting its ankylosis. The decision was made to wait for tooth development, leaving to act as late as possible in relation to occlusion in case there was a need for intervention. Then, 3 years after the trauma, the beginning of cervical resorption in elements 11, 21 and 22 was radiographically observed.

Tooth preservation was maintained for another two years when the patient returned to the dental office reporting mobility of teeth 11 and 21 and was referred to the orthodontist who requested complete orthodontic documentation (Figure 1, 2, 3, 4, 5 and 6).

3 DIAGNOSIS

Facial analysis revealed a convex profile, dolichofacial pattern, absence of passive lip sealing, and exposure of 95% of the maxillary incisors (Figure 1). The lower facial third was enlarged in relation to the other facial thirds.

In the intraoral analysis, it was found that the patient had complete permanent dentition. A relationship of class I molars was verified: right and left sides, right canine in class I and left with a tendency to class II and in infraocclusion (Figures 2 and 3).

Radiographically, it was found that there was the presence of germs of elements 28, 38 and 48. Periapical radiographs showed endodontic treatment of elements 11, 21, 22 and 23, as well as advanced cervical resorption in elements 11, 21 and 22 (Figures 4, 5 and 6).

Fig 1. Initial Facial Photographs

Fig. 2 Intraoral frontal view

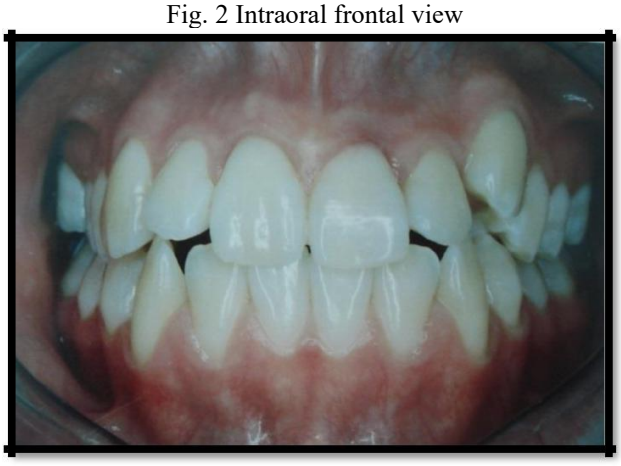

Fig 3. Right and left intraoral lateral view.

Fig. 4- Periapical radiographs of the anterior region.

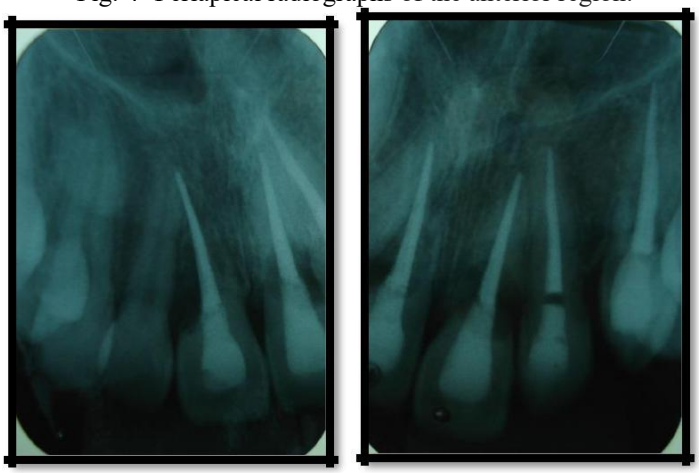

Fig. 5 - Initial panoramic radiograph.

Fig 6 - Initial lateral teleradiography.

4 DIAGNOSIS

Facial analysis revealed a convex profile, dolichofacial pattern, absence of passive lip sealing, and exposure of 95% of the maxillary incisors (Figure 1). The lower facial third was enlarged in relation to the other facial thirds.

On intraoral analysis, the patient has complete permanent dentition. A relationship of class I molars was verified: right and left sides, right canine in class I and left with a tendency to class II and in infraocclusion (Figures 2 and 3).

Radiographically, there is presence of the germs of elements 28, 38 and 48. Periapical radiographs show endodontic treatment of elements 11, 21, 22 and 23, as well as advanced cervical resorption in elements 11, 21 and 22 (Figures 4, 5 and 6).

Cephalometrically, a Class I skeletal pattern was observed, with convex profile, with upper and lower incisors projected and proclinated (Table I and Figure 7).

Fig. 7 - Initial cephalometric tracing.

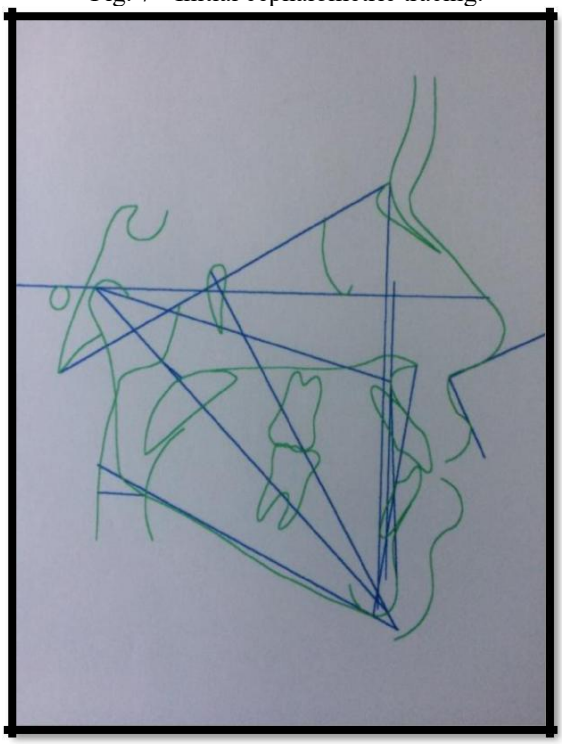

Table I – Initial cephalometric data.

	Norm	Patient's initial
SNA	82nd	81st
SNB	80th	80th
ANB	2nd	First
1.NA	22nd	33rd
1-NA	4mm	10mm
1.NB	25th	27th
1-NB	4mm	7mm
1/1	131st	120th
FMA	25th	27th
IMF	68th	65th
IMPA	87th	87th

In the analysis of models, there was a discrepancy between models with 4 mm negative in the lower arch and 3 mm negative in the upper arch.

5 TREATMENT

The proposed treatment was upper and lower fixed appliances with extraction of elements 14, 23, 34 and 44 to correct the biprotrusion, and insertion of natural provisional elements in the region of 11, 21 and 22 until the end of the orthodontic treatment with future installation of implants and dental prostheses in this region.

In order to correct the dental malocclusion presented, as well as to solve the problem of cervical resorption, the decoronarization technique was recommended in order to preserve the vestibular bone of this region for future dental implants of elements 11, 21 and 22. The patient was informed that the implants could only be performed after the end of bone growth so that there would be no damage to the aesthetics of the upper anterior prostheses in the future.

After the banding in elements 16 and 26, decoronarization was performed. Then, the crowns of the teeth were cleaned to be included in the orthodontic appliance, which was glued to the upper arch at the same appointment (.022" roth slot prescription), in order to preserve the patient's aesthetics and speech (Figure 8,9,10).

Fig.8 - Frontal intraoral view with fixed orthodontic appliances including the crowns of the patient's incisors.

Fig. 9 - Right and left lateral intraoral view, with fixed orthodontic appliances including the patient's natural incisor crowns.

Fig. 11 - Panoramic radiography 4 months after decoronarization.

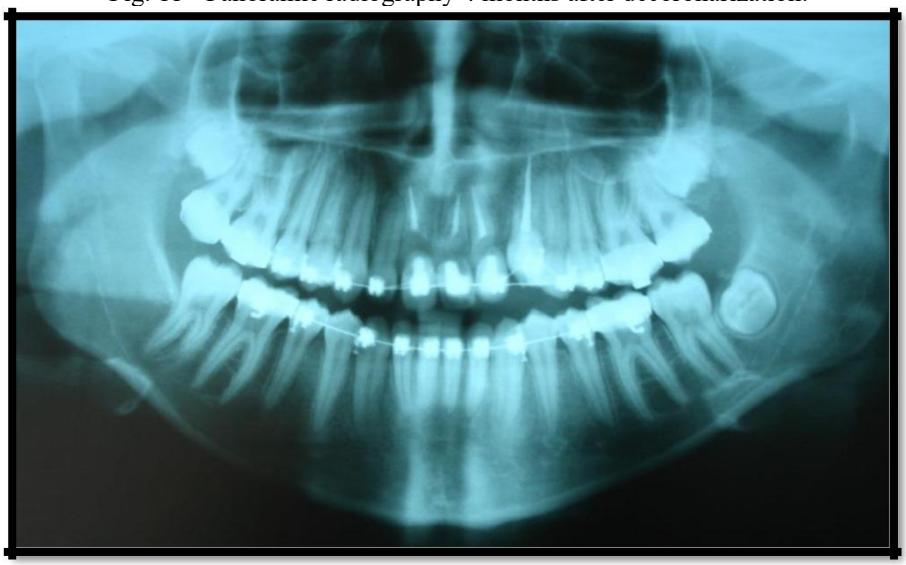

Fig. 12 - Periapical radiograph of the anterior region after decoronarization.

The treatment continued with bonding of the fixed appliance in the lower arch.

Four months after the surgical procedure and the beginning of orthodontic treatment, panoramic and periapical radiographs of the anterior region were requested (Figures 11 and 12) to preserve the tissues surrounding the tooth roots.

During the treatment, a sequence of orthodontic archwires were installed for alignment and leveling in sequence (0.014" of Niti, 0.016", 0.018", 0.020" of stainless steel) in the upper and lower arches. These arches were used for both the upper and lower arches.

The moment of tooth extraction (14, 23, 34 and 44) occurred when the 0.18' stainless steel archwire was used in order to start the retraction of the canines (13, 33 and 43) 14 days after surgery, to start the retraction of elements 13, 33 and 43, with elastic chain.

Afterwards, 0.19' x 0.25' retraction archwires were made, with a 5 mm high loop in the region between lateral incisors and canines, with the purpose of closing spaces by sliding.

Remembering that at each arch change, the natural crowns of the missing elements in the anterior region (11, 12 and 22) were tied to the arch and conjugated with 0.010" tie wire and tied with 0.10' tie wire (tietogether) so that there would be stability for these teeth during speech and chewing.

Orthodontic completion was performed with a .019' x .025' stainless steel archwire, and, as the patient presented complete bone growth, seen through overlapping lateral radiographs, it was sent to the implantologist, who installed the implants of teeth 11, 21 and 22 (Figure 13).

