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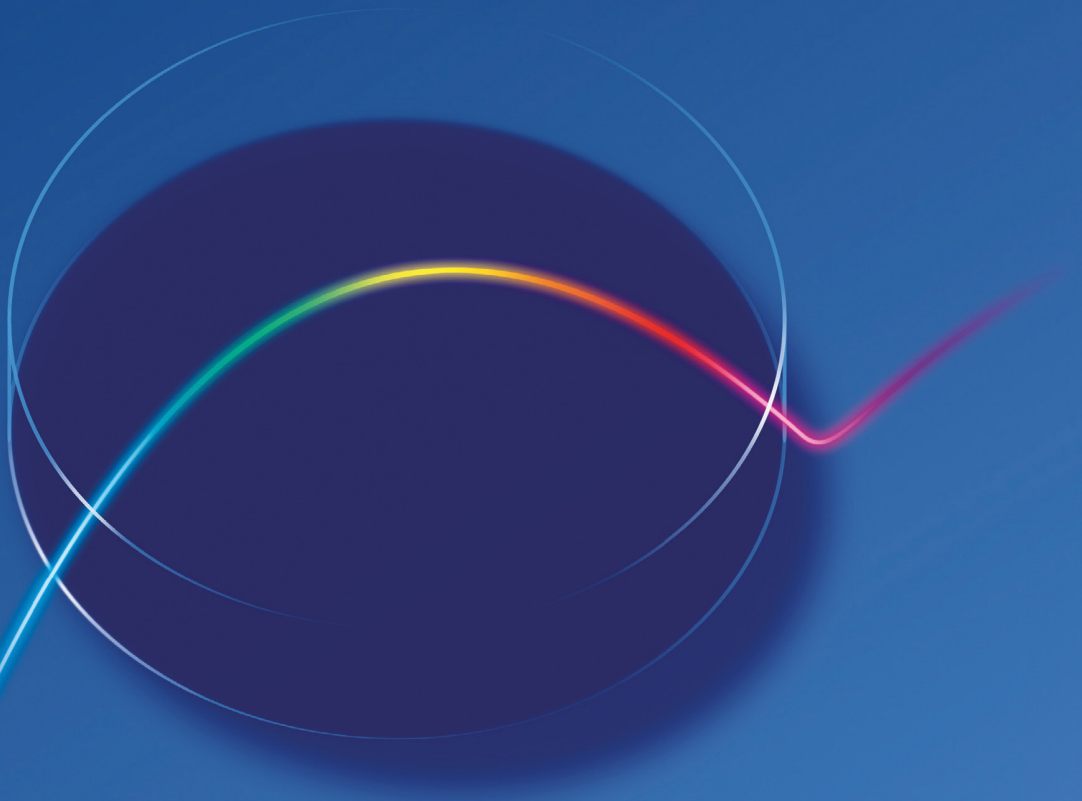

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Conteúdo

ARTIGOS ORIGINAIS

RELATOS DE CASO

CLRD in Clinical and Laboratorial Research in Dentistry | Prosthodontics

Transverse microhardness of artificial teeth

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ABSTRACT | *Objective*: Hardness is an indicator of several mechanical properties of artificial teeth, also related to wear resistance. The purpose of this article is to map the microhardness of artificial teeth as a function of depth and commercial brand. *Methods*: Knoop microhardness of sectioned artificial second molars was measured every 200 µm starting at a depth of 100 µm up until 4700 µm of the following brands: Premium (Pr), Orthosit (Or), SR Postaris DCL (Po), Biotone (Bi), Artiplus IPN (Ar), VITA MFT (Vi), Natusdent (Na), Trilux (Tr), and Biolux (Bx). Results were analyzed with ANOVA for repeated measures and Tukey test (5%). *Results*: SR Orthosit PE commercial brand presented higher hardness values (until the depth of 3.1 mm was 30 N/mm²), significantly higher than the other brands analyzed. *Conclusion*: Knoop hardness did not present differences between layers for eight of the nine brands studied. Different hardness values were found between superficial and cervical areas for the brand SR Orthosit PE.

DESCRIPTORS | Artificial Tooth; Hardness; Acrylic Resins.

RESUMO | **Microdureza de dentes artificiais em suas diferentes camadas** • *Objetivo*: A dureza é tida como indicador de várias propriedades mecânicas de dentes artificiais, e relacionada a resistência ao desgaste. O objetivo foi mapear a microdureza de dentes artificiais de 9 marcas em função da profundidade. *Métodos*: foi medida a microdureza Knoop de segundos molares cortados num plano sagital em intervalos de 200 µm a partir da profundidade de 100 µm até 4700 µm, das marcas: Premium (Pr), Orthosit (Or), SR Postaris DCL (Po), Biotone (Bi), Artiplus IPN (Ar), VITA MFT (Vi), Natusdent (Na), Trilux (Tr) and Biolux (Bx). A ANOVA de medidas repetidas e o teste de Tukey (5%) analisaram os resultados. *Resultados*: A marca SR Orthosit PE apresentou a maior dureza (até a profundidade de 3,1 mm foi da ordem de 30 N/mm²), significativamente maior que todas as outras medidas realizadas (da ordem de 20 N/mm²). *Conclusão*: A dureza Knoop não evidenciou diferenças entre camadas para oito das nove marcas estudadas. Foi constatada diferente dureza entre a superfície e a região cervical para a marca SR Orthosit PE.

DESCRITORES | Dente Artificial; Dureza; Resinas Acrílicas.

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INTRODUCTION

Artificial teeth selection represents an important contributing factor for the rehabilitation success of edentulous subjects. Wear resistance of artificial teeth during function and the outcome of the treatment are related, as masticatory efficiency, vertical dimension maintenance, and denture longevity depend on wear resistance. However, occlusal wear of acrylic resin teeth is a common complication.[1] One study shows that the wear of most acrylic tooth tested by sliding against enamel was significantly greater than that of porcelain material against enamel,[2] suggesting that the best combination for wear is porcelain-enamel, although this combination is able to produce micro cracks in enamel (50% of the samples).

To enhance the wear resistance, manufacturers have developed new materials, such as micro-filled composite and/or cross-linked and/or interpenetrated polymer network and/or different monomers.[3-8] The latter being the case of Trubyte Bioform IPN (Dentsply International/Pennsylvania, USA). Literature states that this product contains interpenetrated polymer networks (IPN), which are materials made of two polymers, each one in a different network shape, one network being inside the other.[6-9] Another manufacturer (Sustained Life Material - Dentsply, PA) despite not self-qualifying as IPN, declares that there would be an improvement in this product (Trublend SLM) caused by the incorporation of cross-links in the polymer networks with polyethylene particles of high molecular weight, which would also enhance the lubricant effect.[8,10] Composite resin teeth with silica particles were found in SR-Ortosit PE (Ivoclar, Schaan, Liechtenstein), detected by the analysis with EDX.[5]

Wear resistance improvement is usually accompanied by the decrease of artificial teeth--denture base adhesion, because this adhesion is related to the ability of the monomer to induce the swelling of the resin polymer, which decreases as the polymer cross-linked rate increases. Likewise, a high percentage of filler particles increases wear resistance, but the polymer area available for adhesion decreases.[11]

Manufacturers have overcome this properties contraposition by making artificial teeth in layers of different compositions. The layer corresponding to the enamel layer is expected to be resistant to fissures, solvents, and wear, while the base layer should present a lower degree of cross-links, allowing a better adhesion to the acrylic resin.[12] Therefore, the different layers of the artificial teeth can present specific properties of hardness and monomer diffusion.[5] Conventional acrylic resin teeth can also be made in layers, aiming at aesthetics improvement.

The grinding of the external layer corresponding to the enamel in artificial teeth might be caused by chewing or by occlusal adjustments performed by the dentist.[6] One of the reasons that might determine these adjustments is the polymerization process and the resin base contraction, which can displace the artificial teeth and change the occlusal contacts.[13] In addition, after a period of adaptation, the denture is accommodated in the mucosa and the tooth arrangement need to be adjusted.[14] In addition to the grinding of the external layer, the material removal of the cervical region is also performed when there is not enough space for tooth placement. In these cases, the most favorable of the tooth area might be reduced for the denture base adhesion, which is the region that presents a smaller degree of cross-linked polymer. In both situations, wear affects the performance of teeth manufactured in layers with specific properties.

No reports of hardness values through the various layers of artificial teeth were found in the literature. Hardness is considered a material property related to wear resistance and it is usually used as an indicator of several mechanical properties of synthetic restorative materials and artificial teeth.[15-17]

The aim of this study was to map the microhardness of nine artificial teeth brands according to depth. The null hypotheses were that all commercial brands of analyzed teeth present

similar hardness and that all depths present similar hardness.

MATERIALS AND METHODS

Microhardness was measured on upper second molars of each commercial brand (n=3): Premium (Pr) (Heraeus Kulzer GmbH/Hanau, Germany), Orthosit (Or) (Ivoclar-Vivadent AG/Schaam, Liechtenstein), SR Postaris DCL (Po) (Ivoclar-Vivadent AG/Schaam, Liechtenstein), Biotone (Bi) (Dentsply/Petrópolis, Brasil), Artiplus IPN (Ar) (Dentsply International/Pennsylvania, USA), VITA MFT (Vi) (Vita Zahnfabrik/Bad Säckingen, Germany), Natusdent (Na) (Dentbras Industria, Comercio, Importacao e Exportacao de Produtos Odontologicos Ltda/Pirassununga, Brazil), Trilux (Tr) (VIPI Indústria Comércio Exportação Importação de Produtos Odontológicos Ltda/Pirassununga, Brazil), and Biolux (Bx) (VIPI Indústria Comércio Exportação Importação de Produtos Odontológicos Ltda/Pirassununga, Brazil) (Table 1).

Table 1 | Brand of denture teeth used (information supplied by the manufacturer)

Denture teeth	Code	Characteristics	Manufacturer
Artiplus IPN	Ar	PMMA; BADMA18; high quality INPEN ® material	Dentsply Ind e Com Ltda., Petrópolis, RJ, Brazil
Biolux	Bx	PMMA; EDMA; double cross-linked	Vipi Ind. e Com Ltda., Pirassununga, SP, Brazil
Biotone IPN	Bi	PMMA; high-performance density cross-linked resin	Dentsply Ind e Com Ltda., Petrópolis, RJ, Brazil
Natusdent	Na	PMMA; EDMA	Dentbras Industria, Com. Imp e Exp. de Produtos Odontológicos Ltda., Pirassununga, SP, Brazil
Premium	Pr	PMMA; MPM (multiple polymeric matrix); microfiller combined with a viscoelastic nano filler (Nano Pearls®)	Heraeus Kulzer, GmbH/Hanau, Germany
SR Orthosit PE	Or	Isosit; UDMA6; highly cross-linked	Ivoclar Vivadent, Inc., Amherst, New York
SR Postaris DCL	Po	High-performance double cross-linked	Ivoclar Vivadent, Inc., Amherst, New York
Trilux	Tr	PMMA; EDMA; OMC (Organically Modified Ceramic); double cross-linked	Vipi Ind. e Com Ltda., Pirassununga, SP, Brazil
VITA MFT	Vi	PMMA; densely cross-linked	Vita Zahnfabrik, Bad Säckingen, Germany

Note: PMMA, polymethyl methacrylate; BADMA, butylene glycol dimethacrylate; EDMA, dimethacrylate of polymerized ethylene glycol.

Artificial teeth were grinded in the frontal plane until the tip of the mesial cusps was reached. Fragments were imbedded in a ½ inch polyvinyl chloride (PVC) tube (Tigre SA, Brazil) with chemically activated acrylic resin (Jet Classico/São Paulo, Brazil). After complete cure, samples were polished with the following sandpaper (Norton, Brazil) sequence: 320, 400, 500, 600, 800, 1200, and 2000. At each grit change, samples were washed during thirty seconds in running water.

Knoop microhardness was measured with a HMV-2000 micro durometer (Shimadzu, Japan) attached to a computer and a Cams-Win software (New Age Industries, USA). A 25 gf load was applied for 15 s, and the longer diagonal was measured in 40X. Twenty-two sequential indentations were applied in each specimen: the first indentation started in a distance of 100 µm from the occlusal surface of the tip of the palatal cusp and the next 21 were applied sequentially in increments of 200 µm towards the center of the cervical line of the tooth-cutting plane. Despite Vickers hardness being used for artificial teeth analysis,[19,20] the selection of Knoop hardness appeared to be more appropriate, since the longer diagonal is less susceptible to dimensional alterations and, as a consequence, Knoop hardness value does not depend on material ductility.[3]

Data related to depths of 100, 300, 1100, 2100, 3100, and 4100 µm were analyzed on Statistica 8.0 software (StatSoft. Inc., USA) with repeated

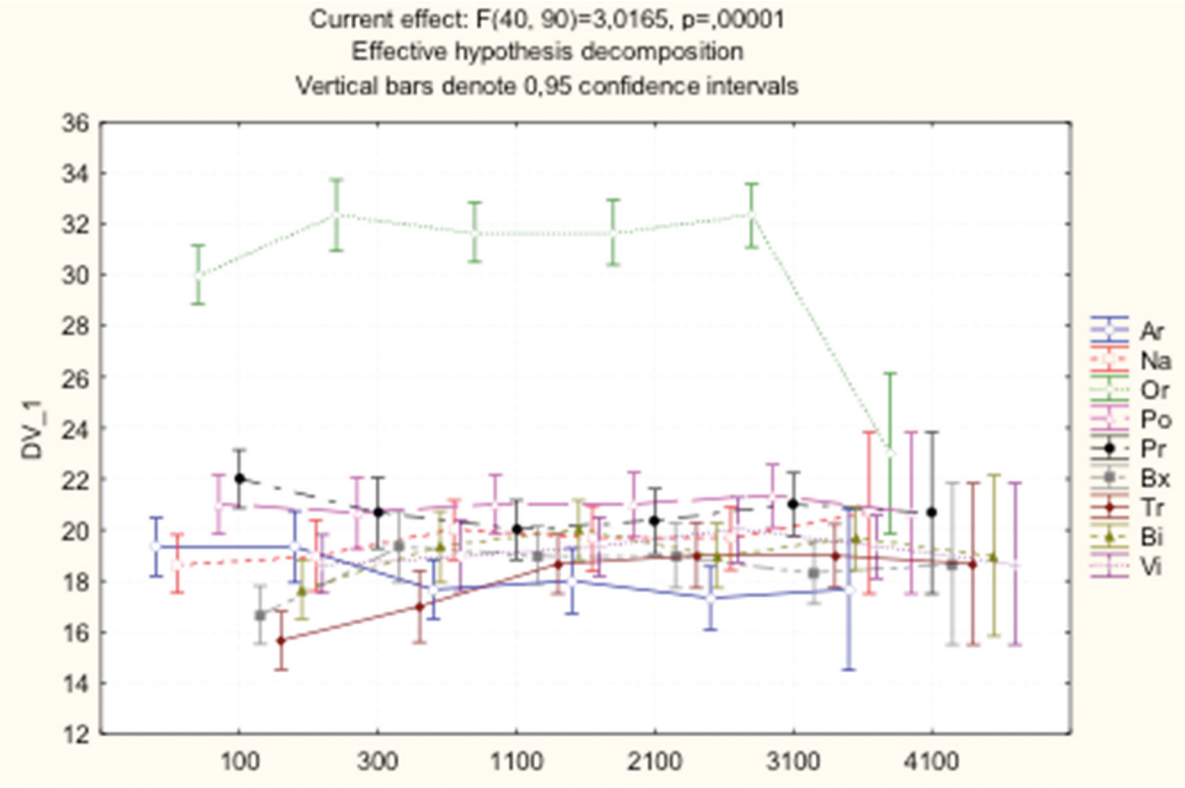
measures ANOVA analysis. The comparison between means was done with Tukey test ($\alpha \leq 0.05$).