The patient was waited 4 months after the insertion of the implants with orthodontic appliances. Soon after, the appliance was removed, the necessary orthodontic retainers were performed (upper wraparound and lower 3-3 bar) and the patient was referred to the dental prosthesis specialist for the preparation of the definitive prosthetic dental elements (Figures 13, 14, 15, 16, 17 and 18).

The total duration of orthodontic treatment was 32 months.

Fig. 13 - Postoperative moment of implant installation of elements 11, 21 and 22.

Fig. 14 - Intraoral frontal view after the installation of the definitive crowns.

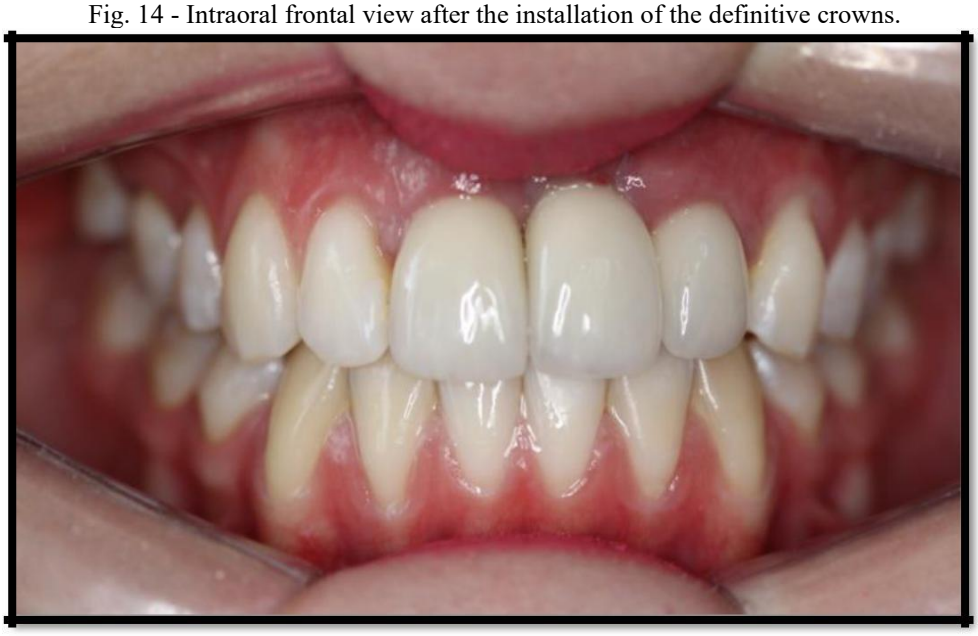

Fig. 15 - Lateral intraoral view, right and left side after orthodontic completion.

Fig. 16 – Final panorama.

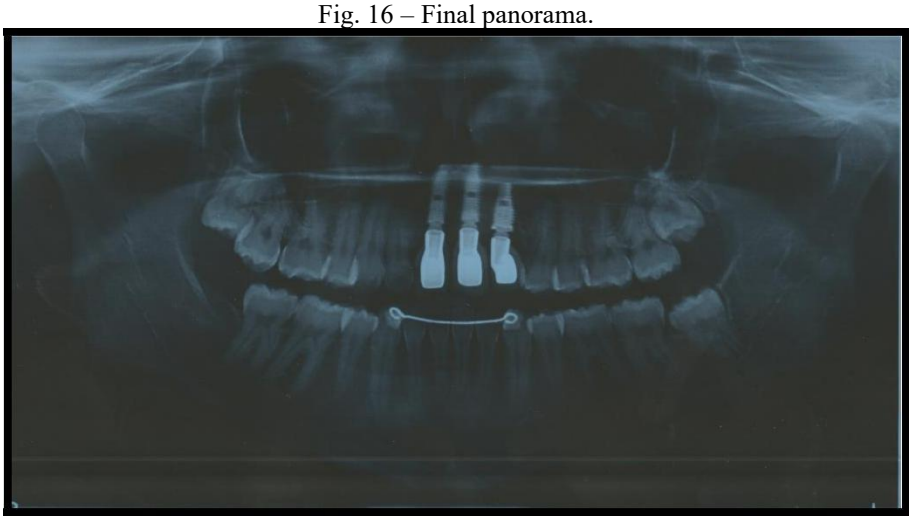

Fig 17- Final lateral teleradiography.

Fig. 18- Final cephalometric tracing.

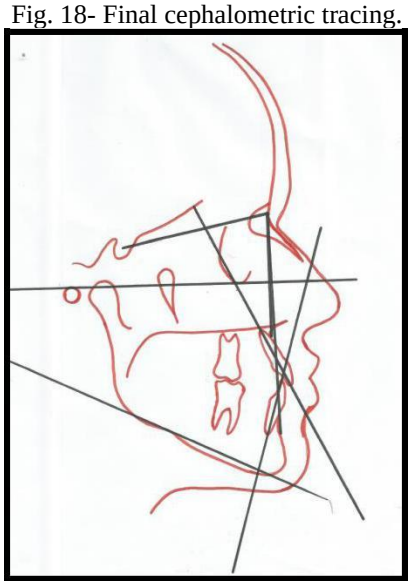

Table II – Final cephalometric data.

	Norm	Patient's Ending
SNA	82nd	82nd
SNB	80th	81st
ANB	2nd	First
1.NA	22nd	28th
1-NA	4mm	8 mm
1.NB	25th	19th
1-NB	4mm	4mm
1/1	131st	133rd
FMA	25th	27th
IMF	68th	72nd
IMPA	87th	81st

Fig. 19- a) Post-treatment frontal view b) Front view smiling post treatment c) Lateral view of post-treatment profile.

Fig. 20- Close-up view of the patient's smile after treatment.

At the end of the treatment, it was observed that the patient had an aesthetically pleasing facial profile with the presence of passive lip sealing (Figure 19 a, b and c). In the intraoral analysis, a good posterior intercuspation (molar and canine class I) and a good incisor interrelationship (overjet and overbite of 2 mm) were established (Figure 14,15).

The maxillary first premolar performed the function of the upper canine on the left side. Both arcades were well aligned and level.

The total duration of orthodontic treatment was 32 months.

The patient was very satisfied with the outcome of the treatment (Figure 19.20).

6 DISCUSSION

Dental trauma are emergencies that must be treated promptly and correctly in order to reduce suffering, costs, and time for patients (1). There are a number of clinical protocols that aim to preserve

dental structures in situations of dental trauma. Specifically for avulsed teeth, dental replantation is considered the first choice of treatment, although its success depends on many factors and the long-term prognosis is uncertain (2,3).

In the reported case, dental replantation was performed soon after tooth avulsion. When the time is less than 60 min, there is a greater probability of success in the case of dental replantation (15, 6,3). This time is almost guaranteed that the tooth will undergo ankylosis (3,17).

Element 23 ankylosis, in the case reported here, was diagnosed during follow-up, 12 months after the trauma, due to its infra-occlusal position in the arch. Andreasen (2012) suggests that preservation should be carried out over a period of 4 weeks, 3 months, 6 months, 1 year and then annually, through clinical and radiographic examinations. (18)

Another sequelae found during preservation was tooth resorption of elements 11, 21 and 22. According to Soares *et al.,* (2008), approximately 63% of the reimplanted teeth analyzed in their sample underwent root resorption, corroborating the result found. (12)

The treatment proposed for the patient was the extraction of the resorbed and ankylosed teeth, as they already had a certain degree of cervical dental resorption and could not be used during the orthodontic treatment.

Ankylosis in young patients with growth can have a negative effect on the patient's aesthetics. The recommended treatment is tooth extraction (10, 11, 13,14), but it may be accompanied by removal of part of the alveolar bone, especially when the removed elements are in the maxilla region with a thin bone board (15, 6).

In this case, the elements reabsorbed by the decoronarization technique were first removed. This is justified by the fact that these teeth are in the anterior region of the maxilla where the removal of the bone crest affects aesthetics, causes bone deformities and difficulty in achieving the ideal prosthetic treatment (3, 15)

This technique is easy to perform (19), has predictable success rates, and assists in the favorable growth of the alveolar ridge (20). It consists of the removal of part of the crown and instrumentation of the pulp duct to stimulate bleeding, and is suggested as a more conservative approach to bone preservation until implants are placed (14).

The timing of decoronarization is important and should be planned taking into account the patient's age, growth pattern and intensity(15,20). The option of performing dental transplantation and the presence of an overjet of less than 2 mm are exclusionary factors for cases where this decoronarization technique is indicated(11).

Its primary purpose is to maintain marginal bone in young growing patients, and by preserving the root in the alveolar bone, it helps stimulate vertical bone growth (6). Thus, the bone is maintained

by the presence of the root for the placement of future implants, and in this case the need for larger bone grafts was avoided. In this case, no bone graft was performed.

The emotional and psychological impact on the behavior of children and adolescents after dental trauma changes their quality of life, demanding aesthetic and functional rehabilitation in order to ensure the patient's reintegration into their normal life. (21) In the present case, the crowns of the resorbed teeth were included in the orthodontic appliance, in order to preserve the patient's aesthetics and speech.

Temporary rehabilitation was performed during the transitional period that the patient would be without teeth, it can also be performed with removable retainers and with artificial teeth, which would make use difficult. (22) However, temporary rehabilitation is more easily tolerated and better preserves aesthetics when teeth with the same shape, color, size, and alignment are used as neighboring teeth(11,16), justifying the use of natural crowns suspended by orthodontic appliances.

The treatment of anterior tooth avulsion in young, growing patients is a challenge for the dentist, as its treatment must be performed in an interdisciplinary manner because it requires prosthetic and orthodontic treatment, and subsequent implant placement(22).

According to Malmgren et al.2001, the *waiting time for orthodontic treatment in patients who have suffered moderate or severe trauma (dislocation, extrusion, intrusion, avulsion) is one year*(18). In this case, we report a patient in whom the sequelae of avulsion appeared after a few years of trauma, which justifies the need to preserve dental trauma during childhood and adolescence.

Decoronarization was efficient for the maintenance of the bone ridge during bone growth, however, there was a need for a graft so that there was an adequate and sufficient ridge to support the implant. There would probably have been greater bone loss if the roots of the teeth had not been kept in the anterior region of the bony ridge of the upper arch.

7 CONCLUSION

According to the clinical case presented, it was found that it is possible to perform orthodontic treatment with rehabilitative functions where there is a need for the interaction of several specialties such as general practice, endodontics, implantology, dental prosthesis and orthodontics for the case to be successful. Decoronarization proved to be an appropriate technique for the case. However, the choice of the best treatment for each case should be a reflection of adequate clinical evaluation and scientific knowledge of what can be done to solve each specific case.

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Tongue necrosis caused by trauma - Case report

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ABSTRACT
Tongue necrosis is a rare injury that often occurs, especially after trauma. This article reports the case of a 39-year-old patient who experienced partial tongue necrosis due to trauma. The patient underwent medical and prophylactic treatment with favorable results, avoiding the need for glossectomy.

Keywords: Trauma, Tongue, Necrosis.

1 INTRODUCTION

Tongue traumas are common, especially in domestic and traffic accidents where individuals may bite their own tongues due to the force of impact. The resulting trauma can lead to simple injuries, ulceration, laceration, tissue necrosis, and even partial organ amputation. A retrospective study by SHAIKH and WORRAL (2002) on patients up to 18 years old with facial trauma found that 46.4% of intraoral soft tissue injuries involved the tongue. This article aims to report and discuss the case of a patient who experienced partial tongue necrosis due to local trauma and underwent medical and prophylactic treatment, avoiding the need for glossectomy.

2 CLINICAL CASE

A 39-year-old male patient, with fair skin, was received at the Oral and Maxillofacial Surgery outpatient clinic of Casa de Saúde Hospital (HCS) in Santa Maria city, with a case of tongue necrosis due to a traffic accident. The patient reported biting his tongue with the force of the impact caused by the accident. In immediate hospital care, the tongue was sutured; the next day, the suture fell, and the patient was referred to the HCS oral and maxillofacial outpatient clinic. In the medical history, the patient reported being diabetic and denied smoking or alcohol consumption. Clinical examination revealed extensive tissue necrosis on the dorsal and apical part of the left side of the tongue (Figure 1).

Figure 1 - Initial appearance of the lesion

As a course of action, the patient was advised hospitalization for case observation, and partial glossectomy was planned. As adjuvant treatment, intravenous Clindamycin 300 mg every 6 hours was prescribed to control infection and prevent the progression of necrosis. Additionally, nursing staff received instructions for prophylactic cleansing with 0.12% chlorhexidine digluconate every 12 hours, tissue scraping with sterile gauze, and a recommendation for a liquid and cold diet. After 4 days of hospitalization, an improvement in the patient's clinical condition was observed, with a better appearance of the tongue and a pink color, indicating increased tissue vascularization and a decrease in necrotic tissue (Figure 2).

Figure 2 - Seventh day of clinical follow-up

On the seventh day of hospitalization, the lesion was reassessed, and it was observed that there was tissue regeneration in almost the entire affected area of the tongue, eliminating the need for glossectomy. Consequently, the patient was discharged, prescribed oral Clindamycin 300 mg every 6 hours for 7 days, instructed on local care, oral hygiene with 0.12% chlorhexidine digluconate for 7 days, and scheduled for a follow-up in 5 days for further evaluation. At the follow-up appointment, 20

days after the trauma, tissue regeneration was evident (Figure 3). The patient reported satisfaction with the treatment outcome and the absence of difficulties in speech, swallowing, and chewing.

Figure 3 - 20 days after the trauma, 5 days after hospital discharge

3 DISCUSSION

The tongue plays crucial roles in chewing, swallowing, taste, speech, and airway protection, making it a vital organ for an individual's nutrition and overall well-being. Total or partial loss of the tongue can lead to irreversible physical and emotional damage to the patient (SEITZ et al., 2017). According to (tarara), open approaches to the base of the tongue negatively impact functional and aesthetic outcomes for the patient. WEISSMAN et al. (2004) reported a case of a patient with multiple tongue lacerations who underwent surgery for organ suturing. Despite antibiotic and anti-inflammatory prescriptions postoperatively, the patient experienced a change in color in the region, progressing to necrosis on the eighth day, requiring partial glossectomy. A case of tongue necrosis in the anterolateral region, similar to this study, was reported by MAAHS et al., involving a patient with cranial arteritis. The patient was treated with corticosteroids and immunosuppressants, showing good progress, but the treatment extended over 3 months until satisfactory tongue regeneration. In this case report, the accurate diagnosis and treatment facilitated the positive evolution of the patient, leading to hospital discharge with tongue preservation. The collaborative care provided by all professionals demonstrated that teamwork contributes to the resolution and quality of life for service users.

4 CONCLUSION

Clindamycin and prophylactic cleansing with 0.12% chlorhexidine digluconate had a positive effect on tongue regeneration in this case of partial tongue necrosis and should be considered when analyzing therapeutic options for tongue necrosis cases.

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SEVEN publicações acadêmicas

Simulating non-carious cervical lesions by chemical and mechanical alteration on dentin: Bond strength of universal adhesive systems

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ABSTRACT
Introduction: Non-carious cervical lesions (NCCL) is a very common dental pathology frequently demanding resin composite restoration.
Objective: This in vitro study had the objective to test the effect of altered dentin substrate by erosion and erosion/abrasion comparing it to sound dentin on the microtensile bond strength (μTBS) of All-Bond Universal (ABU) and Scotchbond Universal (SBU).
Materials and methods: Seventy-two teeth were randomly divided in twelve experimental groups according to the adhesive system – ABU and SBU; approaching – self-etch (SE) and Etch-and-rinse (ER); and dentin condition – sound (S), eroded (E) and eroded/abraded (EA) dentin. The teeth/restorations were reduced to sticks and the μTBS was performed after 24 hours and 12 months of storage in water at 37°C.
Results: Fractured specimens were analyzed under stereomicroscope to determine the failure patterns in adhesive/mixed or cohesive. μTBS data was analyzed through three-way ANOVA and Tukey's test (α=5%). It was demonstrated that the adhesive system and the substrate influenced on the results (p=0.00), but aging did not (p=0.81). Regardless of time, SBU SE performed higher values of bond strength on E than the EA and S.
Conclusion: EA dentin simulating NCCL did not impair the bond strength and presented similar behavior to sound dentin.

Keywords: Dental materials, Tooth abrasion, Tooth erosion, Tensile strength.

1 INTRODUCTION

Non-carious cervical lesions (NCCLs) are a pathology that affects mineralized tooth structures close to the cement-enamel junction. Such pathology is characterized by mineral loss frequently generating a wedge-shaped cavity or a concave and smooth one.[1,2] NCCLs commonly result from the synergy between erosion and abrasion processes where the dental substrate suffers an erosive attack caused by acidic diet and, in sequence, excessive brushing accelerates the cavity formation.[3] Its multifactorial etiology is widely accepted, which includes erosion, abrasion, attrition and abfraction.[4]

NCCLs frequently require adhesive restoration to reduce hypersensitivity, to prevent the loss of tooth structure or the increase of such loss, besides providing esthetics.[5] Resin composites are the first choice as restorative material and it is frequently suggested in association with universal adhesives

on different approaches such as: etch-and-rinse, self-etch or selective etch, according to the clinician's choice.[6,7] The best adhesive approaching to be employed in resin restorations of such lesions is frequently discussed,[7,8] as well as erosive and abrasive tissues characteristics[9,10] involving different processes concerning the substrate that may affect the adhesive systems performance.

This *in vitro* study had the objective to compare the bond strength of two universal adhesives applied over sound dentin versus chemically and mechanically altered substrates by erosion and by erosion/abrasion. The tests were performed after 24h and after 12m. The null hypothesis tested was that the altered dentin substrates do not influence on the bond strength, regardless of time.

2 MATERIALS AND METHODS

2.1 TEETH SELECTION AND PREPARATION

Seventy-two extracted caries-free human third molars donated by the institutional permanent human teeth bank were used in the present study. The study protocol was reviewed and approved by the Research Ethics Committee. All teeth were inspected to verify their integrity and to discard the ones that presented enamel defects, cracks or restorations. The selected teeth were cleaned, disinfected in 0.5% chloramine-T solution for seven days.[11] The occlusal surface was cut in a cutting machine to obtain a flat dentin surface (Labcut 1010, Extec Co., Enfield, USA). The smear layer was standardized with 600 silicon carbon sandpaper in a circular mechanical polishing machine under running water for 60 seconds.

2.2 MATERIALS

Materials composition, manufacturers and batch numbers are shown in Table 1.

Table 1. Materials composition and manufacturer.

	All-Bond Universal (ABU)	**Scotchbond Universal (SBU)**	**Filtek Z350 XT**	**37% Phosphoric acid**
Manufacturer	BISCO, Schaunburg, IL, USA	3M ESPE, St. Paul, MN, USA	3M ESPE, St. Paul, MN, USA	2, Joinville, SC, Brazil
Composition	MDP phosphate monomer, bis-GMA, HEMA, ethanol, water, initiators	MDP phosphate monomer, UDMA, HEMA, Vitrebond copolymer, water, ethanol, initiators, silane	Silica 20nm, zirconia 4-11nm, bis-GMA, bis-MOM, UDMA, PEGDMA,TEGDMA	37% Phosphoric acid, aqueous gel base
Batch number	1200002617	1926600462	591639	281019
10-MDP: 10-methacryloyloxydecyl dihydrogen phosphate; Bis-GMA: bisphenol A glycidyl methacrylate; HEDMA:1,6-hexanediol dimethacrylate; HEMA: 2-hydroxyethyl methacrylate; PENTA: dipentaerythritol penta acrylate monophosphate.				

2.3 EXPERIMENTAL DESIGN

Seventy-two teeth, which were included in this study, were randomly divided in twelve experimental groups according to the adhesive system and approaching (4) - All-Bond Universal (ABU) and Scotchbond Universal (SBU), both in self-etching (SE) and Etch-and-rinse (ER) approaching. Besides the adhesive system, they were separated in groups according to their dentin condition (3) - sound dentin (S), as control group; eroded dentin (E) where the dentin was chemically demineralized and finally, eroded/abraded dentin (EA) - where the dentin suffered a combined action of chemical demineralization and mechanical abrasion, as it is explained below:

2.3.1 Dentin condition - applied protocols

(1) Sound dentin, (n=24): immersion in artificial saliva (1.5 mM Ca (NO3)2 • 4H2O, 0.9 mM NaH2PO4 • 2H2O, 150 mM KCl, 0.1 M Tris buffer, 0.03 ppm fluoride, pH 7.0) during the experimental period.

(2) Eroded dentin, (n=24): following the pH-cycling model:

3 daily pH-cycles of 5 minutes of agitated immersion in cola drink (Coca-Cola [pH: 2.6, phosphate: 5.43 mM Pi, calcium: 0.84 mM Ca2+, fluoride: 0.13 ppm F, titratable acid: 40.0 mmol/l OH- to pH 5.5 and 83.6 mmol/l OH- at pH 7.0], Spal; Porto Real, Brazil) were performed with an interval of 6 hours between each cycle.[8]

(3) Eroded/abraded dentin, (n=24): combined erosion challenge and mechanical demineralization.