RESULTS

Variance analysis presented significance for all variance factors: brand ($p<0.001$), depth ($p<0.01$), and the interaction factors ($p<0.001$).

The brand Or presented hardness means significantly higher than the other brands, with depths from 100 to 3100 µm. However, at the 4100 µm, Or hardness does not differ significantly from the other brands. Among the other brands, some significant differences were observed according to depth. The lower numerical value of hardness mean was obtained for the brand Tr (16±0.6) in the 100-µm depth, yet this value does not differ significantly from other 37 means. In general, the hardness of all brands does not significantly differ from each other, except for the brand Or until the depth of 3100 µm, as shown on Graph 1.

Graph 1 | Graphical presentation of Knoop hardness means of the interaction between commercial brand vs. depth



DISCUSSION

The analysis results allowed the rejection of the null hypotheses, since not all teeth brands presented similar hardness (Or is harder than all of the other brands, except in its deeper layer) and not all depths presented similar hardness (as Or presents significant hardness differences depending on depth). The difference between hardness values denotes a difference in resin quality, which might or not influence the teeth's clinical performance. According to some authors[21-23], it would be expected from teeth or layers with similar hardness similar wear behavior. As a principle, an increased hardness might be the result of a higher degree of polymer cross-links and/or inorganic filler particles, which could be related to a worse adhesion between the denture resin base and the teeth.

Some of the indentations at 100 μm presented a tendency of lower hardness than the ones further away from the occlusal surface. This tendency, which did not become significant for any of the brands, could be a result of a small superficial alteration caused by the contact of the acrylic resin monomer used for embedding the teeth for hardness testing. Another plausible reason could be the proximity of the specimen margin, which is known to decrease hardness values because of low mechanical resistance of the thin layer between the indenter and the margin of the specimen. In any case, as the hardness variation was not statistically significant, it could be due to random variables and it should not have a major impact on the quality of the superficial layer.

The manufacturer informs that the Or tooth presents ISOSIT in its composition. It is difficult to know the current and exact composition of this restorative material, which is described[24] as made of "organic filler and liquid matrix based on a modified Bowen resin," and has physical properties similar to the composites. Hardness values obtained in this study for the layers until 3.1 mm are comparable with the ones found in other studies that investigated hardness in composite resins.[25,26] On the other hand, hardness in the layer distanced 4.1 mm from the surface was not significantly different from the hardness of the other brands, which might indicate that this area presents different composition from the other layers in the same tooth. Therefore, we can assume that the portion available for adhesion to the denture base is made of acrylic resin, which would promote a better adhesion. In a study[5], the tooth SR Orthosit PE (coded as Or in this study) presented significant difference between the Vickers hardness values for the enamel and intermediate layers, and for the base layer. These results agree with the ones in this study.

The cross-link polymers are used to improve the properties of materials based on acrylic resin. The different types of monomers and proportions of cross-link agents might also influence the artificial teeth hardness.[3,27] Among the nine brands evaluated in this research, only one manufacturer did not inform the presence of cross-link in the polymer (Na). Besides specific polymers to form cross-links, some manufacturers use other methods or components to enhance the performance of their teeth. The brand Ar uses IPN technology, which is defined as a combination of two or more polymers in network form that are synthetized in juxtaposition.[28] They do not interpenetrate through the chemical reactions in a molecular scale, but are made of finely divided phases of 5-10 nm.[9] However, according to the manufacturer, Pr teeth are made with INCOMP technology, which includes MPM (multi polymeric matrix), which presents high cross-links.

Because of the hardness distribution found in this study (admitting that hardness is expressing the level of polymer crosslinking), even for the Or teeth, the smallest occlusal adjustment grinding might be safely executed, i.e, without damaging the clinical performance, because there will remain a thick layer of the harder material. However, if it is necessary to substantially reduce tooth height due to the lack of interocclusal space, grinding the cervical area of teeth from the Or brand would be contraindicated, because that could affect the adhesion of the tooth to the acrylic resin base. In this study, microhardness measurements were made until 4700 μm of molars, which indicates that there would be approximately 0.5 mm of acrylic resin, a fact that, we assume, is maintained for the other teeth groups. For the studied brands, however, it would not be predictable to find issues of adherence to the denture base when a thicker grinding of the cervical area is needed because, as they do not present different hardness among the layers, it is not expected from the adhesive resistance to be different among them.

According to the available information (Table 1), the analyzed teeth, mainly manufactured with acrylic resin (Or teeth were not considered in this case, for it is mostly made of Isosit, which is a composite), present different chemical compositions, what could influence hardness values. However, in another study,[5] a significant difference between the external layer solubility (correspondent to enamel) and the base layer was observed, which would show

the differences of cross-link between them. The same authors also found a positive linear correlation between hardness and the inorganic content. Nevertheless, when Vickers hardness levels of conventional acrylic resin and high cross-linked resins were compared, the difference was not statistically significant. This would be a sign indicating that the hardness test would differentiate materials with and without fillers, but would not distinguish well cross-linked and non cross-linked resins. It seems interesting to intensify the studies on the correlation between adhesion resistance to the base resin, the solubility of the hardened resin in the monomer and hardness, since the hardness test is easy to apply, however its result might not be useful to clarify certain desirable behaviors of artificial teeth.

In another study,[6] the correlation between wear resistance, hardness and elastic modulus in the layer that corresponds to the dentin was analyzed. Tests were performed in seven artificial teeth brands, among them SR Orthosit PE. Wear resistance was tested in a pin/disc design using nanoindentation. A positive significant correlation between hardness and elastic modulus was observed. Yet no correlation between wear (weight and volume loss) and mechanical properties (hardness and elastic modulus) was found. ACE Teeth and SR Orthosit PE teeth presented the higher hardness and elastic modulus values compared with the other teeth analyzed.

CONCLUSION

Only SR Orthosit PE commercial brand presented significantly higher hardness from the superficial layer to the depth of 3.1 mm, than in the cervical area. However, no other brands analyzed showed significant hardness differences among depths or among brands.

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Association between disc displacement without reduction and temporomandibular joint derangement observed on magnetic resonance imaging

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ABSTRACT | This study aimed to assess possible associations between the following factors: articular disc anatomy and position; articular eminence and condyle morphology; presence of joint effusion; condyle mobility; and lateral pterygoid muscle insertion pattern. Magnetic resonance images of 33 joints of symptomatic patients were assessed. The articular disc was classified as normal, elongated, or folded; displacement was classified as normal, lateral, or medial; the condyle was classified as rounded, convex, flattened, or angulated; the articular eminence was classified as box, sigmoid, flattened, or deformed; condyle mobility was classified as normal, hypomobile, or hypermobile; and the lateral pterygoid muscle insertion pattern was classified as Type I, Type II, or Type III. The most frequent forms of articular disc, articular eminence, and condyle were folded, flattened, and flattened, respectively. There can be a relationship connecting TMJ mobility with a normal disc form (100%); TMJ hypomobility with a folded disc form (48%); and TMJ hypermobility with an elongated disc form (100%). Magnetic resonance imaging allowed the clear observation of articular structures, and no association was found between insertion pattern and sideways disc position, disc form, and condyle form. All cases with joint effusion were related to hypomobility (100%).

DESCRIPTORS | Pterygoid Muscles; Temporomandibular Joint; Temporomandibular Joint Disc; Mandibular Condyle; Magnetic Resonance Imaging.

RESUMO | **Associação entre o deslocamento de disco sem redução com desarranjos internos da articulação temporomandibular observados na imagem por ressonância magnética** • O objetivo deste estudo foi avaliar possíveis associações entre os seguintes fatores: anatomia e posição do disco articular; morfologia da eminência articular e da cabeça da mandíbula; presença de derrame articular; mobilidade da cabeça da mandíbula; e inserção do músculo pterigoideo lateral. Foram avaliadas imagens de ressonância magnética de 33 articulações de pacientes sintomáticos. O disco articular foi classificado como normal, alongado ou dobrado; o deslocamento foi classificado como normal, lateral ou medial; a cabeça da mandíbula foi classificado como arredondado, convexo, achatado ou angulado; a eminência articular foi classificada como caixa, sigmoide, achatada ou deformada; a mobilidade da cabeça da mandíbula foi classificada como normal, hipomobilidade ou hipermobilidade; e o padrão de inserção do músculo pterigoideo lateral foi classificado como Tipo I, Tipo II ou Tipo III. As formas mais frequentes do disco articular, eminência articular e cabeça da mandíbula foram dobrado, achatada e achatado, respectivamente. Pode existir uma relação da mobilidade da ATM que tende a apresentar uma forma de disco normal (100%), hipomobilidade da ATM com forma do disco dobrado (48%); e hipermobilidade da ATM com forma de disco alongado (100%). A ressonância magnética permitiu a observação clara das estruturas articulares e não foi encontrada associação entre o padrão de inserção e a posição lateral do disco, a forma do disco e a forma da cabeça da mandíbula. Todos os casos em que o derrame articular estava presente estavam relacionados à hipomobilidade (100%).

DESCRITORES | Músculos Pterigoides; Articulação Temporomandibular; Disco da Articulação Temporomandibular; Cabeça da Mandíbula; Imagem por Ressonância Magnética.

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INTRODUCTION

The temporomandibular joint (TMJ) is located on both sides of the head, where the mandibular fossa of the temporal bone and the mandibular condyle articulate.[1] Although the lateral pterygoid muscle (LPM) has been extensively studied in recent years, its anatomic and physiological functions are not entirely understood. One possible reason is because most studies on this muscle have been done on cadavers.[2] LPM is a muscle with two separate heads: the superior head originates from the infratemporal surface of the greater wing of the sphenoid bone and from the infratemporal crest, while the inferior head stems from the lateral surface of the lateral pterygoid plate. The former attaches to the anteromedial surface of the TMJ disc and to the condylar neck, and the latter enters the pterygoid fossa lateroposteriorly on the anteromedial condylar surface.[3]

TMJ derangement is related to any disturbance that affects joint function, and is frequently associated to the articular disc, bone structures, and joint effusion.[4] The advantages of magnetic resonance imaging (MRI) regarding TMJ evaluation are well established: it is a radiation-free technique that can effectively show TMJ changes in bones and soft tissue structures.[5] Studies are unanimous on the utility of MRI to analyze changes in the articular disc, articular eminence, and joint effusion.[4,6]

This study aimed to use MRI to investigate any possible associations between disc displacement without reduction, TMJ derangement, condyle mobility, and LPM superior head insertion pattern.

MATERIAL AND METHODS

Patients

Twenty-four symptomatic patients (19 females and 5 males; from 13 to 67 years old – mean = 36.42 years) were enrolled after clinical evaluation by physicians and dentists. All participants reporting at least one sign or symptom of temporomandibular disorder were included in this study, including pain, limited mouth opening, TMJ clicking, and crepitation. The images of patients who underwent surgical procedures or had inflammatory joint diseases, facial growth disturbances, facial bone trauma or fracture, hypoplasia, hyperplasia, or tumors in the mandible head region were excluded from the study. All individuals were well-informed regarding the objectives and procedures of the study, and officially consented to participate. Data on gender, age, anatomy, articular disc location, condyle anatomy, and articular eminence morphology were collected initially in a descriptive manner.

Image acquisition

MRI was carried out with a 1.5-Tesla apparatus (Signa 1.5 T; GE Healthcare, Little Chalfont, UK) using the same surface coil (20-cm diameter, double surface coil). The images were digitally processed in an independent workstation (EasyVision, Philips Medical Systems, Best, Netherlands); recorded in Digital Imaging and Communications in Medicine (DICOM) format; imported to an iMac computer (Mac OsX 10.6, Apple, Inc., Cupertino, USA) with Intel Core i5 2.5GHz Processor, 4GB memory – 500GB, 21.5inch screen, and 1920×1080 pixel resolution; and analyzed in the Osirix MD software (Apple Inc., version 3.9.4, 32 Bits – Pixmeo, Geneva, Switzerland).

Sagittal and coronal T1, T2, and proton density images of the TMJs were obtained with open mouth (openings of 10, 20, and 30 mm), using a intraoral plastic device with a millimetric scale (GE Medical Systems®), and with closed mouth (maximum intercuspation), for a total of 33 TMJs (considering just joints diagnosed with disc displacement without reduction: posterior band positioned anterior to the condyle either at closed or maximum opening mouth positions).

Image evaluation

All diagnoses were performed independently by two oral and maxillofacial radiologists, experienced in the interpretation of TMJ on MRI. In case of any disagreement in the diagnosis, the final diagnosis was made by consensus. The data from their reports were used in this study.

Disc displacement without reduction

All images evaluated were from patients diagnosed with disc displacement without reduction. Disc positions were analyzed in the coronal view, according to three situations: normal (the posterior band of the disc is centered in relation to the condyle and to the floor of the mandibular fossa); lateral displacement (the articular disc is displaced laterally in relation to the condyle); and medial displacement (the articular disc is displaced medially in relation to the condyle).

Lateral pterygoid muscle

The medial sections in both open and closed mouth positions were evaluated to determine the LPM insertion pattern. Insertion patterns were categorized into three groups: Type I – the superior head consists of two bundles, one attaching to the disc and the other to the condyle, while the inferior head reaches the condyle (Fig. 1); Type II – the superior head has one bundle reaching both disc and condyle, while the inferior head involves only the condyle (Fig. 2); Type III – the superior head has a single bundle attaching to the disc, while the inferior head inserts onto the condyle (Fig. 3).[2] Ratings of the upper head of the LPM were performed with open-mouth parasagittal scans to better view the outstretched capsular structures and avoid interposition of the articular tubercle of the temporal bone.

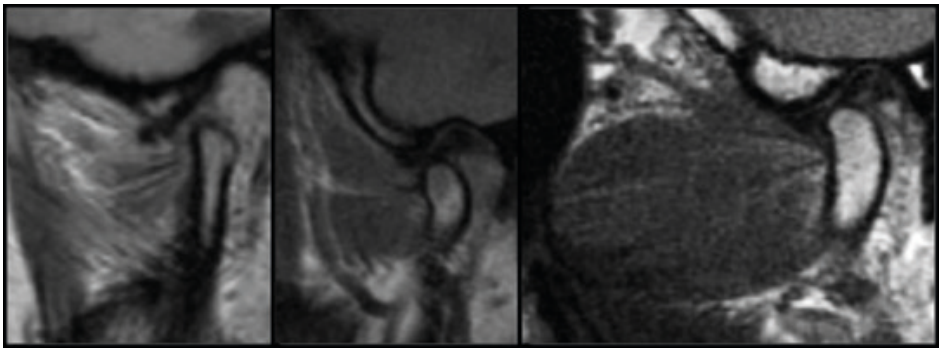

Figure 1 | MRI showing Type I: the superior head consists of two bundles, one attaching to the disc and the other to the condyle, while the inferior head reaches the condyle.

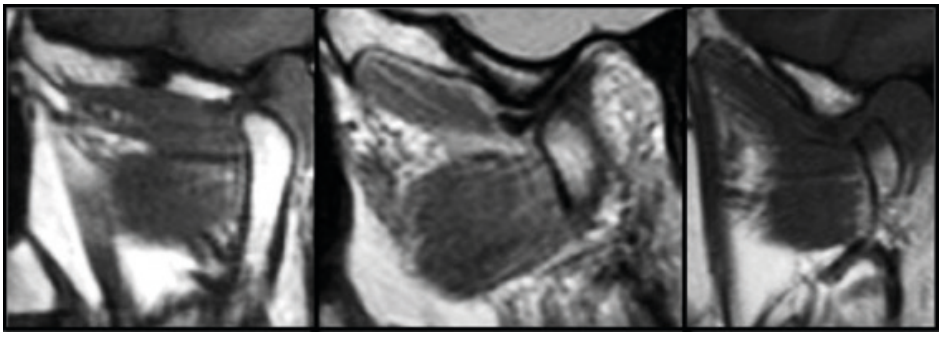

Figure 2 | MRI showing Type II: the superior head has one bundle reaching both disc and condyle, while the inferior head involves only the condyle.

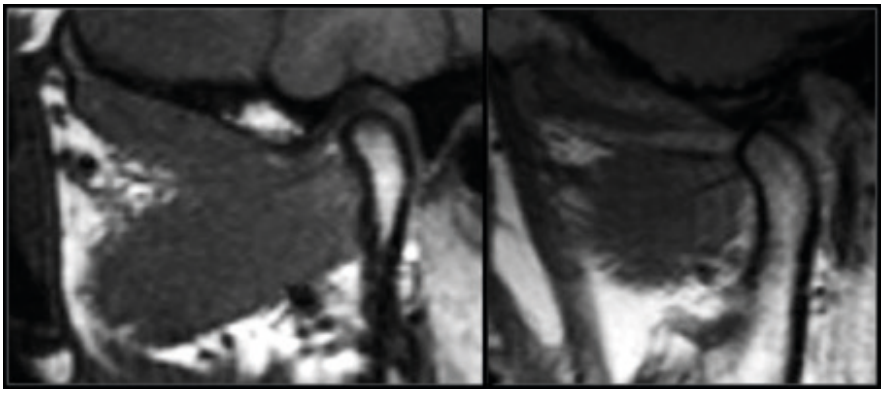

Figure 3 | MRI showing Type III: the superior head has a single bundle attaching to the disc, while the inferior head inserts onto the condyle.

Morphologies

Sagittal plane images were used to assess the anatomy of the articular eminence and the anatomy and position of the disc. The disc was classified as normal (biconcave), elongated, or folded; the articular eminence was classified as box, sigmoid, flattened, or deformed, according to Hirata et al.[7] The condyle was assessed on coronal images. Condyle morphology was classified as convex, rounded, flattened, or angulated, according to Yale et al.[8]

Joint effusion

The presence or absence of joint effusion was evaluated by observing high signal intensity in the articular spaces on T2weighted images. The assessment was quantitative, because only the presence or absence of effusion was considered in the analysis.

Data analysis

Inferential analysis was conducted to confirm or refute the evidence found in the descriptive analysis. Chi-square test and Yates correction were used in the statistical analysis of the data, and the significance level adopted was 5%. The following software were used: SPSS V17, Minitab 16, and Excel Office 2010. This study was approved by the institutional ethics committee (protocol 13/11, CAAE 0015.0.017.000-11).

RESULTS

Table 1 shows the frequency distribution of each item studied: presence of joint effusion; form and position of the articular disc (sagittal and coronal); form of condyle and articular eminence; mobility and insertion patterns of the lateral pterygoid muscle.

Table 2 shows the relation of TMJ mobility with condyle, articular eminence, and disc forms. Of the 29 joints with hypomobility, 11 had a flattened condyle form, 11 had a flattened articular eminence form, and 14 discs were folded. The statistical findings showed that TMJ mobility and insertion pattern were not associated with the qualitative variables, i.e., they were statistically independent variables. We highlight that the relations between TMJ mobility and disc form yielded a statistically significant result on the Chi-square test. However, since there were less than five cases with significant association, we applied Yates correction, which rendered a non-significant result.

Similarly, no association was found between insertion pattern and sideways disc position, disc form, and condyle form (Table 3). Even the results were not significant. There can be a relationship connecting

TMJ mobility with a normal disc form (100%); TMJ hypomobility with a folded disc form (48%); and TMJ hypermobility with an elongated disc form (100%).

Table 4 presents comparisons between joint effusion; disc form; condyle form; articular eminence form; TMJ mobility; and pterygoid muscle insertion pattern. All cases with joint effusion were related to hypomobility (100%).

Table 5 describes the main results obtained in this research.

Table 1 | Disc displacement without reduction related to the frequency distribution of disc form and position, condyle and articular eminence form, presence of effusion, mobility, and insertion pattern.

	Frequency distribution (n=33)	%
Effusion		
Yes	11	33.3%
No	22	66.7%
Disc form		
Normal	8	24.3%
Elongated	12	36.3%
Folded	13	39.4%
Sideways disc position		
Normal	23	69.7%
Medial	7	21.2%
Lateral	3	9.1%
Condyle form		
Flattened	13	39.4%
Convex	6	18.2%
Rounded	8	24.3%
Angulated	6	18.2%
Articular eminence form		
Box	7	21.2%
Flattened	14	42.4%
Sigmoid	8	24.2%
Deformed	4	12.2%
Mobility		
Normal	1	3.0%
Hypo	29	87.9%
Hyper	3	9.1%
Insertion pattern		
Type I	6	18.2%
Type II	14	42.4%
Type III	13	39.4%

Table 2 | Relation of TMJ mobility with condyle, articular eminence, and disc forms.

TMJ Mobility		Normal		Hypo		Hyper		Total		P-value
		N	%	N	%	N	%	N	%	
Condyle form	Flattened	0	0%	11	38%	1	33%	12	36%	0.693
	Convex	0	0%	5	17%	1	33%	6	18%	
	Rounded	1	100%	7	24%	1	33%	9	27%	
	Angulated	0	0%	6	21%	0	0%	6	18%	
Articular eminence form	Box	0	0%	7	24%	0	0%	7	21%	0.784
	Flattened	1	100%	11	38%	2	67%	14	42%	
	Sigmoid	0	0%	7	24%	1	33%	8	24%	
	Deformed	0	0%	4	14%	0	0%	4	12%	
Disc form	Normal	1	100%	4	14%	0	0%	5	15%	0.617 (Y)*
	Elongated	0	0%	11	38%	3	100%	14	42%	
	Folded	0	0%	14	48%	0	0%	14	42%	
Total		1	3%	29	88%	3	9%	33	100%	

* Yates correction.

Table 3 | Association of insertion pattern with sideways disc position, disc form, and condyle form.

Insertion pattern		Type I		Type II		Type III		Total		P-value
		N	%	N	%	N	%	N	%	
Sideways disc position	Normal	3	50%	13	93%	7	54%	23	70%	0.173
	Medial	2	33%	1	7%	4	31%	7	21%	
	Lateral	1	17%	0	0%	2	15%	3	9%	
Disc form	Normal	2	33%	1	7%	1	8%	4	12%	0.083
	Elongated	2	33%	9	64%	3	23%	14	42%	
	Folded	2	33%	4	29%	9	69%	15	45%	
Condyle form	Flattened	2	33%	5	36%	5	38%	12	36%	0.631
	Convex	1	17%	3	21%	2	15%	6	18%	
	Rounded	3	50%	4	29%	2	15%	9	27%	
	Angulated	0	0%	2	14%	4	31%	6	18%	
Total		6	18%	14	42%	13	39%	33	100%	

Table 4 | Comparisons between joint effusion; disc form; condyle form; articular eminence form; TMJ mobility; and pterygoid muscle insertion pattern.

Joint effusion	n	%
Disc form		
Normal	3	27.3%
Elongated	4	36.3%
Folded	4	36.3%
Condyle form		
Convex	1	9.1%
Flattened	4	36.3%
Angulated	2	18.2%
Rounded	4	36.3%
Articular eminence form		
Box	4	36.3%
Deformed	2	18.2%
Sigmoid	1	9.1%
Flattened	4	36.3%
TMJ Mobility		
Normal	0	0
Hypo	11	100%
Hyper	0	0%
Insertion pattern		
Type I	3	27.3%
Type II	3	27.3%
Type III	5	45.4%

Table 5 | Main results obtained in this research.

Variable	Category	N	%
Joint effusion	No	22	66.7%
Disc form	Folded	13	39.4%
Sideways disc position	Normal	23	69.7%
Condyle form	Flattened	13	39.4%
Articular eminence form	Flattened	14	42.4%
TMJ mobility	Hypo	29	87.9%
Insertion pattern	Type II	14	42.4%

DISCUSSION

Several studies have described joint disc displacement in relation to different factors[9,10]. However, it is difficult to pinpoint any definite relationship. This approach does not consider any other hypothesis, such as biochemical changes, and they are not the purpose of this study. Thus, based on the status of the joint, as categorized by some authors,[11] we tried to relate only the cases of disc displacement without reduction and with insertion of the lateral pterygoid muscle.

It is usually not enough to diagnose some conditions based only on the TMJ clinical examination. When analyzing joint disc changes, joint eminence, and joint effusion, a particular overestimation could occur, correlating with clinical symptoms. This study recognizes the presence of clinical symptomatology, although it reports changes in MRI. The most significant advantage of TMJ assessment by MRI is the ability to evaluate the integrity of the anatomic structures and the amount of synovial fluid, as well as the relation between soft and bone tissues. Therefore, MRI is considered the gold standard.[9,10] The sagittal images used in this study were very helpful in diagnosing both TMJ internal derangements and LPM morphology.

Internal derangement can be described as an abnormal relation between the variables of articular disc, condyle, and articular eminence, and may lead to visible degenerative changes in the soft and bone tissues observed in imaging examinations.[9,12] These alterations include articular disc displacement and morphologic changes in the articular disc, articular eminence, and condyle.[4-6] The type of LPM attachment may determine the tendency for TMJ disorders.[13] Medial displacement has been found to result more frequently in a TMJ disorder than in lateral displacement caused by the attachment of the LPM to the medial portion of the disc at the pterygoid fossa.[14,15] Moreover, no correlation has been found between the LPM attachment type and the presence or absence of disc displacement, disc degeneration, or articular surface degeneration.[16,17] Similarly, our study has also failed to establish any correlation.

Disc displacement without reduction is more commonly associated with joint effusion than earlier stage disc displacement with reduction.[11] These results could point to the chronic degenerative process that is associated with disc displacement without reduction being responsible for changes within the TMJ space, ultimately resulting in fluid accumulation.[6] In our study, we evaluated only cases of disc displacement without reduction, and observed that only 33.3% presented joint effusion.

In conclusion, this study did not find a statistically significant correlation between the three types of muscle attachment to disc displacement without reduction. Technological advance is evidently heading toward the improvement of imaging techniques that can enable better understanding of the TMJ. Thus, our findings have raised considerations that suggest what should be focused on further studies.

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Clinical and Laboratorial Research in Dentistry | Prostodontia

Efeito da prática de instrumentos musicais nas disfunções temporomandibulares e distúrbios do sono

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RESUMO | *Objetivo*: Considerando os inúmeros benefícios a saúde física e mental proporcionados pelas atividades artísticas, o objetivo deste estudo é avaliar a relação entre a prática recreativa de instrumentos musicais e as disfunções temporomandibulares (DTM) e os distúrbios do sono (DS) em uma amostra de músicos integrantes de orquestras do interior de São Paulo que praticam instrumentos musicais como forma de lazer. *Método*: Trata-se de um estudo transversal constituído por dois grupos. O grupo controle, com indivíduos da comunidade em geral, apresentou idade média de 28,35 anos (±4,867), enquanto o grupo de músicos instrumentistas, 28,37 anos (±6,712). Ambos os grupos foram constituídos por 43 voluntários, sendo 14 mulheres e 29 homens. Os participantes responderam ao questionário anamnésico de Fonseca e ao questionário de Fletcher e Luckett para avaliar sintomas de DTM e distúrbios do sono, respectivamente. *Resultados*: Foi encontrada uma forte associação entre a presença de DTM e o tempo de prática musical, de modo que os participantes com pouca prática possuem 8,57 (p=0,002) vezes mais chances de apresentarem DTM do que os participantes com muita prática. Os grupos não diferiram quanto aos sintomas de DTM e DS e quanto a variáveis demográficas. *Conclusão*: A prática recreativa de instrumentos musicais em longo prazo pode diminuir as chances de desenvolvimento de disfunção temporomandibular. Este estudo reforça que tocar um instrumento musical por lazer traz benefícios para a saúde física, especificamente como fator de proteção ao desenvolvimento de disfunção temporomandibular.

DESCRITORES | Síndrome da Disfunção da Articulação Temporomandibular; Transtornos da Articulação Temporomandibular; Distúrbios do Sono; Sono; Música.

ABSTRACT | **Effect of music instruments practice in temporomandibular joint dysfunction and sleep disorders** • *Objective:* The aim of this study was to evaluate the relation among recreational practice of musical instruments, temporomandibular disorders (TMDs), and sleep disturbances in a sample of musicians that are members of orchestras in a southeast area of Brazil. The participants practice playing instruments as a leisure activity. *Method*: this was a cross-sectional study with two groups. The comparison group included members from the general population. Both group included 43 adults, being 14 women and 29 men. The mean age of comparison group is 28.35 (±4.867), and the mean age of musician group is 28.37 (±6.712). The participants completed self-rated questionnaires to assess TMDs symptoms and sleep disturbance. *Results:* the groups did not differ regarding the presence of TMDs symptoms, sleep disturbance, and demographic variables. A strong and negative correlation was observed between TMDs and time of playing a musical instrument. The participants with less practice in years in playing a musical instrument have 8.57 more chance of having TMDs than the musicians with a long history of playing an instrument. *Conclusion:* it seems that a long history of practicing a musical instrument as a leisure activity is associated with a lower chance of developing TMDs. This study reinforces the benefits of playing a musical instrument as a leisure activity to physical health, specifically, as a protective factor to developing TMDs.

DESCRIPTORS | Temporomandibular Joint Dysfunction Syndrome; Temporomandibular Joint Disorders; Sleep Disorders; Sleep; Music.

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INTRODUÇÃO

As disfunções temporomandibulares (DTMs) são distúrbios funcionais e estruturais do sistema estomatognático que envolvem os músculos da mastigação e as articulações temporomandibulares (ATMs).[1] Seus sinais e sintomas podem ser facilmente confundidos com outras desordens ou doenças. No entanto, geralmente acarretam dor na região pré-auricular, limitação ou assimetria de movimentos mandibulares e sons articulares. Além de poderem gerar sintomas secundários auditivos, dores referidas ou cefaleias.[2]

Da população em geral, 40-75% das pessoas têm algum sinal de DTM e 33% possuem ao menos um sintoma.[3] Além disso, DTMs são a segunda causa mais comum de dor orofacial, precedida apenas pela dor de origem dentária.[4]

Além dos sinais e sintomas característicos, a DTM pode estar relacionada a alterações na qualidade do sono.[5] Os distúrbios do sono (DS) provocam estado de vigília durante a noite, resultando em sensação de sono agitado, sonolência diurna, estresse psicológico e fadiga crônica, além de comprometerem o humor, a atenção, a memória, provocar irritação e acentuar problemas familiares e sociais.[6] No entanto, apesar de serem tão comuns quanto asma e diabetes, são pouco diagnosticados e tratados adequadamente.[7,8]

A etiologia dos DS é multifatorial e varia desde questões emocionais (depressão, ansiedade), sociais (desemprego, violência), físicas (dor crônica) e ambientais (ruídos internos e externos ao quarto de dormir).[9] Quando prolongados, os distúrbios do sono podem influenciar profundamente a qualidade de vida e a saúde e aumentar o risco de mortalidade.[10,11]

JUSTIFICATIVA

Buscando alternativas de tratamento para alterações tão complexas que acabam por interferir na qualidade de vida dos pacientes, formulou-se a hipótese da influência da prática recreativa de instrumentos musicais nos sinais e sintomas de DTM e distúrbios do sono, proporcionando melhora na saúde física e mental.