Eroded cycle according to what was mentioned in protocol (2) associated to mechanical abrasion where the dentin surface was brushed with a standardized load of 200g for 2 minutes associated to the Colgate Total 12 dentifrice and artificial saliva.[12]

After applying the protocols, the teeth were washed in distilled water and immersed in artificial saliva solution until the next cycle.

2.4 RESTORATIVE PROTOCOL

Adhesive systems were applied on previous prepared dentin surface, which was performed with a trained and calibrated operator according to the adhesive approaching and the manufacturer's recommendations (Table 2). After applying the adhesive system, a resin composite restoration of 5.0 mm high was built. The composite was applied in increments of 1.0 mm and photoactivated for 20 seconds with a photocuring unit (Emiter C, Schuster Eqto Odontol Ltd, Santa Maria, Brazil) with the monitored irradiance of 1000mw/cm2.

Half of the specimens of each group were kept in distilled water and tested after 24 hours. The other half was stored in distilled water - weekly changed - for 12 months in a microbiological incubator

with controlled temperature of 37°C. To perform the test, the teeth were longitudinally sectioned in two perpendicular axes with diamond saw discs in a cutting machine (Labcut 1010, Extec Co, Enfield, USA) to obtain specimens with a cross-sectional area of approximately 0.8mm².

Table 2. Adhesive system approaching (according to manufacturers' instructions).

Approaching	**All-Bond Universal (ABU)**	**Scotchbond Universal (SBU)**
	a. Self-etch 1. Apply two separate adhesive coats with agitation for 10 -15s per coat.2. Evaporate the solvent completely by air drying using an air syringe for at least 10 s. It should be no visible movement of the adhesive.3. The surface should have a uniform glossy appearance. If not, steps 1 and 2 need to be repeated.4. Light cure for 10 s.	a. Self-etch 1. Apply the adhesive or adhesive mixture to the prepared tooth and rub it on the tooth's surface for 20 s. 2. Gently air-dry the adhesive for approximately 5s to make the solvent evaporate.3. Light cure for 10s.
	b. Etch-and-Rinse 1. Etch for 15s.2. Rinse thoroughly.3. Remove the excess of water by blotting the surface with an absorbent pellet or high volume evacuation for 1-2 s, leaving the preparation with visible moisture.4. Apply the adhesive according to the self-etch mode.	b. Etch-and-rinse 1. Apply the etchant for 15s.2. Rinse thoroughly with water and dry with water-free and oil-free air or with cotton pellets; do not overdry.3. Apply the adhesive according to the self-etch mode.

2.5 MICROTENSILE BOND STRENGTH (μTBS)

The specimens were fixed in a μTBS testing device with cyanoacrylate-based adhesive gel (Three Bond Super Gel, ThreeBond Brazil Ind. Com. Ltda., Diadema, SP, Brazil). In sequence, they were submitted to a tensile force in a universal test machine (EMIC DL 1000 – Instron Brazil Ltda. São José dos Pinhais, PR - Brazil) with a 10KgF load cell at a crosshead speed of 1mm/min until they fractured. The experimental unit was the tooth, this way, the average of the results (in MPa) of each tooth stick was used for statistical analysis.

2.6 FAILURE MODE ANALYSIS

After the microtensile test, the specimens were analyzed in a stereomicroscopy (Discovery V20, Carl-Zeiss, Oberkochen, Germany) with 10x magnification to determine the type of fracture and they were classified as adhesive/mixed (interface failure or mixed with cohesive failure) or cohesive (dentin or composite resin failure).

2.7 STATISTICAL ANALYSIS

The Shapiro-Wilk test was used to verify data normality. As data was normally distributed, a three-way ANOVA test was performed to analyze the differences between the groups. Tukey's *post*

hoc test was applied to multiple comparisons between groups. All statistical tests were performed in the IBS SPSS Statistics 25 software (IBM Corp. Chicago, USA).

3 RESULTS

It was demonstrated by the three-way ANOVA test that the adhesive system (p=0.00) and substrate (p=0.00) influenced in the results, but aging, did not (p=0.81). Besides, the triple interaction (adhesive x substrate x aging) was not significant (p=0.11). ABU showed significant difference in the E group between the SE and ER after 24h. The E group showed higher values on the bond strength than the EA and S in the SBU SE at any time. The microtensile bond strength (μTBS) values of the tested groups are shown in table 3.

All types of failures were observed in all groups where adhesive failures were predominant (figure 1 and 2).

Table 3. Microtensile Bond Strength (μTBS) means (standard deviation) in MPa of different experimental groups.

	Eroded dentin (E)		**Eroded + abraded dentin (EA)**		**Sound dentin (S)**	
	24h	12m	24h	12m	24h	12m
ABU SE	51.92 (15.09) Ab	50.84 (8.01) Ab	49.52 (21.54)	47.51 (14.23) Ab	43.40 (14.07) This	45.09 (8.29)
ABU ER	71.06 (12.30)	69.73 (12.85) Ab	65.64 (7.15) ABa	68.42 (10.03)	56.44(16.70) ABa	48.27(15.05) or
SBU SE	71.32 (14.94)	75.59 (13.88)	49.52 (15.12) or	42.26 (19.35) Bb	46.12(9.95) or	51.53(8.30) or
SBU ER	64.20 (8.51) This	67.31 (17.19) Ab	48.32 (9.07)	62.51 (10.20)	57.88(7.70) ABa	52.62(7.25) ABa

ABU: All-Bond Universal; SBU: Scotchbond Universal; SE: Self-etch; ER: Etch-and-rinse.
Means with the similar uppercase (lines) and lowercase (columns) letters indicate no significant difference (p > 0.05).

Figure 1 – Fracture pattern – samples tested in 24 h – adhesive system/approaching.

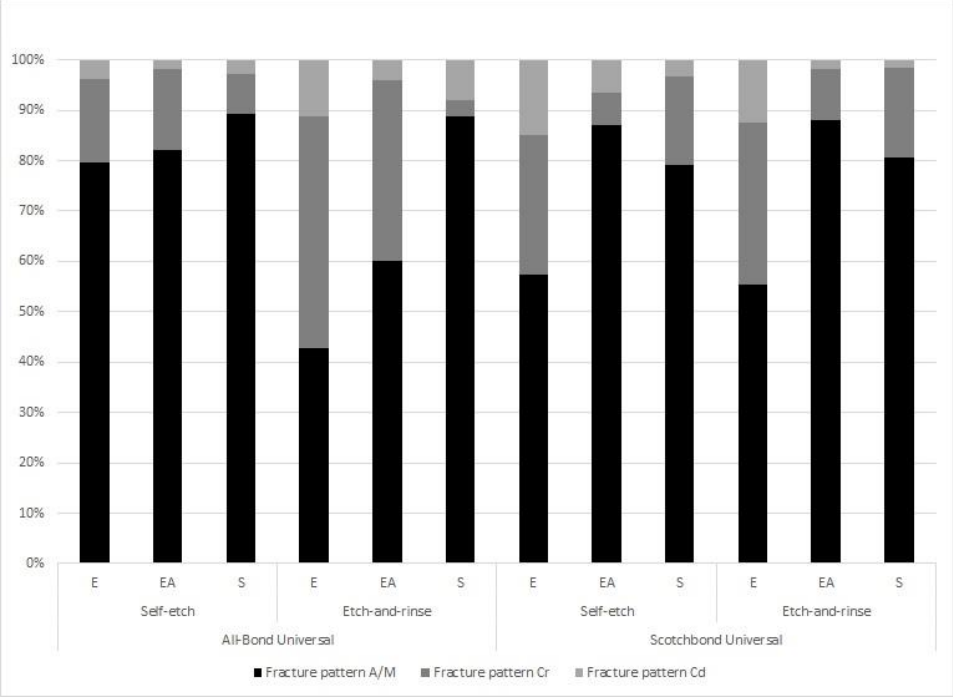
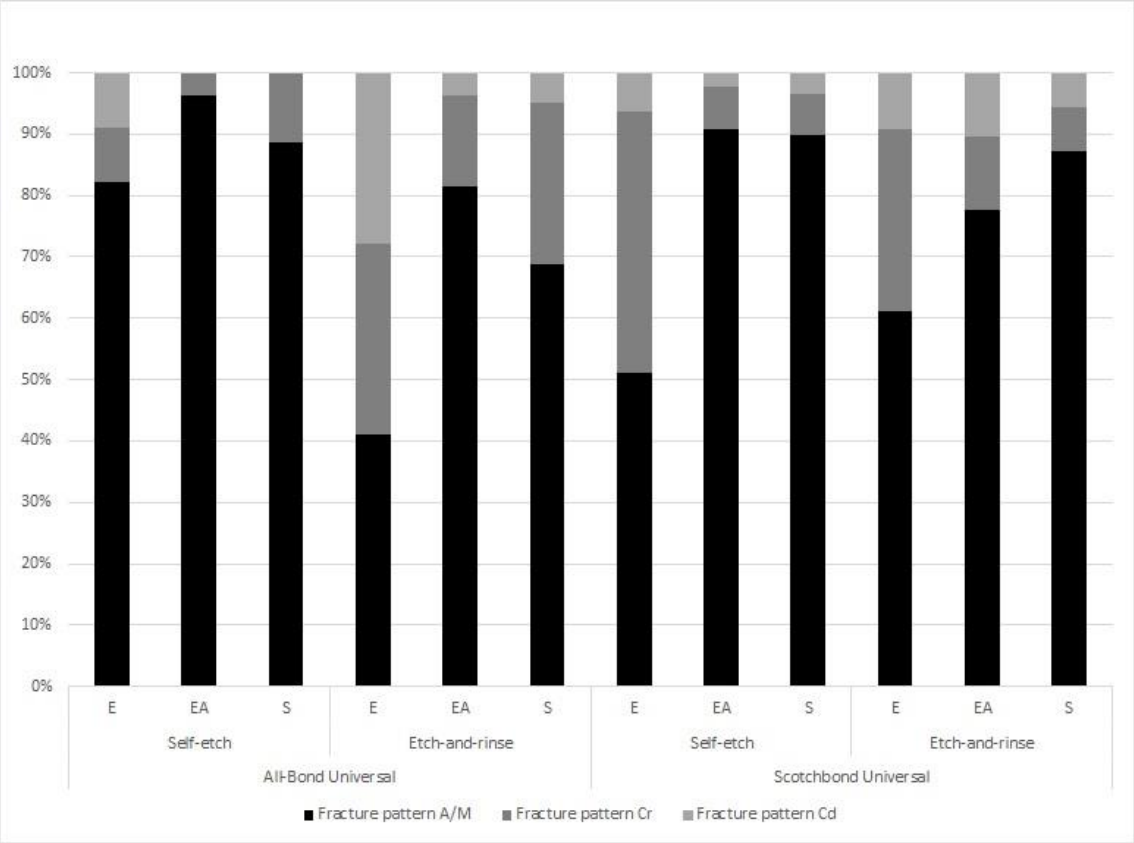


Figure 2 – Fracture pattern – samples tested in 12 m – adhesive system/approaching.



4 DISCUSSION

Concerning dentin substrates submitted to an erosive and abrasive process, laboratory studies have investigated the influence of the cited conditions on bond strength using different adhesive systems.[8,13,14] Clinically, these alterations usually involve physiological processes with dentin responses to external stimuli. These pathological processes result in irreversible loss of mineral caused by well-defined and diverse etiological factors.[15]

This study simulated a clinical condition of erosion and abrasion processes. The EA group simulates dental wear that clinically occurs and may alter the dentin in a different way from that occurring in the erosive process only. The protocol to simulate EA was a combination of two laboratory protocols to first simulate an erosion[8] followed by a simulating abrasion[12] that seems to occur when the patient brushes the teeth immediately after dietary acid defy.[4]

Universal adhesives are widely used for NCCLs treatment because they are versatile, easy to handle and may exclude the step of etch-and-rinse in some situations.[16] This study rejected the null hypothesis since our findings suggest that dentin substrate treated to simulate NCCLs conditions affect the bond strength. ABU ER bond strength of E dentin groups was higher than ABU SE after 24h. It was clear that the dental erosion positively influenced on the bond strength. The artificial erosion promoted by using this proposed method, probably made the dentin substrate seems like the phosphoric acid effect on regular bonding process since the smear layer is removed and superficial

dentine has its collagen fibrils exposed due to the demineralization process that may promote the formation of a very adhesive impregnated hybrid layer.[14]

In the SBU SE, the E group showed higher μTBS values when compared to the EA and S at any time tested. This can be explained by the eroded dentin morphological alteration, which leads to the removal of dentinal buffers and intertubular dentin, as well as the increase in tubule diameter and collagen fiber exposure.[8,14] In addition, the results to EA groups showed no statistical differences in relation to the S groups for both adhesives systems at any time tested. It could be explained by the fact that, after the erosive process, collagen fibrils were exposed and the dentin tubules diameter was increased,[10] then the subsequent abrasive attack may have disorganized the collagen fibrils generating a smooth surface, similar to the sound substrate[4] justifying the similar results of bond strength to the sound substrate.

Regardless of adhesive or approaching used, our findings showed that the aging in water did not influence on bond strength values, what is in agreement with others studies.[17] The presence of MDP as a functional monomer in the composition of the both adhesives may explain the similar results. Since the 10-MDP monomer chemically binds to the dentin, it could benefit the formation of a stable calcium-phosphate structure by the chemical adhesion with the hydroxyapatite calcium.[8] Thus, this monomer chemical structure and mechanism of bonding is considered a contributing factor to adhesion durability,[7,18] resulting in a more hydrolytically stable adhesion to the dental substrate.

5 CONCLUSION

In this study it was clear that generally the E dentin favored the bond strength in 24h and 12m and EA dentin presented similar behavior to S dentin.

- E dentin shows that in 24h the ABU SE group performed lower bond strength than the others;
- EA dentin performed similar results of bond strength for all adhesives and approaching in 24h but in 12m SBU SE performed lower results than ER approaching;
- S dentin performed similar results for all adhesive, approaching and tested times.

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"Pharmacolandas e Odontolandas": A study on the female presence in Pharmacy and Dentistry courses in São Luís – MA (1940-1970)

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ABSTRACT
The present work aims to analyze the female presence in higher education in the state of Maranhão, in the period 1940 – 1970, specifically in the Faculty of Pharmacy and Dentistry of São Luís. It also aims to identify women as students of higher education and their professional performances, understanding higher education as a space for education, instruction and power. It also tends to per-ceive the validity and importance of higher education for women outside the aca-demic sphere and also the social repercussion of female presences in spaces considered male par excellence. In this sense, it is important to highlight the insti-tution of higher education as a privileged space of political and scientific knowledge, where gender relations gain connotation and notoriety, as they reflect the cultural constructs of society in general.

Keywords: Pharmacy and Dentistry, Female presence.

1 INTRODUCTION

The present work aims to analyze the female presence in higher education in the state of Maranhão, in the period 1940 – 1970, specifically in the Faculty of Pharmacy and Dentistry of São Luís. It also aims to identify women as students of higher education and their professional performances, understanding higher education as a space for education, instruction and power. It also tends to perceive the validity and importance of higher education for women outside the academic sphere and also the social repercussion of female presences in spaces considered male par excellence. In this sense, it is important to highlight the institution of higher education as a privileged space of political and scientific knowledge, where gender relations gain connotation and notoriety, as they reflect the cultural constructs of society in general.

By perceiving women as academics, we aim to analyze the power relations existing in higher education, especially because within the specificity of the Faculty in São Luís, the pharmacy course was considered more conducive to women, and dentistry was indicated to men, this aspect already demonstrates a selection of the sexes imbricated by gender relations, with an inclination towards a female presence in courses that sought careers culturally defined as more appropriate to women.

As a result of the effervescence of women's studies, the affirmation of gender equality, and the

greater presence of women in academia, the humanities and social sciences began to have much more systematized studies on the female condition.

It was necessary to discuss women and social groups, until then not privileged in historical writings, however, several authors call attention to the fact that women perform their experiences in a non-isolated way, with daily life, politics and experiences, in general, also being relational aspects, that is, aspects related to men and women in the social dilemmas experienced daily. Hence, the contemplative importance of gender studies is highlighted, as they seek to involve the dialectic of complex daily life involving men and women, women and women, men and men, thus, "[...] gender relations are a constitutive element of social relations based on the hierarchical differences that distinguish the sexes, and are therefore a primary form of significant power relations" (MATOS, 1997, p. 80).

2 DEVELOPMENT

Gender was used to question biology, so much sex would refer to the cultural inscriptions brought by the body and represented as something natural. Gender is the cultural reading constructed through the physical, that is, it would be the cultural approach to biological marks, however, biological marks are also cultural, after all, sex, as well as gender, is invented. Thus, gender represents the cultural meanings of the sexed body, whose biological reading is already imprinted with cultural marks. For Butler, performativity should be understood as a reiterative and referential practice, where the discourse produces effects and names them, it is the construction that is elaborated from a materiality, from the body, from sex. Therefore, the relationship between body, sex, behavior and desire is not linear, it is fluid and can be experienced in different ways, not only within the marks of heteronormativity.

Another factor that deserves to be highlighted was the search for legitimacy and academic breadth by historians of "minorities" and one of the characteristics of this legitimacy was the implementation of an opening in the theoretical conception of gender, highlighting the relational aspect with class and race/ethnicity. Currently, these three notions are understood as a tripod for a substantially more complex analysis, and cannot be ignored or demarcated in the sense of measuring them, although, even using them, we have to be aware that they do not account for the plurality of women's trajectories and behaviors.

Parity between race/ethnicity, class and gender is necessary in order to offer a less superficial and homogeneous analysis of women. It is in this perspective of articulation that the differences between women become more feasible and allow them to be pluralized in their context and time, as Verena Stolcke states "in what way to approach the way in which gender, class and race come together to create not only common factors, but also differences in women's experience" (STOLCKE, 1991, p. 102), cohesion factors are also differentiating.

Thinking about this way of crossing such approaches of gender, class and race/ethnicity, Kimberlé Crenshaw (2002) presents a model of intersectional experience for the perception of women and ethnicity, especially when dealing with violence and oppression against women, considering that the various women experienced sexism differently due to their social condition and/or race/ethnicity. A gender perspective that does not invalidate, on the contrary, privileges the diverse experiences and conditions of women and elaborates the academic construction based on these premises of differentiation.

The historical reflection that privileges the newspaper as a medium, analyzing it in its totality, aggregates diverse reflections on the production, circulation and consumption of a given society. On the other hand, the observation of sources related to official discourses is added to the observation of areas of a relative society that were formally regulators of this so-called society, sometimes as a reflection of real changes and other times as vague definitions that ended up having little social impact. One of the challenges in this methodological process is related to the approximations of these documentary typologies in their analysis. As it is possible to identify the typology of the sources organized for this research, they turn to newspapers and official discourses highlighted by documents prepared in a regulatory character, such as laws and decrees. The periodicals are an important part of the selected inventory and they focus on the construction of meanings, discourses and representations present in societies immersed in media cultural production.

The methodology used is based on the perspective in which the idea of truth present in the journalistic text and/or official discourse is the substrate for considerations about what is considered and/or conveyed as being true at a given historical moment, so we will approach a view on the sources of research, understanding them as 'truths' and relative statements.

At the end of the nineteenth century, higher education was limited in number of institutions and students, concentrating courses in the areas of Medicine, Law, Engineering and Agronomy and was established in only seven cities: Rio de Janeiro, São Paulo, Ouro Preto, Salvador, Recife/Olinda, Cruz das Almas and Pelotas. It was during the period of the First Republic that the number of higher education schools multiplied, reaching other cities and, among them, São Luís, with the foundation of the Faculty of Law, in 1918, and the Faculty of Pharmacy and Dentistry of Maranhão, in 1922 and 1925, respectively.

Even with an encouraging picture of the expansion of higher education in the country, women's access to such courses was limited and slow, some factors help to understand this process: the idea of female intellectual disability; the attachment of women to the domestic sphere (such as the one already mentioned above) and, therefore, the lack of need to obtain extensive knowledge. Also the conception of women's work, for girls from lower classes, associating it with the role of mother in the performance of care for children in primary schools and promoting the massification of women in the teaching of

the first letters, where normal education courses were spread throughout the country.

The association of female education with the teaching of the Normal School contributed to the fact that many women saw this level of education as its apex, especially because it did not have the characteristics of classical and scientific education, which, in turn, were preparatory for higher education. Only in 1971, with the Law of Guidelines and Bases of Education – nº 5692, 11/08/71, there was equivalence between normal and secondary education, but, in practice, the difference between professional and academic courses remained, limiting the chances of those who did not take a more academic orientation course, even though the course was used as a way to fill the gaps to have access to higher education.