OBJETIVOS

O objetivo primário deste estudo foi avaliar a influência da prática recreativa de um instrumento musical nos sinais e sintomas de DTMs e DS por meio do questionário Anamnésico, de Fonseca et al.,[12] e do questionário de Fletcher e Luckett.[13]

Os objetivos secundários foram:

a. Avaliar a prevalência de DTM e DS em músicos instrumentistas e na população em geral
b. Avaliar se há associação entre DS e DTM.
c. Avaliar a influência do tempo de prática musical nos sinais e sintomas de DTM e DS.

MATERIAIS E MÉTODOS

Local e população da pesquisa

Este foi um estudo transversal que avaliou a prevalência de desordens temporomandibulares e distúrbios do sono em uma amostra de adultos do interior de São Paulo. A pesquisa incluiu 86 participantes igualmente divididos em dois grupos: um grupo de Músicos Instrumentistas (MI) composto por 43 membros da Orquestra Jazz Sinfônica, situada no município de São João da Boa Vista (SP) e da Orquestra Filarmônica de Santa Rosa de Viterbo (SP); e um grupo de comparação constituído por 43 indivíduos da população de São João da Boa Vista (SP) que não praticam instrumentos musicais. Esses participantes foram pareados por idade, sexo e nível educacional com o grupo de músicos instrumentistas.

Seguindo os critérios de inclusão preestabelecidos, participaram do estudo pessoas na faixa etária de 18 a 40 anos. No caso dos músicos, exigiu-se um mínimo de três anos de experiência.

Não puderam participar do estudo sujeitos que apresentaram alguma deficiência grave de coluna ou postural, deficiência mental ou alguma outra anormalidade.

Instrumento de coleta de dados

O instrumento de coleta de dados foi composto pelos seguintes questionários (Anexo 1):

a. Questionário de história de hábitos e comportamento, que contempla as variáveis sexo, idade,

profissão, problemas médicos. No grupo MI, também foram abordadas as variáveis tipo de instrumento, horas semanais dedicadas à atividade, há quanto tempo estuda música, além de problemas de saúde relacionados à prática.

b. Questionário adaptado de Fletcher e Luckett,[13] que compreende 38 questões relacionadas ao sono e queixas associadas. Cada uma das 38 questões é pontuada de 0 a 3 (nunca=0, muito raramente=1, ocasionalmente=2, frequentemente=3); o escore global varia de 0 a 114, sendo dividido por 38. Pontuações>1 sinalizam a presença de sintomas significativos de distúrbios do sono.

c. Questionário anamnésico de Fonseca et al.,[12] que consiste em dez questões sobre dores na ATM, pescoço ou ouvidos, ruídos ou dificuldade em movimentar a mandíbula e hábitos parafuncionais. Para cada uma das questões do questionário de Fonseca são possíveis três respostas (sim, não e às vezes) para as quais são preestabelecidas três pontuações (10, 0 e 5, respectivamente). Com a somatória dos pontos atribuídos obtém-se um índice anamnésico que permite classificar os voluntários em categorias de acordo com a severidade dos sintomas: sem DTM (0 a 15 pontos), DTM leve (20 a 45 pontos), DTM moderada (50 a 65) e DTM severa (70 a 100 pontos).

Aspectos legais e éticos da pesquisa

O projeto de pesquisa foi apresentado ao Comitê de Ética em Pesquisa da Faculdade de Odontologia de Ribeirão Preto (FORP) e aprovado sob o protocolo de número 50415315.8.0000.5419. Os indivíduos que aceitaram participar da pesquisa assinaram o Termo de Consentimento Livre e Esclarecido e foram informados sobre os objetivos do estudo, a liberdade em participar ou não, além da garantia de sigilo total das informações coletadas.

Análise estatística

Foi verificada a normalidade dos dados por meio do teste de Shapiro-Wilk. Para os dados com distribuição normal, foi aplicado o teste T, e para os dados sem distribuição normal, foi realizado o teste U de Mann-Whitney. Também foi realizada uma análise pelo teste Qui Quadrado a fim de verificar a associação entre variáveis qualitativas.

RESULTADOS

Não houve diferença entre os grupos avaliados quanto às variáveis gênero [X^2 (1)=0,000, p>0,05] e idade [t(76,58)=0,018, p>0,05], sendo a idade média do grupo instrumentista de 28,37 anos (DP=6,712) e a do grupo controle de 28,35 anos (DP=4,864). Com relação ao tipo de instrumento tocado, 51,16% dos músicos relataram praticar instrumentos de corda, 30,23% instrumentos de sopro, 6,98% instrumentos de percussão e 9,30% praticam instrumentos de sopro e de corda.

Os instrumentistas possuem um tempo médio de prática de instrumento musical de 14,07 anos (DP=7,25), sendo que a amostra varia entre 5 e 33 anos de prática, com mediana de 13 anos. Posteriormente, os instrumentistas foram divididos em dois subgrupos, conforme o tempo médio de prática musical: o grupo com pouca prática, formado por aqueles indivíduos que apresentaram um tempo de prática musical menor que a média do grupo; e o grupo com muita prática musical, formado por aqueles indivíduos que apresentaram um tempo de prática de instrumento maior que a média do grupo. Em relação à quantidade de horas semanais despendidas à prática do instrumento, os participantes variam de 2 a 40 horas semanais, com tempo médio semanal de 16,58 horas (DP=10,67).

Para avaliar se essas duas variáveis (tempo de prática do instrumento musical e quantidade de horas semanais despendidas à prática do instrumento) possuem distribuição normal, foi realizado o teste de normalidade, que observou normalidade dos dados. Assim, a divisão dos instrumentistas em dois grupos conforme o tempo de prática do instrumento musical, utilizando, para isso, a média como ponto de corte, foi mantida nas análises sequentes.

Em relação ao questionário anamnésico de Fonseca, que considera como indicativo de DTM valores iguais ou superiores a 20 pontos, o escore

médio do grupo instrumentista é de 19,77 (DP=2,12) e do grupo controle é de 20,09 (DP=2,93). Não foi encontrada diferença estatisticamente significante entre os grupos (U=831,000, p>0,05).

Já no que se refere ao questionário de Fletcher e Luckett,[13] que permite avaliar distúrbios do sono por meio dos escores dos respondentes, também não foi encontrada diferença estatisticamente significante (U=837,000, p>0,05). O grupo instrumentista possui escore médio de 0,63 (DP=0,36) e o grupo controle possui escore médio de 0,58 (DP=0,30). É válido salientar que escores iguais ou superiores a um são indicativos de presença de distúrbios do sono.

Dentre as cinco categorias distintas em relação ao sono – qualidade do sono (U=917,000, p>0,05), sonolência diurna (U=784,00, p>0,05), ronco (U=823,000, p>0,05) apneia (U=876,500, p>0,05) e queixas associadas [t(84)=0,989, p>0,05] – nenhuma delas apresentou diferença estatisticamente significante entre os grupos. A Tabela 1 apresenta o escore médio e desvio padrão em cada um dos domínios, juntamente com o escore geral de distúrbio do sono e da ATM.

TABELA 1 | Escores médios dos participantes instrumentistas e controles em diferentes questionários e em relação ao número médio de horas de sono e tempo médio em minutos para iniciar o sono e a estatística de comparação entre os grupos conforme os diferentes sintomas

	Instrumentistas	Controle	Estatística
Distúrbios da ATM	19,77 (±2,12)	20,09 (±2,93)	U=831,000 (p>0,05)
Distúrbios do sono	0,63 (±0,36)	0,58 (±0,30)	U=837,000 (p>0,05)
Sono	8,53 (±5,83)	7,84 (±3,88)	U=917,000 (p>0,05)
Sonolência diurna	4,12 (±3,49)	3,16(±2,91)	U=784,000 (p>0,05)
Ronco	4,67 (±3,95)	4,07 (±3,85)	U=823,000 (p>0,05)
Apnéia	0,53 (±1,16)	0,35 (±0,72)	U=876,500 (p>0,05)
Queixas associadas	7,77 (±5,39)	6,67 (±4,83)	t=0,98

Também não foi observada correlação entre os escores no questionário de distúrbio do sono e no de distúrbio da ATM (rS=-0,159, p>0,05).

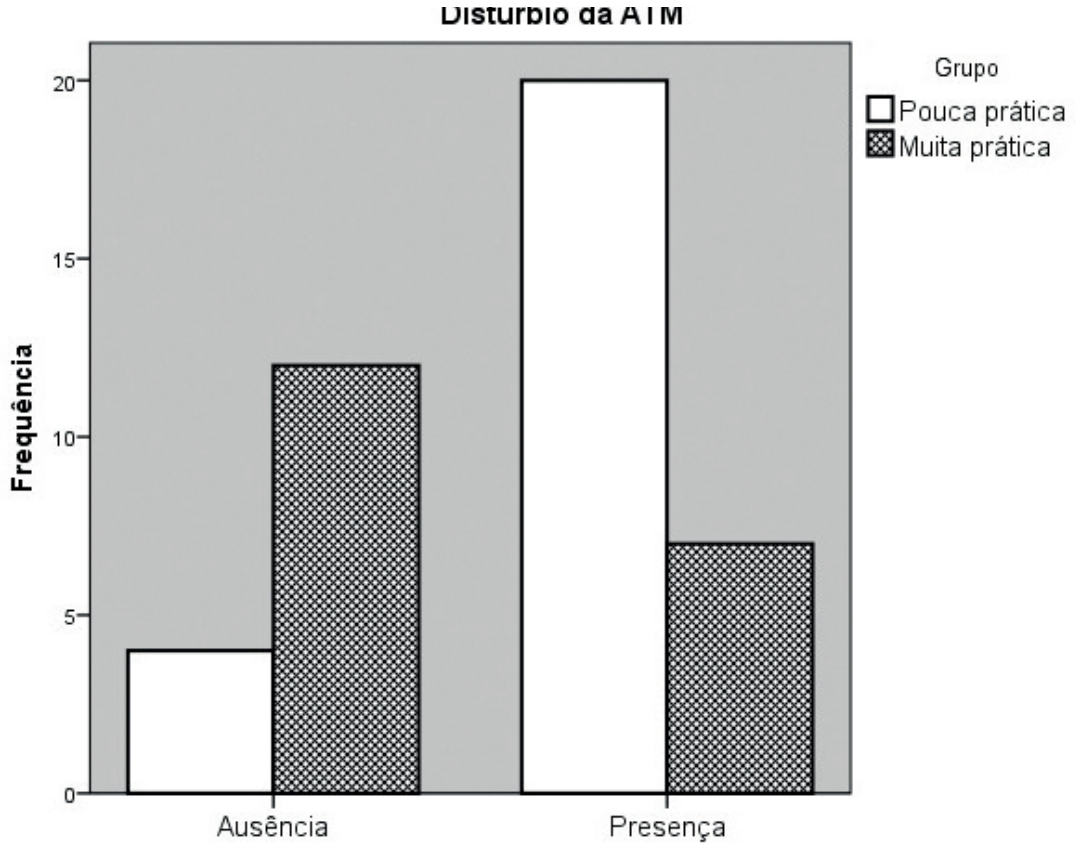
Entre os músicos instrumentistas, observou-se que 62,8% (27 participantes) apresentam distúrbio da ATM. Entre estes, 74,1% (20 participantes) possuem pouca prática musical e 25,9% (7 participantes) muita prática musical. De acordo com o teste de qui-quadrado, há uma associação significativa entre apresentar distúrbio da ATM e o tempo de prática musical, sendo observado que os participantes que possuem pouca prática musical apresentam significativamente maior incidência de distúrbio da ATM do que os participantes com muita prática musical [$X^2(1)=9,811$, (p=0,002)]. Baseado no risco relativo, os participantes com pouca prática têm 8,57 mais chances de apresentarem distúrbio da ATM do que os participantes com muita prática. A distribuição de frequências entre estes grupos pode ser observada no Gráfico 1.

DISCUSSÃO

Este estudo avaliou a influência da prática musical como atividade recreativa nos sinais e sintomas característicos de DTM e DS. A amostra foi composta por músicos instrumentistas de orquestras do interior de São Paulo e indivíduos da comunidade em geral que não praticam atividade musical.

Foi encontrada uma forte associação entre a presença de DTMs e o tempo de prática musical, sendo observado que os participantes com pouca prática têm 8,57 vezes mais chances de apresentarem DTM do que os participantes com muita prática (p=0,002). Em relação à quantidade de horas semanais dedicadas ao instrumento, os grupos não

GRÁFICO 1 | Distribuição de frequência entre os grupos pouca prática musical e alta prática musical em relação a presença ou ausência de distúrbio da ATM.



diferem estatisticamente entre si (p>0,05), portanto, a frequência semanal não influenciou tal associação. O resultado pode ser explicado pela capacidade da música de controlar o estresse e promover experiências de recompensa, prazer e inserção social.[14-16]

O aumento da tensão muscular decorrente da ansiedade e estresse pode promover o desenvolvimento de DTM,[17-19] visto que estudos comprovam que indivíduos com níveis elevados de ansiedade e depressão possuem maior risco de desenvolverem DTM em comparação a indivíduos com níveis inferiores desses sintomas.[17,20] Chisnoiu et al.,[21] também sugere que a ansiedade e o estresse fazem parte da etiologia da DTM e desempenham um papel significativo em manter os sintomas ou piorá-los.

Portanto, como a DTM possui diversas etiologias, entre elas os estressores psicossociais, atividades prazerosas, como a prática recreativa de um instrumento musical (por objetivarem, direta ou indiretamente, a redução dos níveis de ansiedade e estresse), podem ser úteis para diminuir os sinais e sintomas de DTM ou até mesmo impedir seu desenvolvimento.[1]

Embora a prática de um instrumento musical possa ser considerada uma atividade relaxante, há dúvidas quanto à eficácia dessa atividade na diminuição dos distúrbios temporomandibulares, uma vez que há indícios que instrumentistas profissionais estão expostos a riscos ocupacionais que os predispõem a problemas musculoarticulares e a dores, desvios posturais, problemas auditivos, entre outros.[22,23]

A elevada carga horária dedicada ao aperfeiçoamento técnico, posturas incorretas ao tocar, inadequações anatômicas dos instrumentos musicais, além de ensaios e apresentações em

horários tardios são algumas características do trabalho desses profissionais que podem contribuir para um aumento do risco de desenvolvimento de patologias como distúrbios da ATM e do sono, reduzindo a qualidade de vida e a capacidade laboral.[24]

A amostra foi composta majoritariamente por instrumentistas de corda e sopro. Entre os músicos, violinistas e violistas relatam sentir dores no pescoço mais frequentemente que indivíduos da população em geral, 40% e 14%, respectivamente.[25] Essa classe também é mais propensa a apresentar sinais e sintomas de DTM como dor nos músculos masseter e temporal e especificamente dor na região da ATM direita, devido à pressão sofrida pela mandíbula e músculos mastigatórios ao segurar o instrumento por longos períodos.[26] A DTM também apresenta alta prevalência em instrumentistas de sopro, pois a protrusão da mandíbula necessária para a embocadura do instrumento pode exigir forças excessivas da região da ATM, induzindo a sobrecarga das estruturas a ela relacionadas.[25]

A literatura relata, ainda, que há relação entre DS e DTM em membros de orquestras.[27] De modo que a baixa qualidade do sono afeta o indivíduo tanto física quanto psicologicamente, causando desde diminuição na capacidade de desempenhar as atividades do dia a dia até alteração na percepção de dor e desconforto.[28]

No entanto, possivelmente devido à amostra ser composta por músicos amadores, não foi encontrada diferença estatisticamente significante entre os grupos avaliados, fato que sugere que a prática de um instrumento musical não interfere negativamente ou promove o aumento dos sinais e sintomas de DS e DTM.

Em suma, a prática regular de um instrumento musical como atividade recreativa pode ter função terapêutica, pois além de promover a saúde mental mediante a melhora nos níveis de ansiedade e estresse, também promove a saúde física ao diminuir as chances de se desenvolver DTM.[29] Desse modo, estudos futuros devem explorar, quer por meio da utilização de ensaios clínicos randomizados ou estudos longitudinais, os efeitos da prática musical na DTM, manipulando as variáveis entre grupos diferentes.

CONCLUSÃO

De acordo com a metodologia aplicada, os resultados sugerem que a prática recreativa da atividade musical por um longo período pode diminuir as chances de desenvolvimento de disfunção temporomandibular. No entanto, estudos mais aprofundados podem trazer outras conclusões sobre a intensidade do benefício da pratica musical para a redução de sinais e sintomas de DTM.

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Color stability evaluation of micro-hybrid composite resins submitted to accelerated artificial aging

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ABSTRACT | *Objective*: The aesthetics of dental materials is extremely important for the success of oral rehabilitation. Thus, in the present study we evaluated the color stability and the surface degradation of three micro-hybrid composite resins after accelerated artificial aging process (AAA). *Methods*: 24 specimens (n=8) were prepared for each material: Solidex, Artglass and Cesead, dimensions of Ø 15 mm by 2 mm in thickness. Samples were subjected to color analysis, before and after AAA, in a spectrophotometer according to the CIE L*a*b* parameters, and a sample of each material was selected for morphological evaluation under scanning electron microscopy (SEM). Data were submitted to one-way ANOVA and Tukey test (α=0.05). *Results*: Artglass showed higher stability regarding the presence of red and yellow ($p<0.05$) when subjected to AAA and fewer of these pigments ($p<0.05$) when compared to the Cesead and Solidex, which showed the highest luminance stability ($p<0.05$). ΔE Cesead was the most unstable ($p<0.05$). All resins analyzed by SEM showed superficial degradation when submitted to AAA, mainly in resin Cesead. *Conclusion*: All materials analyzed demonstrate color change and surface degradation and Cesead resin showed the worse results.

DESCRIPTORS | Accelerated Artificial Aging; Color Stability; Composite Resin; Esthetics Dental; Morphological.

RESUMO | **Avaliação da estabilidade da cor de resinas compostas micro-híbridas submetidas ao envelhecimento artificial acelerado** • *Objetivo*: A estética dos materiais dentários é extremamente importante para o sucesso da reabilitação oral. Assim, no presente estudo, avaliamos a estabilidade de cor e a degradação superficial de três resinas compostas micro híbridas após o processo de envelhecimento artificial acelerado (EAA). *Métodos*: Foram preparados 24 espécimes (n=8) para cada material: Solidex, Artglass e Cesead, dimensões de Ø 15 mm por 2 mm de espessura. As amostras foram submetidas a análise de cor, antes e depois do EAA, num espectrofotômetro de acordo com os parâmetros CIE L * a * b *, e uma amostra de cada material foi selecionada para avaliação morfológica por microscopia eletrônica de varredura (MEV). Os dados foram submetidos à one-way ANOVA e teste de Tukey (α=0,05). *Resultados*: A Artglass apresentou maior estabilidade quanto à presença de vermelho e amarelo ($p<0,05$) quando submetida ao EAA e menor quantidade destes pigmentos ($p<0,05$) quando comparado à Cesead e Solidex, as quais apresentaram maior estabilidade de luminância ($p<0,05$). ΔE Cesead foi o mais instável ($p<0,05$). Todas as resinas analisadas por MEV apresentaram degradação superficial quando submetidas ao EAA, principalmente na resina Cesead. *Conclusão*: Todos os materiais analisados demonstram alteração de cor e degradação da superfície, a resina Cesead apresentou os piores resultados.

DESCRITORES | Envelhecimento Artificial Acelerado; Estabilidade de Cor; Resinas Compostas; Estética Dentária; Morfológico.

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INTRODUCTION

Dental materials such as composite resins has enabled dental tissue reconstruction with biofunctional properties, excellent aesthetic potential and acceptable longevity using a minimally invasive approach.[1] The composites have become the dentists' materials of choice for most restorations, due to their sophisticated aesthetic characteristics in the anterior region and due to their adequate biomechanical strength when used in posterior teeth.[2-5]

Choosing an esthetic restorative material is largely due to its ability to imitate the color of the dental element.[6] Using it as a model for obtaining the optical characteristics of dentin and enamel is based on the concept of natural stratification, a simple and effective approach to manufacture highly aesthetic direct restorations. However, preparing aesthetically perfect restorations with direct composite resin is still a challenge for clinicians, because of the complexity to reproduce in these materials the optical properties of natural teeth.[4]

Besides color, fundamental to aesthetic harmony, an ideal composite must have adequate physical and mechanical properties to maintain its stability and longevity in the long run.[7] There are many factors in the oral environment that can affect the lifespan of these restorations, due to adverse conditions in the oral cavity and the complex oral microflora, such as caries, solubility, fractures, staining, abrasion. Therefore, one of the goals of contemporary dentistry is to develop new solutions to solve such problems.[8,9]

The difficulties presented by conventional resin composites have led the dental industry to develop new materials, such as indirect resins reinforced by fibers, glass polymers, ceromers or laboratory resins. These materials combine high loads of hybrid micro filler particles ranging from 0.4 to 1 µm, with portions of colloidal silica and multifunctional monomers. This combination gives the resins similar mechanical characteristics to natural teeth, as well as increased hardness, lower solubility, excellent polish, and better discoloration resistance.[7]

The color stability of a composite is not only determined by the material composition, finishing and polishing of the restoration, it can also be affected by exposure time in the oral cavity and by the patient's eating habits.[6] There are three types of color change reported in the literature: (a) external, due to plaque buildup; (b) surface or subsurface, due to surface degradation or slight penetration and adsorption of dyes within the surface layer of the composites; and (c) inherent, due to the physicochemical reactions on the surface of the resin matrix and in the deeper layers of the material, caused by UV radiation, thermal energy or moisture, the latter usually simulated in *vitro* studies via artificial accelerated aging.[10-12] Over the years, studies[13,14] have examined the effects of type, size and filler particles on the optical properties of composites, and as the aesthetic maintenance of restorations is a critical factor for their longevity, the objective of this investigation was to evaluate three different modified composites (micro-hybrids) for color stability, after being subjected to the accelerated artificial aging (AAA) process and to surface degradation by scanning electron microscopy. The null hypothesis tested was that accelerated artificial aging (AAA) would have no effect on color stability and surface degradation of different modified composites.

MATERIALS AND METHOD

Twenty-four micro-hybrid composite resins were prepared (n=8): Artglass (Heraeus Kulzer, South America Ltda. Batch: 020117), Cesead (Kuraray Medical Inc. Batch: 410db) and Solidex (Shofu Dental Corporation. Batch: 060332), for this preparation Teflon matrices with a diameter of 15 mm and a height of 2 mm were used.

The matrix was filled with the resin in unique increments and excesses were removed with 26x76 mm glass slide (Perfecta Ind. Com. de

lâminas de vidro, Ibitinga, Sao Paulo/Brazil), which gave specimens plane and polished surfaces. Subsequently, the set matrix/resin was polymerized in curing oven according to the manufacturer's recommendations for each trademark used in the study, elapsed time of polymerization, the specimens were removed from the matrix for further analysis.

Samples were submitted to color readings using a spectrophotometer (PCB 6807 BYK GARDNER, Geretsried/Germany), and initial color values of the samples were obtained. The observation standard simulated by the equipment followed the CIE *L*a*b** system. This system uses three parameters to define color, light, shadow and saturation. Luminosity is the light level and dark object, represented by the L* value (L*=100 for white and L*=0 for black), and a* b* parameters (shaded) represent the red +a * and green is -a*, yellow if +b * and -b* is blue.[10,15]

After the first reading, the samples were placed in the AAA chamber (Comexim Matırias Primas Ltda, Sao Paulo/Brazil) for non-metal substances C-UV under ultra violet (UV) radiation and condensation in different repeated cycles (successively and automatically). The AAA procedure is performed in a laboratory environment that indicates the behavior of a material under certain conditions and it is widely used for development and control of different properties of materials.[16,17] In this equipment, the UV-B source was fluorescent light bulbs that emitted concentrated ultraviolet light. Condensation was produced by exposing one surface of a specimen to a heated, saturated mixture of air and water vapor while the reverse side of the specimen was adhered to metal plates with silicone, specifically indicated, under the action of the condensation process at a distance of 50 mm from the light source. The system was programmed to expose specimens to UV-B at 50°C for 4 h, followed by 4 h of condensation at 50°C, totaling 191 h of aging, which is equivalent to 5 years of aging.[15]

After aging, the specimens were subjected to another color reading process by the spectrophotometer. Thus, we obtained measures of color change (ΔE) before and after artificial accelerated aging, which was automatically calculated by the formula:[18] $\Delta E^*=[(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2]^{1/2}$. Values of Δ L*, Δa*, Δb*, correspond to the difference of the values L*, a*, b*, respectively, compared to the first color reading (initial). ΔE values ≥ 3.3 are considered clinically unacceptable.[12,19,20]

Morphology of specimens before and after AAA was analyzed by scanning electron microscopy (XL-30 FEG; Philips, Eindhoven/The Netherlands) at an accelerating voltage of 20kV.

Data were submitted to the following statistical tests: normality test (Kolmogorov-Smirnov), parametric test (ANOVA) and multiple comparisons test (Tukey-α=0.05). The NCSS 2007 (NCSS, Kaysville, UT/USA) software was used in the analyses.

RESULTS

Table 1 shows the average values for coordinates *L *, a ** and *b **, before and after AAA. The Artglass and Cesead resins showed significantly different luminosity averages before and after the AAA, unlike Solidex that showed no statistical difference ($p>0.05$). Comparing the overall average, the luminosity measurement of Artglass was significantly higher ($p<0.05$) when compared with other resins, which showed that Solidex had higher luminosity rates ($p<0.05$) than Cesead.

The coordinate values of a* show that the measurement of the amount of red was statistically different ($p<0.05$) only for Cesead and Solidex resins. Regarding the overall average, the values of a* for Artglass were significantly lower than those of Cesead and Solidex, which were similar ($p>0.05$).

The amount of yellow for Artglass was similar ($p>0.05$) before and after AAA and significantly higher ($p<0.05$) after AAA for Cesead and Solidex resins. In general, the coordinate b* values of

Table 1 | Mean and standard deviation (SD) values for coordinates L *, a* and b * before and after accelerated artificial aging (AAA).

		Before AAA	After AAA
Artglass	L*	78.35(0.91)[a]	78.94(0.53)[b]
	a*	2.13(0.17)[a]	2.02(0.13)[a]
	b*	17.64(0.29)[a]	17.04(1.04)[a]
Cesead	L*	74.92(1.18)[a]	73.41(1.04)[b]
	a*	4.03(0.29)[a]	3.66(0.43)[b]
	b*	20.34(0.72)[a]	23.36(1.38)[b]
Solidex	L*	76.55(0.56)[a]	76.56(0.48)[a]
	a*	4.05(0.36)[a]	3.47(0.38)[b]
	b*	21.54(0.92)[a]	23.53(0.71)[b]

† Equal lowercase letters in the same line indicate statistical similarity
‡ L*: Luminosity; a*: Coordinate red/green; b*: Coordinate yellow/blue

Table 2 | Comparison of mean ΔE and standard deviation (SD) of different resins.

Resin	Δ E (SD)
Artglass	1.31 (0.90)a
Cesead	3.51 (1.04)b
Solidex	2.12 (0.06)a

† Equal lowercase letters in the same column indicate statistical similarity
‡ ΔE Color change

the Artglass composite were significantly lower (p<0.05) when compared to the others and in the pre-aging time the measurements of Cesead were lower (p<0.05) when compared to Solidex.

The color stability analysis (Table 2) indicated that only the composite Cesead showed unacceptable color change (ΔE≥3.3). Artglass (ΔE=1.31±0.90) and Solidex (ΔE=2.12±0.06) resins showed clinically acceptable results.

All resins showed superficial changes after AAA detected by morphological analysis (Figure. 1, 2 and 3).

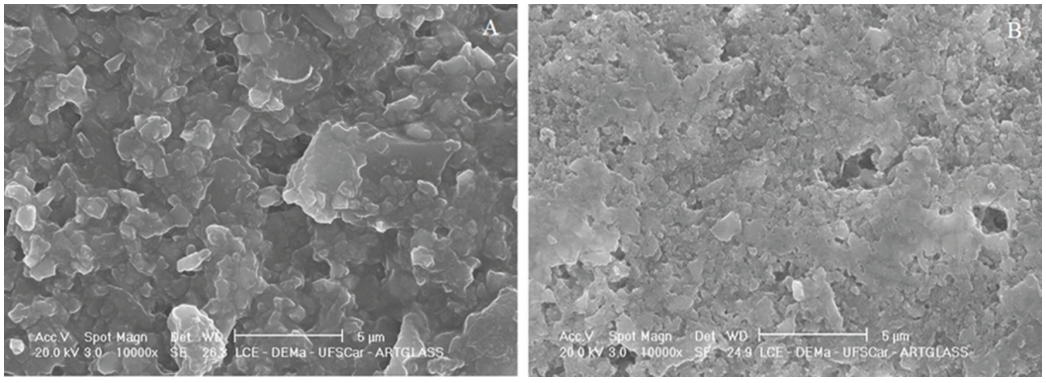

FIGURE 1 | **A**: Resin Artglass before accelerated artificial aging (AAA). **B**: Resin Artglass after AAA.

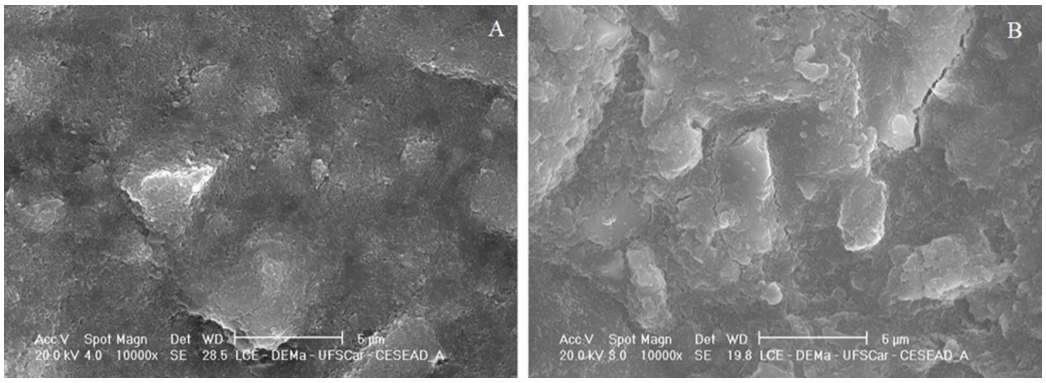

FIGURE 2 | **A**: Resin Cesead before accelerated artificial aging (AAA). **B**: Resin Cesead after AAA.