Throughout the second half of the twentieth century, the growth of women in higher education became significant, especially in courses in areas considered feminine. Thus, women had a higher concentration of women in secondary education preparation courses in the areas of Letters, Humanities and Philosophy and a lower number of students in bachelor's degree and science courses, so much so that the number of female enrollments only registered a large increase from the registration of courses in the areas already mentioned.

In São Luís, the educational situation, throughout the nineteenth and twentieth centuries, resembled the national scenario, with the beginning of the republican period as a time of attempts to organize education in the state. One of the milestones in this process was the foundation of the Normal School in São Luís, in 1890.

> Despite the precariousness of female education and the great difference in the number of schools and enrollments offered to both sexes3, which showed the priority of male education, there were small advances at the turn of the century. Women's progress in education was more feasible when women were able to access public secondary education, not only in normal schools, but also in preparatory courses for higher education, which was made possible by the educational reform of 1879 (ABRANTES, 2012, p. 256).

The beginning of the twentieth century also marks the establishment of isolated Faculties in Maranhão: in 1918, the Faculty of Law and in 1922, the Faculty of Pharmacy, counting, in 1925, with the creation of the Dentistry course and becoming the Faculty of Pharmacy and Dentistry of Maranhão. These higher education schools established themselves as a mostly male space, at least in the first years of operation, however, even so, women were registered in the academic environment and the first to graduate in Law, in Maranhão, was Zélia Campos, in 1925.

During the Estado Novo, higher education institutions were closed and resumed operations in the 1940s, with this reopening a gradual greater female presence in the aforementioned courses, as well as the opening of new courses culminating in the federalization of higher education in the State and the creation of the Federal University of Maranhão, in 1966. During this period, it was possible to notice more and more women present in undergraduate courses, either as students or professors, and it is at

this point that some observations of this work are anchored, which seeks to write the history of higher education in Maranhão with emphasis on the analysis of the female presence, highlighting the spaces they occupied, their performances, conflicts involving gender issues and power struggles.

Thus, the proposal of this work culminates in a perspective that aims to break with the opposite poles of man x woman, dominator x dominated and problematizes the constitution of each pole, evidencing them as plural. The deconstruction suggests that the polarity and the implicit hierarchy should be historicized in order not to reproduce an analysis in which men are always seen as agents and women always suffer the action, this research seeks the multiple relationships of women in society, in instruction and professional practice, evidencing the way they built their practices when dialoguing, assimilating and resisting the asymmetries of gender, but also of origin, social condition and race, even if these questions were not always clearly posed to the interlocutors of this research or were read by them as a pertinent issue in their life histories.

3 RESULTS AND DISCUSSION

Knowledge, as a synonym of power, was sectorized and disallowed to women as modern Western society was organized around science and knowledge. Women who showed a lot of knowledge were constantly watched and controlled, when they could not be controlled they were taxed, ridiculed and associated with negative aspects, a clear example of this was the dissemination of the image of the witch and the persecutions suffered by a significant number of women throughout the fifteenth to sixteenth centuries in Europe and in the places of its political influence. For women, knowledge should be limited and mediated by men, and women's rural and popular knowledge escaped this.

This process culminated in the Scientific Revolution, imposing negativity on forms of knowledge outside the axis legalized by science, which, for the most part, were mediated by poor women from rural areas and being harshly fought, causing a negative conception of the relationship between women and knowledge. This view extended for centuries, corroborating an ideal of female intellectual incapacity and their consequent inferiorization in the school, scientific and professional spheres, where it was believed that women should know only what is indispensable.

In Brazil, since the Proclamation of the Republic and the significant changes in the economic system, there has been a strengthening of cities, industry and commerce, resulting in new social and behavioral requirements. There was also a resignification of the female role in the private space and, with it, new patterns of marriage and motherhood, a fact that promoted a broad discussion among educators, politicians and intellectuals about the levels of education and quality of what should be offered to women in schools. The most widely accepted conception would be that such education should meet domestic desires, but, above all, the desires of the ideal of the nation, where women would contribute with aspects related to health, hygiene, food and instruction of their offspring, for the

formation of republican citizenship. In this way, the participation of women in the country's normalist courses was disseminated.

> Differentiated education was advocated, because women were seen as less intelligent and more fragile than men. Home Economics was included in his curriculum, because 'the woman is the queen of the home'. The co-ed school was criticised for being 'promiscuous'. The formation of teachers was encouraged, because they, 'true mothers', have a 'vocation to the priesthood' which is the magisterium. Differentiated education was fought , arguing that it served to relegate women's labor to the 'reserve army', causing them to occupy positions with lower pay than those occupied by men in the labor market (ROSEMBERG, 2012, p. 338-339).

The most immediate consequence of this whole process was the greater presence of women in public spaces and educational institutions, as students and teachers, in factories, in commerce, etc., that is, it was increasingly notorious that women were outside the domestic axis, both those of the lower class (who, due to economic needs, already circulated in public spaces), as well as those of the middle and upper classes. Such female dynamics in the cities did not go unnoticed and caused several reactions, mostly of criticism and irony, an example of which were the various records made in newspapers that, from the end of the nineteenth century to the middle of the twentieth century, conveyed positions contrary to women's education and work under allegations that society would be harmed. Below is one of these approaches made in the newspaper **Notícias,** which circulated in São Luís in the 1950s.

> The maelstrom of modern life, the economic crisis of the present day, brings, as a sad consequence, the distancing of women from the home. And this is one of the greatest or the greatest evils of the present hour. For hours and hours on end, sometimes for a whole day, the Mother remains outside the home. [...] And if we are sad to see that the proletarian mother is forced by economic deficiencies to withdraw from her duties at home, it is revolting to see the abandonment of the well-to-do homes for more futile reasons. The middle-class mother, trying to increase a budget, more or less sufficient, makes the mistake of devoting herself to occupations outside the home. [...] There is no amount of money capable of compensating for the moral damage suffered by the child who lacks the loving maternal vigilance. The woman's place was, is and always will be the home, because the woman of today, like the woman of yesterday and tomorrow, always has the same mission on earth - the sublime mission of 'Being a Mother' (MARTINS, 14 jul. 1952, p. 3).

Under the aegis of a "mission" of women in society, the **Women's Page** of the newspaper **Notícias**, written by Reinaldo Martins, addressed themes more focused on married women and mothers, reinforcing that every woman, even single women, exercised a little of motherhood, such as the teacher's imagery, as she combined profession with child care.

However, such justifications, which limited the education of young women, were increasingly confronted by the growing enrollment in secondary and higher education courses.

> Of the global growth in higher education, the increase in women's participation was remarkable: from 26% in 1956 to 40% 15 years later. However, the expansion of enrollments has not occurred uniformly, so much so that, in Engineering, there are still only 3% of women. In fact, there is even an increase in the concentration of female students in a few

> 'feminine' careers which, culturally defined as more appropriate to women, have traditionally had a predominance of women among their students (BARROSO, 1976, p. 52).

The entry of women into higher education represented new possibilities of insertion in public spaces, as academic training expanded the branches of professional practice, even though, for this, women had to face constant challenges to prove competence or seek some branch that would bring them closer to the characteristics considered close to the feminine essence, for example, working with other women, elderly or children.

In another example of the writings in newspapers, the discomfort with the markedly sexist language of the speeches raised on the occasion of the May 1st commemorations stands out, in which a collaborator of the **Jornal do Maranhão**, signed only by Natasha, evidenced the mistake of the language in characterizing workers only as men.

> Everyone was talking about workers, the square was full of men, the speakers were addressing the workers. Everything was work in a 'masculine' sense. And don't we, women, also have our role in the world of work? Of course we do. Today we find millions of women in factories, warehouses , shops, offices, not to mention what is most peculiar to women's work : the infirmaries, the nurseries, the gardens, the schools. Therefore, we see that women have entered the world of work, and still want to conquer new positions. We can already see women in the practice of law, in the courts, in medicine , women ambassadors, deputies... (NATASHA..., May 6, 1962, p. 3).

However, after this same author noted the achievements of women in the labor market, she ends the text by noting that women have the capacity to occupy any public office, but their greatest role would be developed in the home, that is, a reinforcement of the attributions historically attributed to women. Points:

> And I concluded that women can conquer any field, no matter how high it may be, with their work, but the natural place, where their activity can best express itself and give them the greatest satisfactions, is a home: their own home. (NATASHA..., May 6, 1962, p. 3).

Having a greater number of women in secondary education, vocational courses, colleges and the labor market did not in itself represent female emancipation in terms of the roles of wife and mother, but it was still a reflection of the struggle of many Brazilian intellectual women who sought greater equality through education and professional experience.

In order to better understand the relationship between education and women in twentieth-century Brazil and with attention to the reality of Maranhão, this work emphasized a look at the historical context of society and formal higher education, as well as the propagation of behaviors involving women, with criticism, new demands and even the rupture of social standards about the feminine. Thus, it can be observed that the country was increasingly urbanized, with the expansion of education and the generation of new jobs, also resulting in greater training and female participation in professional courses, higher education and the labor market.

Still aiming to identify the influence of higher education for women, especially in Maranhão, this research was based on local documentary contributions, sources that told the history of higher education in the state and also through interviews with five women who attended higher education in the capital between the period 1950 and 1970.

4 CONCLUSION

In the written sources, it is possible to observe the constant record of women in the University, even if in smaller numbers, as in the Law and Dentistry courses, however There is no record of women authors of scientific articles or issuing opinions in these student spaces, in these same newspapers the dissemination of the feminine image was very much associated with beauty (with contests among students) or with being patients of men in advertisement images; in the Academic Directory sections, female participation is also noted, but in functions considered secondary, such as secretaries and treasurers.

In the interviews, it was possible to notice various forms of intimidation to which the women were subjected and which were often reported as something "normal". Firstly, it is noteworthy that all the interviewees stated that they were not interested in politics as university students, and that there was an association between the conception of politics and partisan issues, in which they demonstrated that they had no interest.

They also assumed a sexist discourse of knowledge, by attributing to men some knowledge, such as logic and mathematics, and to women others, such as humanities. During their undergraduate, graduate and work studies, they reported several conflicts in their daily lives, including situations of inferiority for being women, poor, black or from the Northeast. In college, they had to always demonstrate their competence through grade disputes, disputes over who would represent the class in academic papers, and demonstration of intellectual competence when their abilities were questioned.

Their discourses were, in general, based on the traditional female roles of wife, caregiver and mother, even for the only interviewee who did not have children. Despite this reinforcement of a vision of the feminine, which was already growing in people's imagination, the interviewees constructed discourses about their experiences where they were able to re-signify the female role with the categories of student and professional as added to the demands of the modern woman.