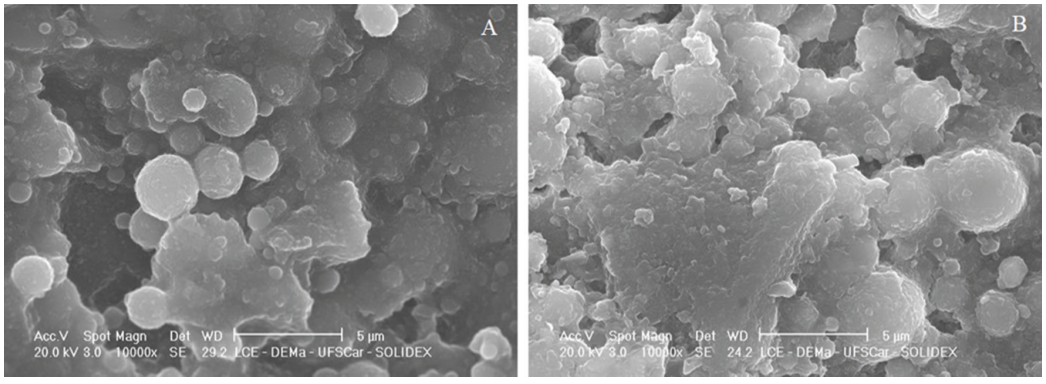

FIGURE 3 | **A**: Resin Solidex before accelerated artificial aging (AAA). **B**: Resin Solidex after AAA.

DISCUSSION

Resin restorations are continuously exposed to coloring and degradation agents due to daily intake of pigmented food and beverages, and adverse conditions in the oral environment.[5,6] There is no unanimity about the incidence of failures that lead to replacing the composites, however, today the main cause of changing resins, direct or indirect indication, is the change in color. As a result and because of the aesthetic excellence sought by patients, composite manufacturers continuously seek to improve the optical properties of these materials to enable the adequate reproduction of natural teeth characteristics.[17,21]

The size and number of internal particles and differences in the chemical structure of composites can affect light scattering and affect these materials color stability .[14,17] The breaking of chemical constituents can also change the color of resins in time[19,22], a situation reproduced in the study through artificial accelerated aging, which simulates the effect of ultraviolet UV-B, responsible for photochemical degradation and moisture, which coupled with other factors can lead to polymer degradation.

The results of this investigation support the rejection of the null hypothesis that there would be no influence of AAA in color stability and surface degradation of different modified composites. Evaluated by the optical luminosity L*, the materials showed variability from the point of view of this factor, in which the Solidex resin demonstrated highest pre stability (L* 76.55±0.56) and Cesead the lowest after aging (L* 76.56±0.48) . Luminosity

is an important property for modified indirect composites to meet the necessary aesthetic requirements of a restoration, therefore it is expected of an ideal composite to maintain this characteristic over time.

AAA causes internal discolorations in the resin, therefore the change in color of the composites after UV irradiation has been associated with changes in chemical activators or initiator system, and in the resinous matrix. Therefore, the degradation of the residual amine and the oxidation reaction of carbon double bonds result in the formation of yellowish compounds.[12,21] In this study, the effect of aging on the Artglass resin did not significantly affect the amount of yellow, unlike other materials, and Cesead and Solidex showed higher b* values after AAA.

The total color change, that is, Delta E (ΔE) change is related to changes in the resin matrix, as well as to changes in the matrix/filler set. Indirect resins, micro-hybrids, have a differentiated matrix/filler system to prevent the discoloration of resins, which attributes polyglass or ceromer characteristics to these materials. In this system, AAA promotes a color change in the composites, due to the erosion of the matrix and exposure of the filler particles.

In this study, three different intervals were used to determine color changes: $\Delta E<1$ – imperceptible to the human eye; $1.0<\Delta E<3.3$ – visible only by a skilled and clinically acceptable individual; $\Delta E>3.3$ – easily observed and clinically unacceptable.[12,19,20] Considering these intervals, only the Cesead resin showed unacceptable color change ($\Delta E=3.51\pm1.04$), the other two, Artglass and Solidex, showed acceptable and similar results.

According to some authors, composites with lower load particle concentrations have higher ΔE values, contrary to what was observed for the Cesead resin, which had the highest filler amount (82% silica and quartz glass, and 18% resin and additives), which showed a higher color change, results that were also previously observed by other authors.[17,19]

In addition to discoloration, other damages were observed in the materials investigated. Scanning electron microscopy images revealed the presence of cracks, especially in the Cesead resin, and deterioration of the organic matrix with the non-adhesion of filler particles, which produces pores and provides higher color change, results that have been also found in other studies.[10,12] These failures could vary with different filler particles[23] and may be potentialized in the oral environment due to its greater destructive capacity, which combines physical factors, such as temperature fluctuations and changes in pH, and mechanical interferences, such as shear stress and compression strength.[24]

Although the Solidex resin had the highest color stability and Artglass had clinically acceptable results, it should be noted that all composites analyzed showed color instability when subjected to AAA. Therefore, in light of the limitations of each material, it is up to the dentist and the dental prosthesis technician to use the proper materials according to their indication.

All materials analyzed exhibited color instability and surface degradation, however, only the Cesead resin demonstrated clinically acceptable results.

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CLRD in Clinical and Laboratorial Research in Dentistry | Oral Radiology

The influence of film type and processing method on radiographic density for occlusal caries diagnosis

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ABSTRACT | *Objective*: This study aimed to investigate how the radiographic processing method affect the radiographic density of two types of film. *Methods:* Radiographs from non-cavitated occlusal caries lesions obtained in a previous study were used. We analyzed 28 films from 12 patients that were obtained with the same X-ray device. Seven Ektaspeed (Kodak Eastman Kodak Co, Rochester, NY, USA) and seven Ultraspeed (Kodak Eastman Kodak Co) films were manually processed, while seven Ektaspeed and seven Ultraspeed films were automatically processed. The angle of incidence of the X-ray beam and the distances between the apparatus, the tooth and the film were standardized. Therefore, the study comprised four groups: GE1: Ektaspeed manually processed; GE2: Ektaspeed automatically processed; GU1: Ultraspeed manually processed; and GU2: Ultraspeed automatically processed. The images were digitized (G40450 Scan Jet C/T, Hewlett-Packard) and analyzed using Digora for Windows 2.7 (Soredex Medical Systems) to obtain the average radiographic density, and data were analyzed using Student's t test for paired data (Bioestat 5.3). *Result*: Only the Ektaspeed film showed statistically significant differences among radiographic densities with different processing methods (p = 0.0037). *Conclusion*: The Ektaspeed film automatically processed is better suited for the early diagnosis of caries lesions.

DESCRIPTORS | X-Ray Diagnosis; Dental Caries; Digital Dental Radiography; Community Dentistry.

RESUMO | **Influência do tipo de filme e método de processamento na densidade radiográfica para diagnóstico de cárie oclusal** • *Objetivo*: Este estudo tem como objetivo estudar a influência do método de processamento na densidade radiográfica de dois tipos de filmes. *Métodos*: Foram utilizadas radiografias de lesões de cárie oclusais não cavitadas obtidas em estudo prévio. Foram analisados 28 filmes obtidos de 12 pacientes cujas radiografias foram realizadas com o mesmo aparelho radiológico. O mesmo número de filmes (n=7) Ektaspeed (Kodak Eastman Kodak Co, Rochester, NY, USA) e Ultraspeed (Kodak Eastman Kodak Co) foram processados manualmente e automaticamente. Desta forma, o estudo compreendeu quatro grupos: GE1: Ektaspeed processado manualmente (n=7); GE2: Ektaspeed processado automaticamente (n=7); GU1: Ultraspeed processado manualmente (n=7) e GU2: Ultraspeed processado automaticamente (n=7). As imagens foram digitalizadas (G40450 Scan Jet C/T, Hewlett-Packard) e analisadas utilizando o programa Digora for Windows 2.7 (Soredex Medical Systems) para obter a média da densidade radiográfica. Os dados foram analisados através do teste T de Student para dados pareados (Bioestat 5.3). *Resultado*: Apenas o filme Ektaspeed mostrou diferenças estatisticamente significantes entre as densidades radiográficas com os diferentes métodos de processamento (p = 0.0037). *Conclusão*: O filme Ektaspeed processado automaticamente é mais apropriado para o diagnóstico precoce de lesões de cárie oclusal.

DESCRITORES | Diagnóstico Radiográfico; Cárie Dental; Radiografia Dental Digital; Odontologia em Saúde Coletiva.

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INTRODUCTION

The diagnosis of dental caries using imaging has evolved significantly, and a detailed analysis of images using appropriate software facilitates the early diagnosis of dental caries. The use of direct and semi-direct digital systems or conventional radiography (indirect digital radiography) associated with specific software programs provides detailed information that can be used for diagnosis. By using these resources, density and contrast can be changed to improve the interpretation of images.[1] The use of dedicated software, such as Digora for Windows 2.7, Image Tool, or Vix Win, enables the measurement of degrees of grey in the images, which may be quantified and translated to numerical values of image density. The 8-bit system display a range of 256 degrees of gray on a scale from zero, fully radiolucent, up to fully radiopaque.[1,2]

Regardless the method used to evaluate a radiographic exam, many factors contribute to a suitable radiographic image, including exposure time, processing method, angle of incidence of the radiation beam and type of film used.[1-5]

Therefore, this research aims to verify the effect of the processing method, either manual or automatic, with two types of film, Ektaspeed and Ultraspeed, on the radiographic density values of occlusal, non-cavitated caries lesions using Digora for Windows 2.7®.

METHODS AND MATERIALS

Radiographs were used from non-cavitated occlusal caries lesions obtained in a previous study by Silveira[6]. Twenty-eight radiographs obtained from 12 patients at the same time were analyzed using Spectro II (Dabi Atlante, Ribeirão Preto, SP, Brazil) at 50 kV, 10 mA, and an exposure time of 0.5 s. Seven Ektaspeed (Kodak Eastman Kodak Co, Rochester, NY, USA) and seven Ultraspeed (Kodak Eastman Kodak Co, Rochester, NY, USA) films were processed manually according to the temperature/time table provided by the manufacturer, while seven Ektaspeed and seven Ultraspeed films were processed in a Peri-Pro III nonroller automatic processing machine (Air Techniques, New York, NY, USA). Radiographs were taken with a standardized angle of incidence of the X-ray beam and at a standardized distance between the appliance and the tooth film, which was determined using an acrylic resin bite guide.[6] Therefore, the radiographs could be repeated with the same distance from the film source (40 cm) and the same vertical and horizontal angulations. Two types of radiographic films and the same X-ray device were used for each patient.

This study comprised four groups: GE1: Ektaspeed manually processed; GE2: Ektaspeed automatically processed; GU1: Ultraspeed manually processed; and GU2: Ultraspeed automatically processed.

Radiographs were digitized at a resolution of 75 dpi using a scanner with a transparency reader (ScanJet G40450 C/T, Hewlett-Packard, Palo Alto, CA, USA). The images were stored in JPG format with maximum quality, without image manipulation. The digitized radiographic images were analyzed using Digora for Windows® 2.7 (Soredex Medical Systems, Tuusula, Finland) to obtain the average radiographic density. These values were tabulated and analyzed using Student's t test for paired data to determine whether there was a significant difference between groups (Bioestat 5.3).

RESULTS

Results were obtained by correlating the radiographic density and processing method (automatic or manual) for the two types of films.

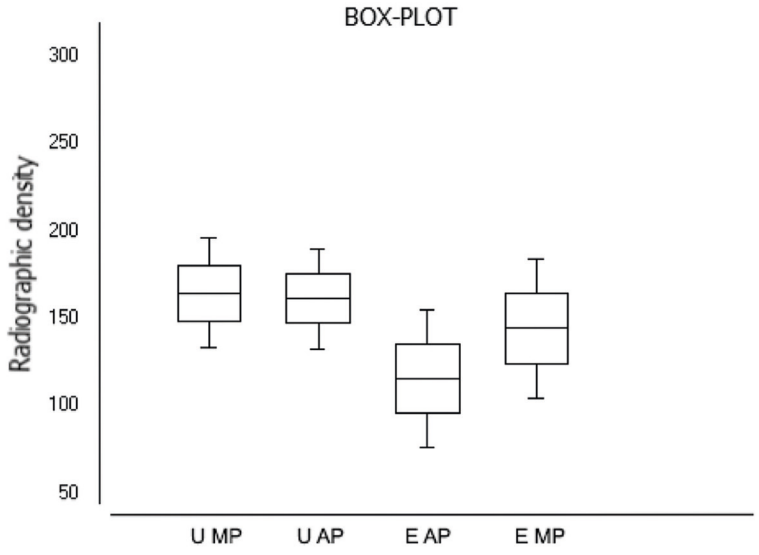
Statistical analysis of the digitized radiographs showed a statistically significant difference in radiographic density between processing methods with the Ektaspeed film (p=0.0037). The

Ultraspeed film showed no statistically significant difference between processing methods. Mean values and confidence intervals for the two types of films are shown in Table 1, and Graphic 1 shows the distribution of the radiographic density values for the four groups.

Table 1 | Mean radiographic density according to the processing method for Ektaspeed and Ultraspeed films using Student's t test (means, standard deviation (SD) and 95% confidence interval of differences).

Film	Manual	Automatic	Paired Differences		
	Mean (±SD)	Mean (±SD)	Mean (±SD)	95% confidence interval of differences	P†
				Lower Upper	
Ektaspeed (n=14)	144.35 (±19.91)	116 (±19.67)	-28.35 (±30.08)	-45.72 -10.99	0.0037
Ultraspeed (n=14)	164.42 (±15.71)	161.35 (±14.30)	3.07 (±22.46)	-9.89 16.04	0.6175

Note: Paired difference values were obtained by subtracting the initial value from the final value; therefore, negative values indicate an increase in the coefficient after 12 months of follow-up. † Significance level



Graphic 1 | Radiographic density of both types of films using manual processing (MP) and automatic processing (AP).

DISCUSSION

This study originated from the study of Silveira,[6] which evaluated the effect of different pit and fissure sealing materials in the treatment of non-cavitated occlusal caries lesions. In this study, the radiographs used for the control treatment were obtained in a standardized manner using a positioner customized for each patient. In addition, the X-ray device, film type and processing method were standardized. The current lack of standardization in the chemical processing of radiographs is common in different types of dental care. According to Costa,[7] professionals do not follow quality control programs. The difficulties in

obtaining high-quality radiographs are related to a lack of adequate facilities, the use of visual processing methods, incomplete chemical processing, and a lack of knowledge about the characteristics of the processing solutions.[7]

Generally, the progression of a lesion in dentin causes a partial collapse of the enamel, resulting in color changes and/or translucency of the tissue. On a radiographic examination, these initial tissue changes produce radiolucent images below the amelodentin junction. However, recent studies have reported the possibility of lesion progression in dentin under apparently intact surface enamel that are difficult to detect in grooves and pits using conventional clinical methods; these studies show the necessity of radiographic examinations to help to diagnose these lesions.[8-10] In addition to aiding in the diagnosis, the radiographic examination can be useful for clinical monitoring and it is the preferred method for progression analysis of these lesions.[2,11-15]

Regarding the quality of radiographic examinations, continuous studies should be performed with different types of film, chemical solutions and processing methods to improve the accuracy of these examinations and, consequently, the diagnosis and/or monitoring of carious lesions in their initial stages of development. Early diagnosis can make conservative and/or minimally invasive treatments possible. Worldwide, 60-90% of schoolchildren and nearly 100% of adults have tooth decay.[16] This fact made this disease a focus of those who practice conservative dentistry and prioritize minimal intervention to maintain the integrity of dental elements over conventional restorative treatments that require a more invasive approach to caries lesions and weaken the dental elements.[17]

According to Lotto,[18] the use of radiographs in the diagnosis of carious lesions is possible because of differences in radiolucency among tissues. More mineralized tissue appears as a white area or radiopaque on a radiographic examination, while softened tissue appears dark or radiolucent. In a radiographic exam, an injury in dentin below an apparently sound enamel appears as a radiolucent line between the enamel (more radiopaque) and the sound dentin (middle radiolucency). Special care must be taken to avoid misinterpreting this line as the "mach band" effect, i.e., an optical illusion due to the adjacency of a dark area to another light area, giving the impression of an intermediate area between the two that could be confused with dentine lesions.[18] The film quality and activity of processing solutions are important for obtaining a good-quality image that can assist in the diagnosis and may be assessed using the sensitometric method, which measures characteristic curves of such properties as contrast, sensitivity and latitude.[7]

Two factors may be responsible for the variation in the results: the latitude and the sensitivity of the films. Sensitivity is the response of a film to electromagnetic radiation (light or X-rays) and is verified after radiographic processing to obtain optical densities.[19,20] Latitude is the larger or lesser ability of a film to be under-exposed or over-exposed and still produce images of adequate quality for interpretation.[19,20] Manual and automatic processing resulted in statistically significant differences for Ektaspeed film images, which can affect clinical diagnosis when using this type of film. This film is more sensitive, which can be attributed to its lower processing latitude and may be explained by Graphic 1, in which there is a visible difference in radiographic density between manual and automatic processing. The Ultraspeed film has increased processing latitude, probably because its radiographic density varies less between different types of processing.

Regarding the use of films in dental clinics, a film with a small latitude would have a greater capacity to show an incipient carious lesion than a film with a greater latitude, which, in turn, would be less sensitive. This is a critical choice in community dental

health clinics, in which early diagnosis is critical,[21] but controlling such variables to obtain good radiographic images may be very difficult. However, as we consider that the processing techniques should be controlled as much as possible to obtain optimal image quality, the more suitable film for auxiliary diagnosis exams of incipient dental caries lesions is the E group of sensitivity (Ektaspeed), which also exposes patients to lower radiation doses. In clinical practice, it is important to observe the processing type (manual or automatic) and the type of film used to obtain the best possible image and, consequently, make the correct diagnosis.

CONCLUSION

E films (Ektaspeed), which are more sensitive, are more suitable for auxiliary diagnosis exams in the early diagnosis of caries lesions, particularly if they are processed automatically for better control of the image quality. However, when practitioners are less experienced and automatic processors are not available, or when undergraduate students are interpreting images, less sensitive films such as the Ultraspeed are indicated.

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CLRD in Clinical and Laboratorial Research in Dentistry | Oral Pathology

Keratoacanthoma associated with cutaneous horn manifestation: case report and difficulty of diagnosis

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ABSTRACT | *Background*: Cutaneous horn (CH) is a conical hyperkeratotic projection of skin with keratotic material. A broad variety of lesions may be found with clinical aspect of cutaneous horn, including malignant tumors. *Case report*: We report a case of a 77-year-old male patient, presenting an asymptomatic lesion with clinical aspect of CH in the lower lip. The clinical diagnosis hypothesis was squamous cell carcinoma (SCC) and an incisional biopsy was performed. The histopathological analysis revealed a keratoacantoma (KA) and the lesion was completely removed. The two year follow-up revealed no recurrence. *Discussion*: CH is rarely accompanied by KA. However, KA shows a greater degree of nuclear atypia than SCC, making the differentiation of the two diseases very difficult. This case highlights the importance of histopathological examination to rule out malignancy.

DESCRIPTORS | Neoplasms; Keratoacanthoma; Squamous Cell Carcinoma.

RESUMO | **Ceratoacantoma associado a manifestação de corno cutâneo: relato de caso e dificuldade de diagnóstico** • *Introdução*: O corno cutâneo (CC) é uma projeção hiperceratótica cônica da pele. Uma ampla variedade de lesões pode ser encontrada com aspecto clínico de corno cutâneo, incluindo tumores malignos. *Relato de caso*: Relatamos um caso de paciente do sexo masculino, 77 anos de idade, apresentando uma lesão assintomática, com aspecto clínico da CC no lábio inferior. A hipótese de diagnóstico clínico foi de carcinoma espinocelular (CEC) e uma biópsia incisional foi realizada. A análise histopatológica revelou um ceratoacantoma e a lesão foi completamente removida. Em um ano de acompanhamento nenhuma recidiva foi observada. *Discussão*: CC raramente é acompanhada por ceratoacantoma. No entanto, ceratoacantoma mostra um maior grau de atipia nuclear do que CEC tornando a diferenciação de duas doenças muito difícil. Neste caso ressaltamos a importância do exame histopatológico para descartar malignidade.

DESCRITORES | Neoplasias; Ceratoacantoma; Carcinoma Espinocelular.

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INTRODUCTION

Cutaneous horn is a clinical term for describing the hyperproliferation of compact keratin that may arise from a wide range of benign and malignant epidermal tumors.[1-4] The incidence of CH on a benign lesion as keratoacanthoma (KA) is very rare.[2] This study aimed to describe a case report of KA in lower lip associated with a CH and discuss the difficulty to establish the diagnosis.

CASE REPORT

A 77-year-old male patient presenting an asymptomatic tumor in the lower lip with a one--month history was submitted to evaluation. The clinical examination revealed an exuberant, nodular, sessile tumor with brownish and blackish coloration, measuring 30 x 20 x 15 mm (Figure 1A). Upon palpation, the tumor was firm and quite infiltrative in the lip mucosa. Based on the clinical features, the diagnostic hypothesis was CH. Incisional biopsy was performed under local anesthesia (Figure 1B), followed by histopathological analysis. Histologic sections revealed a hyperplastic epithelium with interconnecting groups of well-differentiated squamous cells surrounded by connective tissue. In some areas, the formation of keratin pearls and keratinization of individual cells were observed (Figure 2). The epithelial basal layer was intact and no dysplasia was detected. Diffusely scattered lymphocytic infiltrate was found in the underlying submucosal fibrous connective tissue (Figure 3). From these characteristics, the diagnosis of KA was established and the surgical excision was performed. The histopathologic analysis of the entire specimen confirmed the diagnosis: keratin hyperproliferation in the central area, keratin pearls in deeper layers of the epithelium (Figure 4A), proliferation into the connective tissue without invasion and not exceeding the limit of the underlying muscle, maintenance of the basal layer, and chronic inflammatory response (Figure 4B). The patient was reassessed after two years and no signs of recurrence were observed. The patient is currently in clinical follow up (Figure 5A and B).

Figure 1 | Clinical appearance. **A**: Nodular tumor situated on lower lip exhibiting sessile base and brownish-blackish coloration. **B**: Incisional biopsy performed on edge (black circle).

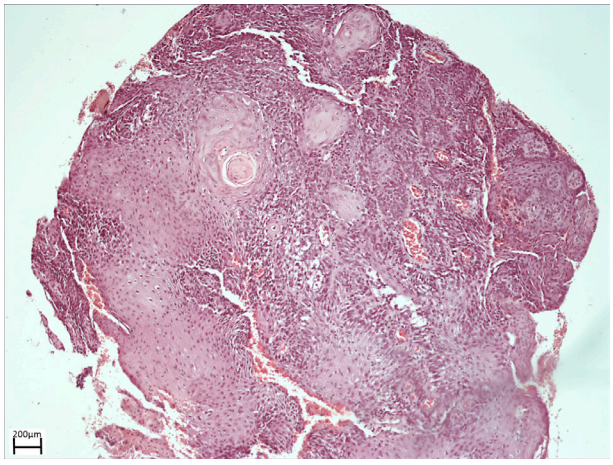

Figure 2 | Histopathological aspects of incisional biopsy; Note the acanthotic proliferation of well-differentiated stratified squamous epithelium that merged with the underlying connective tissue (hematoxylin and eosin stain; original magnification: 100×). Formation of keratin pearls and some degree of dyskeratosis were observed.

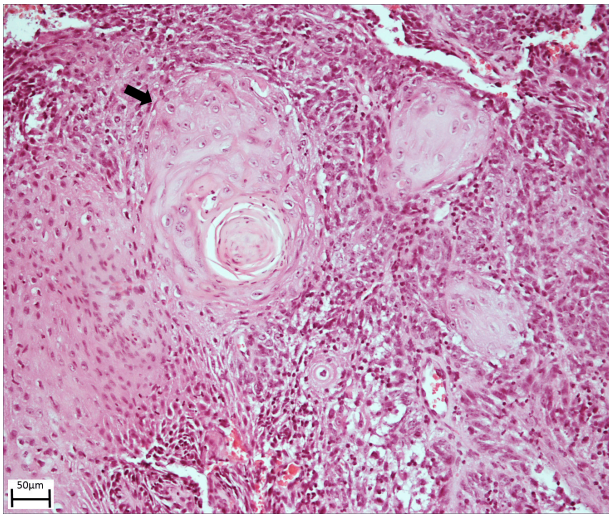

Figure 3 | Intact epithelial basal layer (black arrow) and cells without pleomorphism (hematoxylin and eosin stain; original magnification: 200×).

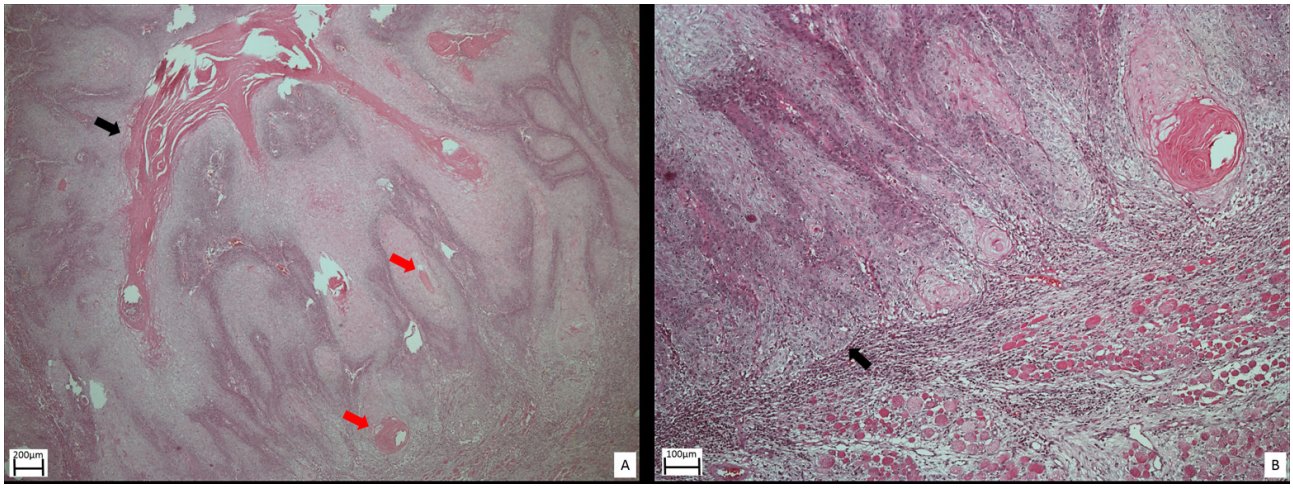

Figure 4 | Histopathological appearance of excisional biopsy. **A**: Keratin hyperproliferation in central area (black arrow) and keratin pearls in deeper layers of epithelium (red arrows). **B**: KA with proliferation into connective tissue without invasion and not exceeding limit of underlying muscle; Maintenance of basal layer (black arrow) associated with adjacent chronic inflammatory infiltrate.

Figure 5 | Clinical appearance one year after treatment. **A, B**: extraoral and intraoral examinations with no signs of recurrence.

DISCUSSION

KA is a benign, proliferative, epithelial tumor that arises from hair follicles,[5-7] but its etiology is unknown.[8] Exposure to solar rays has been implicated in its pathogenesis, since such tumors appear in exposed areas in approximately 90% of cases.[5-7] Clinically, KA is an exophytic mass that exhibits rapid growth (six to 12 weeks). KA develops in three phases: proliferative, mature, and involution. Rapid growth occurs in the first stage.[5,9] The second stage is characterized by stabilization and a regression of the tumor is observed in the third stage, leaving a scar with an area of depression.[9]

The histopathological differentiation should be performed with squamous cell carcinoma (SCC), as both tumors have similar clinical and histopathological characteristics. KA can be histologically aggressive during early development, but it regresses over time, indicating benign behavior.[10] The histological aspects of KA reveal mature cells, considerable dyskeratosis, and keratin pearls. The surface epithelium on the lateral edge of the tumor seems normal, but the epithelium at the base of the crater proliferates downward. KA causes an intense, chronic, and inflammatory cell response. All these features make KA and SCC very similar.[5,6] The microscopic examination of the incisional biopsy in the present case revealed the acanthotic proliferation of well-differentiated epithelium with the formation of keratin pearls, which are common features of SCC. However, the basal layer was intact. Moreover, the epithelial cells had not invaded the connective tissue and exhibited both uniformity and monotony (Figure 3).

The manifestation of a giant CH on KA is very rare – only one case involving the face is reported in the literature.[2] CH has been reported in exposed areas of skin, but the lower lip is a very rare location.[3] Regarding the underlying diseases in which cutaneous horns appear, malignant tumors are more common than benign tumors.[4]

KA generally heals spontaneously and leaves a scar. However, its rapid growth causes tissue destruction. Thus, the treatment of choice is complete surgical excision,[2] although some authors have described the use of cryotherapy, electrodissection and curettage, radiation therapy, CO_2 laser surgery, intra-tumor or topical treatment with 5-fluoracil, corticosteroid, and methotrexate. All these treatments are indicated for small tumors.[5]

This study described a rare case of a patient with a giant cutaneous horn in the lower lip and discussed the importance of the histological evaluation to the definition of the final diagnosis of KA, which is

generally a considerably difficult task, as the main differential diagnosis is a malignant tumor (SCC).

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Clinical and Laboratorial Research in Dentistry

Can ameloblastomas arise from odontogenic keratocysts?

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ABSTRACT | *Background*: The ameloblastoma is a locally aggressive odontogenic tumour that has high recurrence rates. It rarely presents a histological aspect similar to the odontogenic keratocyst, because of the presence of keratinised areas. This study aimed to report a case of ameloblastoma in the mandible, diagnosed and treated incorrectly as an odontogenic keratocyst because of unusual macroscopic characteristics and rare histological aspects that impaired a correct diagnosis. *Case report*: A 57-year-old female patient, presenting an asymptomatic lesion at the left mandibular angle, was treated by incisional biopsy and decompression. The histological sections showed an aspect suggesting odontogenic keratocyst. At the 3-year postoperative period, the patient returned with a new lesion on the left side of the mandible and was then subjected to curettage. The histological sections showed a pattern of ameloblastoma and, because of this, the patient remained with a 6-month follow-up. At the 4-year postoperative period after the second operation, the patient returned with a new recurrence. The biopsy showed an ameloblastoma and the patient was submitted to mandibular resection and reconstruction as treatment. After the final procedure, the recovery was uneventful and the patient is now undergoing a postoperative period of four years, without recurrences. *Conclusion*: This case highlights the importance of carrying out a proper biopsy and an adequate examination by a specialised professional, because of the possibility of atypical lesions occurring restricted to the head and neck region.

DESCRIPTORS | Ameloblastoma; Jaw; Odontogenic Tumors.