Thus, from the written sources and reports in the interviews, it can be emphasized that the instruction represented a huge step for the women, but it also brought with it some burdens because they were inserted in historically masculine spaces and, therefore, they had to develop some protection strategies such as seriousness and sobriety in the instruction environments, leaving no room to associate their images with frivolous situations or uncommitted to studies. Even as adults and doing a master's degree, a doctorate or taking public exams, they had to prove that they could be good students or

professionals, even if they were already mothers or married and lived through different situations in which their husbands or fathers put their professional choices in check and represented some barrier to the performance of their jobs, once again these interviewees resorted to strategies, sometimes with open confrontation and other times more veiled, to continue their goals.

Finally, the numerical increase of these women in higher education keeps, within each issue, several stories of struggles, of overcoming, personal and family, which were lived in environments that were sometimes hostile to women and preventing equal conditions in academic training and the exercise of the profession.

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Alteration of the vertical dimension of occlusion: Clinical repercussions

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ABSTRACT
The loss of the vertical occlusion dimension (OLD) is the result of a major occlusal imbalance, where, in addition to the loss of dental elements, the responsible factor may be parafunctions, such as bruxism. The reestablishment of the vertical dimension of occlusion is very important for the preparation of prosthetic works since its non-establishment can cause damage. The objective of this study was to conduct a narrative review of the literature to clarify the clinical repercussions caused by the alteration of the vertical dimension of occlusion. Studies on the subject were searched electronically through the Medline database, via PUBMED, without restricting the language of the publications and the limit of publication dates. The search strategy was developed using a combination of keywords and general terms related to the vertical dimension of occlusion and dental prosthesis. A total of 31 references were included in this review. According to the reviewed articles, we can infer that if the vertical dimension of occlusion is not correctly reestablished, remaining increased or decreased, damage may occur in the teeth, muscles, TMJ, swallowing, phonation, auditory system, and even in the patient's posture, affecting their balance, so its reestablishment is of paramount importance for the success of oral rehabilitation.

Keywords: Vertical dimension of occlusion, Dental prosthesis, Occlusion.

1 INTRODUCTION

Often tooth wear is found in several patients, some factors such as age, presence of parafunction, occlusion, eating habits, and conditions such as amelogenesis or dentinogenesis imperfecta interfere with the degree of wear. When tooth wear becomes excessive, it is necessary to evaluate and reestablish the vertical dimension of occlusion (OLD).

The vertical dimension is considered as the height of the face determined between two fixed points, one located in the maxilla and the other in the mandible. The height of the face when the teeth are at maximum intercuspation is defined as the vertical occlusion dimension (OLD)[1]. The height of the face when the teeth are separated and the jaw is in a position of physiological balance is called the vertical resting dimension (RLD)[2].

The correct reestablishment of OLD is essential for the proper function and comfort of the patient, however, it is one of the greatest obstacles in oral rehabilitation3. Its inadequate

reestablishment will lead to the failure of prosthetic work, and even to iatrogenesis. Decreased or increased OLD can cause damage related to masticatory, muscular, articular, phonetic, postural and aesthetic function4; 5; 6; 7;8.

In the era of evidence-based dentistry and despite 50 years of publications on the subject, the determination of OLD remains a process basically based on professional clinical experience9. Therefore, the objective of this study is to review the literature and verify the clinical repercussions caused by the alteration of the vertical dimension of occlusion.

2 METHOD

2.1 DESIGN AND RESEARCH QUESTION

The present study was conducted as a narrative review of the literature in order to answer the following question: "What are the clinical repercussions generated by the alteration of the Vertical Dimension of Occlusion?".

2.2 SEARCH STRATEGIES

Studies on the subject were searched electronically through the Medline database, via PUBMED, without using a limit of publication dates. The search strategy was carried out using a combination of keywords and general terms related to OLD and dental prosthesis. The following combination was performed (occlusion vertical dimension AND dental prosthesis).

An examiner independently screened titles, abstracts and subsequent selection of references for complete reading. Literature reviews, systematic reviews, clinical cases, and books that addressed the topic were included in this review. The references of all included studies were manually analyzed for possible inclusion of studies. The electronic search (Pubmed) resulted in the identification of 144 references. Of these, 46 were excluded in the screening of titles, and 72 in the screening of abstracts, 26 references were evaluated in full. Some additional references were found through manual search, totaling 32 references.

3 LITERATURE REVIEW AND DISCUSSION

The vertical occlusion dimension (OLD) is the vertical distance between the mandible and the maxilla when the teeth are in contact10. Over time, patients may suffer changes in this dimension due to tooth loss and wear, which is also common in restorative procedures, during orthodontic treatments, and in patients with temporomandibular disorders4.

According to some authors, the physiological resting position, as it is a position determined by muscle balance regardless of the presence and/or position of teeth, remains constant throughout the individual's life in the presence or absence of teeth and could be used as a reference in the

reestablishment of OLD11; 12; 1314, except for minor changes due to age, the relative stability of the clinically determined resting position is generally accepted[11; 12; 13].

The resting position implies harmony in the tonicity of the levator and depressor muscles, but its presence, by itself, is not indicative of muscle harmony. The observation that the clinically determined resting position does not always coincide with the limit of minimum muscle activity suggests that the neuromuscular mechanism is much more complex than previously thought15. An important aspect of the jaw resting position is the free functional space (FFE) that is present between the occlusal surfaces of the upper and lower teeth when antigravity tone is maintained. This space varies with the type of occlusion and with the hypotonicity or hypertonicity of the muscles related to mastication. In the anterior part of the arches, this space, on average, can vary between 1 and 4mm.

Tooth wear is frequently diagnosed in many patients, and the loss of morphology of the incisal edge of the maxillary central incisor, for example, is considered physiological tooth wear, since the characteristics are lost with age16. Therefore, it is difficult to determine when tooth wear is physiological or pathological, because there is no fixed degree of comparison, what is known is that major wear requires interventions17.

Tooth wear is classified according to its etiology as: attrition, abrasion, abfraction and biocorrosion18. In friction, there is a loss of dental tissues, exclusively as a result of the activity of functional or parafunctional contact of the teeth, whereas in abrasion there is a wear caused by the friction action of a foreign body on the teeth, which is considered pathological[19].

In abfraction, there is loss of dental tissue due to occlusal trauma, and in biocorrosion (erosion), loss of tissue due to a chemical process. In most cases, there is a combination of these processes, so there is difficulty in establishing a differential diagnosis20;21. The degree of wear and tear can vary and depends on factors such as: age, occlusion, presence of parafunction, gastrointestinal disorders, excessive intake of citrus foods and low-pH beverages, environmental and salivary factors, and congenital anomalies such as amelogenesis imperfecta and dentinogenesis imperfecta.

Some moderate changes in OLD are not harmful, as they do not lead to symptoms of temporomandibular disorders and do not cause muscle overactivity22 However, both the indiscriminate increase and decrease in OLD lead to undesirable changes. Changes in OLD generate various damages that are related to aesthetic, dental, muscular, swallowing, articular, phonetic, periodontal and even postural problems3; 4; 5; 6; 7;8.

The increase in OLD can cause damage such as: pathological bone resorption, increase and decrease in the stretching of some muscles, tooth wear, headache, TMD symptoms, TMJ pain, bruxism, phonation difficulty and masticatory deficit23;24. This is due to the decrease in free functional space and these consequences have repercussions on the main characteristics present in patients with

increased OLD, which are: enlargement of the lower 1/3 of the face, dental contact in the emission of wheezing sounds and pain23;25.

On the other hand, the decrease in OLD causes an excessive increase in the free functional space, resulting in: traumatic occlusion that affects the periodontium and causes tooth wear, hearing problems, TMJ overload, aging (loss of facial muscle tone), short face, appearance of acute and chronic oral pathologies, modification of the adrenocortical response leading to an increase in urinary cortisol levels and consequent reduction in urinary volume4;24. The main characteristics of patients with decreased OLD are: Reduction of the lower 1/3 of the face, large free functional space, excessive lip contact, and presence of angular cheilitis23;25.

Symptoms related to decreased OLD, such as hearing loss, dizziness and pain in the temporomandibular joint caused by the posterior displacement of the condyle, which compresses the retrodiscal zone, became known as Costen's Syndrome5.

A study aimed to seek an association between the type of bite and changes in the vertical dimension of occlusion with temporomandibular disorder in children and adolescents. A total of 105 individuals were evaluated, however, only 61 met the inclusion criteria, of which 35 were women and 26 were men, and the authors found no correlation between the type of bite, decreased OLD and TMD in the sample26.

In 1987, Wilding et al investigated the prevalence of TMD, diagnosed using the Helkimo index, in a sample of 51 individuals with total edentulous individuals with loss of OLD. In addition, they aimed to search for a possible association between TMD and OLD loss27. This study concluded that the loss of vertical occlusion on its own is not responsible for the temporomandibular joint dysfunction observed in patients with prostheses with reduced vertical height, since there was no statistically significant correlation between TMD and loss of OLD26.

In addition, changes in OLD can cause changes in head and neck posture, leading to a disturbance in body posture control, which can affect gait stability and make it difficult to maintain body balance7;28.

To determine if there was an alteration in the OLD, some points should be observed, if there was loss of posterior restraint; the speed of tooth wear, because if the wear is slow, there may be compensation for tooth eruption, but if it is fast, as in bruxism, there may be a change in the OLD; phonetic assessment with the use of sibilant sounds; at an interocclusal distance by marking two points, one on the nose and the other on the chin; facial appearance29;25. To evaluate these points, several methods have been proposed over the years5, the most commonly being the facial proportions, phonetic and metric methods.

4 CONCLUSION

The key to the success of prosthetic rehabilitation treatment lies in the reestablishment of functional and aesthetic parameters that have somehow been altered or lost during the course of the individual's life. Among the parameters that need to be reestablished, vertical occlusion dimension (OLD) is one of the main determinants of rehabilitation treatment, both from a functional and aesthetic point of view. According to the reviewed articles, we can infer that the reestablishment of the OLD is of paramount importance for the success of oral rehabilitation and that if the OLD is not reestablished correctly, remaining increased or decreased, damage may occur in the teeth, muscles, TMJ, swallowing, phonation, auditory system, aesthetics and even in the patient's posture, affecting their balance.

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The efectiveness of topical anesthesia on pain during oral injections - A randomized clinical trial

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ABSTRACT
The aim of this study was to evaluate the efficacy of a topical anesthetic in pain and anxiety control during oral injections. The experimental design was a randomized, double-blind, split mouth model. Anesthesia was performed in the infraorbital and posterior superior alveolar nerves in 10 healthy and normotensive patients. Before anesthesia randomization was performed on one side to apply the topical anesthetic (benzocaine 20%) and the other placebo. The pulse and blood pressure were assessed before, during and after anesthesia injection, and the pain in puncture was measured using a visual analog scale (VAS). The results showed statistically significant difference (p = 0.04) in pain of the needle puncture between the groups at the infraorbital nerve. In the posterior superior alveolar nerve no statistically significant difference was found between groups (p = 0.39). In the evaluation of systolic and diastolic blood pressure no significant diferences showed between groups in any of the times evaluated. In assessing the pulse was no statistically significant difference (p = 0:02) between the topical anesthetic and placebo only for the infraorbital nerve at the time of puncture. In conclusion, the topical anesthetic decreased the pain in anesthesia of the infraorbital nerve when compared to placebo.

Keywords: Anesteshics, Placebos, Benzocaine.

1 INTRODUCTION

Topical anesthetics are used to eliminate the pain of the needle puncture during local anesthesia. When topical anesthetics are applied, a decrease of pain stimulus occurs through the reversible block of nerve impulse transmission[1].

Local topical anesthetic may present in the form of ester or amide, the most popular compositions are Benzocaine, Lidocaine and EMLA (Eutectic Mixture of Local Anesthetics)[2]. Benzocaine is a ester topical anesthetics, has poor solubility in water and low systemic absorption, toxicity reactions are rare [3]. Topical anesthetics are diffused to a depth of two to three millimeters from mucosa. To have adequate efficacy should be left in contact with the mucosa for 2-3 minutes [4].

The issue of using topical anesthetics in control of pain during local anesthesia is a very controversial subject[5,6,7,8]. Most professionals dispense this step, because there are no studies proving the efficacy of topical anesthetics. Therefore, due to the lack of studies in the literature, this study aims to compare the efficacy of topical anesthetic (benzocaine 20%) compared to placebo in reduction of pain perception, in anxiety and blood pressure at the needle puncture.

2 MATERIALS AND METHODS

This study was characterized by a pilot study, with the experimental design a randomized clinical trial, double-blind, split-mouth model.

Patients greater than 18 years old, healthy, with no history of allergic reaction to anesthetics or their components sensitivity. The maximum blood pressure to consider normotensive patients was 139/89 mmHg (Brazilian Guidelines on Hypertension) in measurement prior to anesthesia. Patients who have local and / or systemic changes that no indicate the procedures, smokers and pregnant women were excluded from the study.

Patients were informed about the objectives of the study and those who agreed to participate signed a consent term. This study was approved by the Ethics Committee of UNIFRA, protocol 398.375. As this is a pilot study sample size was not calculated, so 10 patients participated in each group.

Eligible patients participated in both groups, on one side of the patient was used topical anesthetic benzocaine 20% Benzotop® (DFL, São Paulo, Brazil) (test group) and in other side placebo (Novaderme, Santa Maria, Brazil). The products had their packages covered and the codes were revealed after statistical analysis. Due topain difference between the anterior and posterior maxilla by the presence of more nerve branches in the anterior region, the anesthetics were performed in the same anatomical region, two blocks in the same patient's infraorbital nerve and two of the posterior superior alveolar nerve. Randomization was performed by a second examiner who made the draw through coin toss, determining if the topical anesthetic or placebo was used first.

Anesthesia was performed by a single operator previously trained. After randomization, the mucosal was dried whith sterile gauze and a topical anesthetic (test group) or placebo (control group) were deposited with a swab in the region of puncture needle. Two minutes was awaited for the anesthetic technique. The needle used for anesthetic technique was a short, 30-gauge Injex® (Ourinhos, São Paulo, Brazil). 100.00 (DFL, São Paulo, Brazil). The use of one cartridge of 2% lidocaine with epinephrine at a concentration of 1 was advocated.

Heart rate and blood pressure were assessed 10 minutes before, during needle puncture and 10 minutes after anestethic infiltration by digital sphygmomanometer Omron® HEM 742 Automatic INT

(Kyoto, Japan). The painful sensation was evaluated during needle puncture through the Visual Analogue Scale (VAS).

Data normality was tested using the Shapiro-Wilk test. Descriptive measures were evaluated using mean and standard deviation. Differences between groups were evaluated using the Student t test. The level of significance was set at 5%.

3 RESULTS

Ten patients were included and completed the study, 5 male and 5 female. The average age was 30 years of age with a range of 18-45 A total of 40 sites were included, 20 for the infraorbital nerve and 20 for posterior superior alveolarnerve.

Corresponding to the level of pain reported by patients on the VAS results were shown in Table I.

Table I: Mean and standard deviation of the reported pain as assessed by a Visual Analogue Scale (VAS) after puncturing the posterior superior alveolar nerve and infraorbital. n=10

	Nervo Alveolar Superior Posterior		Nervo Infraorbitário	
	Anestésico Tópico	Placebo	Anestésico Tópico	Placebo
VAS (Mean ± S.D.)	3,1 ± 1,19	3,4 ± 1,07	2,8 ± 1,31	3,8 ± 1,31
p*	0,39		0,04	

* Teste T de Student.
Diferença estatisticamente significante p<0,05.

Statistically significant difference was observed between the topical anesthetic and placebo for the infraorbital nerve (p = 0.04). There was no statistically significant difference between groups for the posterior superior alveolar nerve (p = 0.39). It was observed that the pain perception reported by patients was similar between the infraorbital nerve, and the posteriorsuperior alveolar nerve.

In the evaluation of pulse, the results were divided into before, during and after the puncture and are shown in Table II.

Table II - Mean and standard deviation of Pulse reported, assessed before, during and after the puncture in the posterior superior alveolar and infraorbital nerves. n = 10

Pulso	Nervo Alveolar Superior Posterior Anestésico Tópico	Placebo	p	Nervo Infraorbitário Anestésico Tópico	Placebo	p
Prévia (Mean ± S.D.)	84,70±11,85	84,40±7,47	,929	83,00±9,59	85,00±7,22	0,225
Durante (Mean ± S.D.)	86,10±12,60	87,10±8,44	,736	82,30±10,91	89,00±8,90	0,020
Após (Mean ± S.D.)	84,00±11,28	86,40±8,40	.539	83,70±10,70	88,80±8,54	0,101

* Teste T de Student.
Diferença estatisticamente significante p<0,05.

Statistically significant differences were found during the pulse between the punch and placebo topical anesthetic to the infraorbital nerve (p = 0.02). There was no statistically significant difference between the previous period and after the puncture of the needle to the infraorbital nerve. In the posterior superior alveolar nerve no statistically significant difference was observed in both seasons.

The results corresponding to blood pressure (BP) of patients were divided into systolic and diastolic blood pressure are shown in Tables III and IV.

Tabela 3 – Média e desvio-padrão da PA sistólica reportada, avaliada Antes durante e após punção nos nervos alveolar superior posterior e infraorbitário. n=10

P.a. sistólica	Nervo Alveolar Superior Posterior Anestésico Tópico	Placebo	p	Nervo Infraorbitário Anestésico Tópico	Placebo	p
Prévia (Mean ± S.D.)	130,30±13,19	130,60±10,14	0,909	132,10±12,03	137,00±9,10	0,144
Durante (Mean ± S.D.)	132,90±12,35	134,30±11,43	0,549	135,90±10,74	140,40±13,62	0,167
Após (Mean ± S.D.)	131,10±10,02	133,30±10,41	0,158	136,20±11,08	139,20±9,77	0,402

* Teste T de Student.
Diferença estatisticamente significante p<0,05.

Tabela 4 – Média e desvio-padrão, avaliada através da Pa diastólica. Antes, durante e após punção nos nervos alveolar superior posterior e infraorbitário. n=10

P.A. Diastólica	Nervo Alveolar Superior Posterior Anestésico Tópico	Placebo	p	Nervo Infraorbitário Anestésico Tópico	Placebo	p
Prévia (Mean ± S.D.)	79,50±11,81	83,00±11,36	0,079	80,90±11,80	85,50±11,16	0,086
Durante (Mean ± S.D.)	83,20±11,90	81,30±13,42	0,348	84,10±12,96	86,80±12,37	0,281
Após (Mean ± S.D.)	81,20±11,09	82,60±12,55	0,396	85,30±11,51	85,90±10,60	0,809

* Teste T de Student.
Diferença estatisticamente significante p<0,05.

There was no statistically significant difference in blood pressure (BP) and diastolic BP between the topical anesthetic and placebo in all evaluated periods.

No adverse effects were observed in the use of topical anesthetic, placebo and anesthetic cartridges.

4 DISCUSSION

The present study showed less pain during needle puncture when the 20% Benzocaine topical anesthetic was used for the infraorbital nerve.

The advantages related to the use of topical anesthetic in reduction of pain during needle insertion and anxiety control are not consolidated in the literature, since there are many studies with conflicting results on this topic [7,9,10].

Importantly, the anesthetic technique, the deposition rate of the anesthetic, the temperature of local anesthetic and anatomical region are factors that influence directly on the pain sensation the patient [4] . Caring cited in the literature for control and predictability of anesthetic technique were used during the study. Previously the use of topical anesthetic and placebo, the mucosa was properly dried to prevent solubilization by saliva and the time of application of the product was monitored [4].

Regarding pain puncture, was statistically significant difference only for the anterior maxilla, agreeing with data obtained in previous studies [6,8].

Topical anesthetic showed superior result to placebo in the infraorbital nerve region, which can be explained by this site has more nerve branches[11], which highlights the importance of using topical anesthetic.The results showed that despite being a pilot study, sample was sufficient to show a statistically significant difference between groups.

For the evaluation of the pulse of patients before, during and after the puncture needle, Rosivack et al.[12] showed that values ranged from an average of 2.2 beats per minute, and that these values do not have clinical relevance. In the present study, during the evaluation of pulse, statistically significant

difference was found only for the infraorbital nerve during needle puncture, however the differences between mean values has minimal clinical relevance.

It was observed that independent of the anesthetized region there was no significant difference in blood pressure at any of the time points analyzed, which would occur in a situation of pain in the puncture needle. In these situations the endogenous catecholamine release could lead to increased blood pressure[13,14].

5 CONCLUSION

The prior application of topical anesthetic causes a decrease in pain and reduction of pulse during needle puncture in the infraorbital nerve region, and this reduction in the anterior maxila isprobably associated with the presence of more nerve branches in that region. The application of topical anesthetic is a procedure that should be performed in the anterior maxila to reduce the pain during anesthetic procedures.

In posterior superior alveolar nerve no statistically significant differences between the topical anesthetic and placebo were observed. Prospective studies are needed to prove the advantages of the use of topical anesthetic.

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