RESUMO | **Os ameloblastomas podem surgir a partir dos queratocistos odontogênicos?** • *Introdução*: O ameloblastoma é um tumor odontogênico localmente agressivo, com altas taxas de recorrência. Raramente o ameloblastoma apresenta aspecto histológico semelhante ao queratocisto odontogênico devido à presença de áreas queratinizadas. O objetivo deste estudo é relatar um caso de ameloblastoma na mandíbula, diagnosticado e tratado incorretamente como um queratocisto odontogênico devido a características macroscópicas incomuns e aspectos histológicos raros que prejudicaram um correto diagnóstico. *Relato de caso*: Paciente do sexo feminino, 57 anos, apresentando lesão assintomática no ângulo mandibular esquerdo tratado inicialmente com biópsia incisional e descompressão. Os achados histológicos mostraram um aspecto sugestivo de queratocisto odontogênico. No pós operatório de 3 anos, a paciente retornou com uma nova lesão no lado esquerdo da mandíbula e foi então submetida a curetagem. Desta vez, as seções histológicas mostraram um padrão de ameloblastoma e, devido a este fato, a paciente permaneceu com um seguimento de 6 meses. No pós operatório de 4 anos da segunda operação, a paciente retornou apresentando nova recidiva. A biópsia mostrou um ameloblastoma e a mesma foi submetida a ressecção mandibular e reconstrução como tratamento. Após o procedimento final, a recuperação foi sem intercorrências e a paciente passou por um pós-operatório de quatro anos sem recidivas. *Conclusão*: Este caso destaca a importância de se realizar uma biópsia e um exame adequado por profissional especializado, devido à possibilidade de lesões atípicas que ocorrem restritas à região da cabeça e pescoço.

DESCRITORES | Ameloblastoma; Maxilares; Tumores Odontogênicos.

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INTRODUCTION

Odontogenic tumours are lesions from epithelial, ectomesenchyme, and/or mesenchyme elements, which were or are part of the tooth forming apparatus. According to the World Health Organization, these tumours are found exclusively in the maxillofacial region and can occur at any age.[1]

The ameloblastoma is a benign epithelial odontogenic neoplasia derived from cellular components of the enamel organ, and it is the second most common odontogenic tumour, accounting for about 1-2% of all tumors and cysts of the jaws.[1,2]

The clinical presentation of ameloblastomas is variable. However, it is commonly associated with asymptomatic bulges in the posterior mandible. Regarding the imaginological aspect, these neoplasms may present a uni or multilocular pattern, with well-defined margins, and they are associated with impacted teeth in most cases.[1,3]

Due to painless growth and prevalence in the posterior region of the mandible, the odontogenic keratocyst is considered one of the differential diagnoses of ameloblastoma. This lesion also has a slow growth; it is asymptomatic and mostly has a unilocular radiographic appearance.[4]

In addition to these similarities, hybrid or combined lesions of odontogenic keratocyst and ameloblastomas that impaired diagnosis have been described in the literature. Geng et al.[4] reported a case of a patient who had a lesion in the maxilla with histological features similar to keratocyst and ameloblastoma. On this occasion, due to the predominance of keratinised epithelium areas, the authors classified the neoplasm as a solid keratocyst associated with ameloblastic transformations.

By these similarities between clinical, histological, and imaginological characteristics, a correct diagnosis is mandatory to carry out the appropriate treatment, bearing in mind that the behaviour of these two lesions differs in many aspects. Therefore, it is recommended to perform a proper biopsy, collecting several samples from the lesion to help the anatomopathologic study.

This study aimed to report the case of a patient with an ameloblastoma at mandibular angle treated erroneously as an odontogenic keratocyst because of improper diagnosis and similar features.

CASE REPORT

A 57-year-old female patient was referred to the Maxillofacial Unit of the Santa Casa de São Paulo School of Medical Sciences, SP, Brazil. At the time, she had an increase of painless volume in the left mandibular angle topography with 6 months of evolution.

The skin of the region had a normal appearance, and the mucosa associated with the bulge was unchanged. Radiography showed a lesion of approximately 1.5 cm, unilocular, radiolucent, and with well-defined margins in the left mandibular angle region (Figure 1A; 1B). At the time, the hypothesis was of a unicystic ameloblastoma, and an incisional biopsy was performed to confirm the diagnosis. During the biopsy procedure, yellowish fragments were observed, suggesting keratin, which is clinically compatible with odontogenic keratocyst. From this, a small area of the lesion was removed for histopathology and, at the same time, a decompression device was installed for the treatment.

The histological sections showed odontogenic neoplasm of cystic organisation, covered by keratinised stratified squamous epithelium. The capsule consisted of dense connective tissue that showed a diffuse mild mononuclear cell infiltration. There were no epithelial islands immersed in the conjunctiva capsule (Figure 2A; 2B).

Due to these facts, the final diagnostic of the lesion was odontogenic keratocyst, and the patient was followed clinically and radiographically to observe signs of lesion regression. The lesion responded well to the treatment and showed total

regression in eight months. The patient was monitored every six months in a period of two years.

Curiously, in the three-year postoperative period, the patient returned complaining of jaw bulge in the operated area. New imaging tests detected a small unilocular lesion in the left ramus mandibular region (Figure3A; 3B). Considering this fact, the diagnosis of recurrence of keratocyst was suggested and the proposed treatment was curettage of the lesion complemented by peripheral ostectomy.

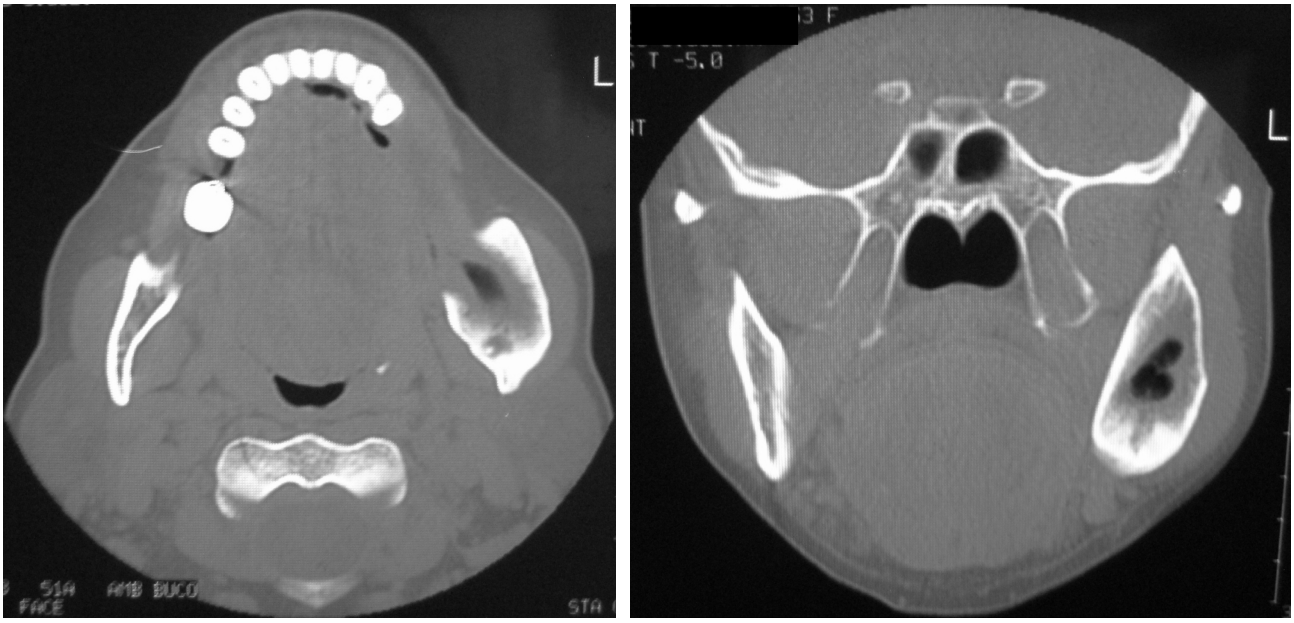

Figure 1 | **A, B**: Bone CT scans showing the unilocular aspect of the tumour associated with lateral bulge and the absence of cortical fenestration. Note the heterogeneous pattern of the lesion and areas with hypodense aspect.

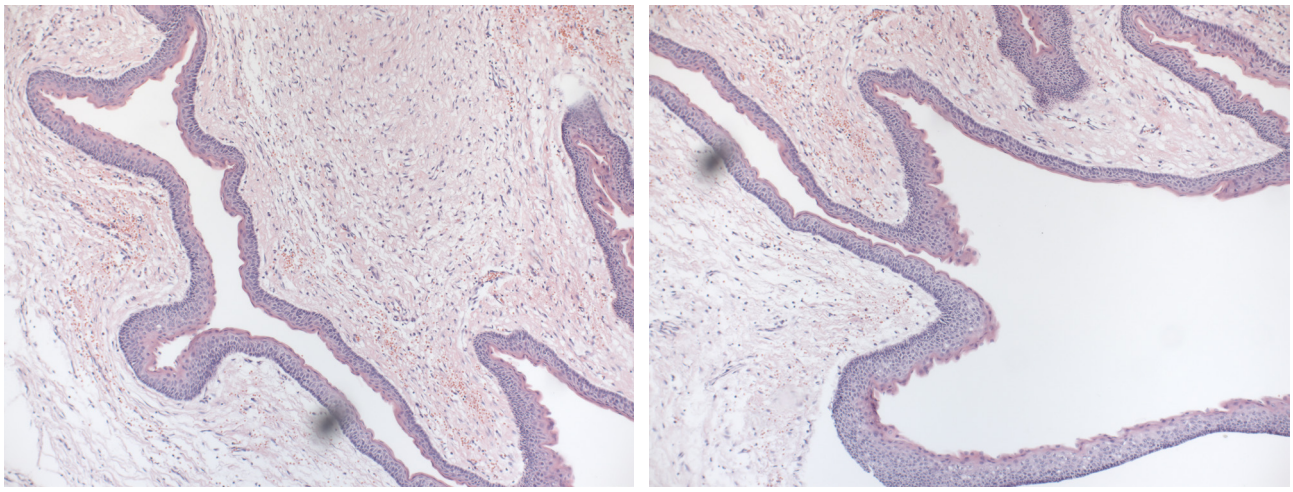

Figure 2 | **A**: Histological sections showing cystic arrangement, covered by keratinised stratified squamous epithelium. **B**: The capsule consisted of dense connective tissue that showed diffuse mild mononuclear cell infiltration. There are no epithelial islands immersed in the conjunctiva capsule.

The curetted surgical specimen was sent back for pathological and anatomical examination, and the results were compatible with ameloblastoma. The histological sections showed large cystic spaces covered by odontogenic epithelium. The stromal lesion consisted of dense connective tissue and, immersed in it, numerous odontogenic epithelial islands were found. Peripheral epithelial cells had assumed a palisade arrangement and had reverse nuclear polarisation and hyperchromatism. They were more loosely arranged at the center, with a appearance similar to the stellate reticulum of the enamel organ (Figure 4.A; 4.B).

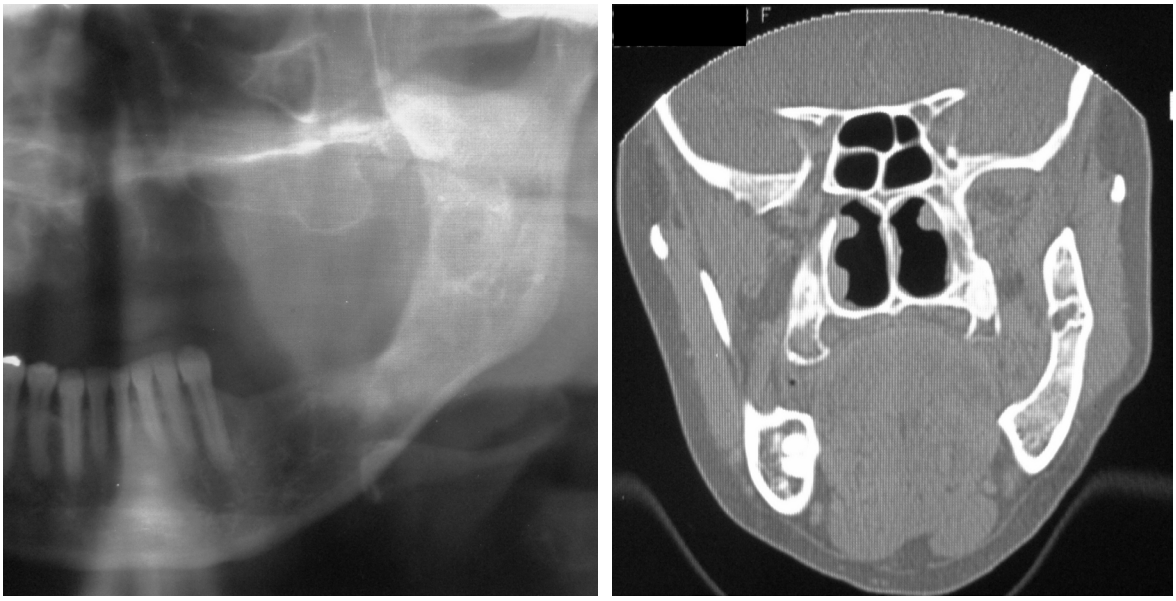

Figure 3 | **A**: Panoramic X-ray showing a radiolucent mandibular ramus. **B**: Bone CT scan showing a small lesion at the mandibular ramus, suggesting a recurrence of the neoplasia.

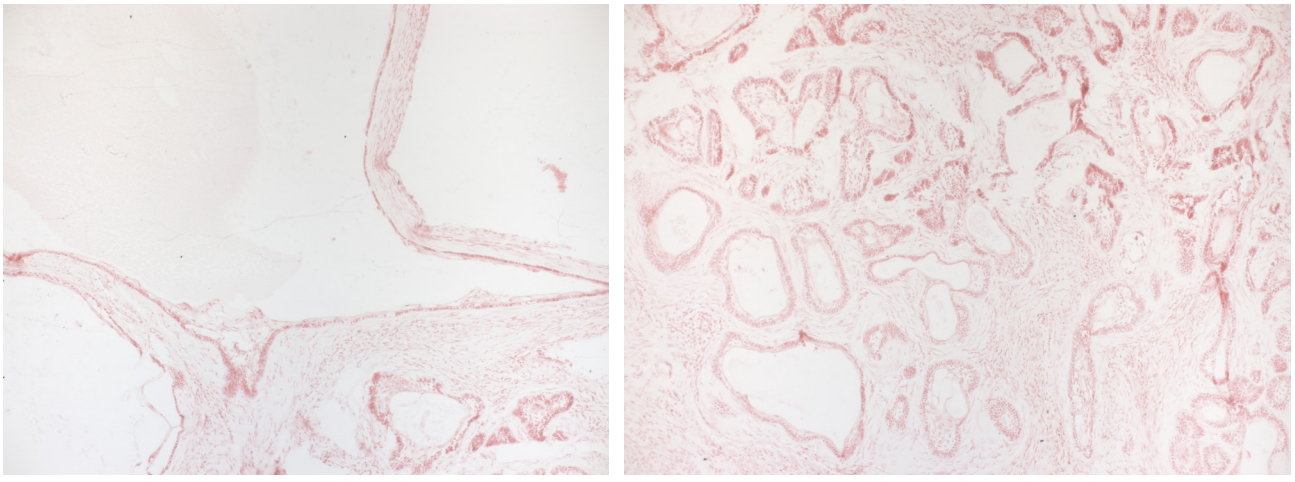

Figure 4 | **A**: Large cystic spaces covered by odontogenic epithelium. **B**: The stroma shows dense connective tissue with numerous odontogenic epithelial islands. They are more loosely arranged at the center, with a appearance similar to the stellate reticulum of the enamel organ.

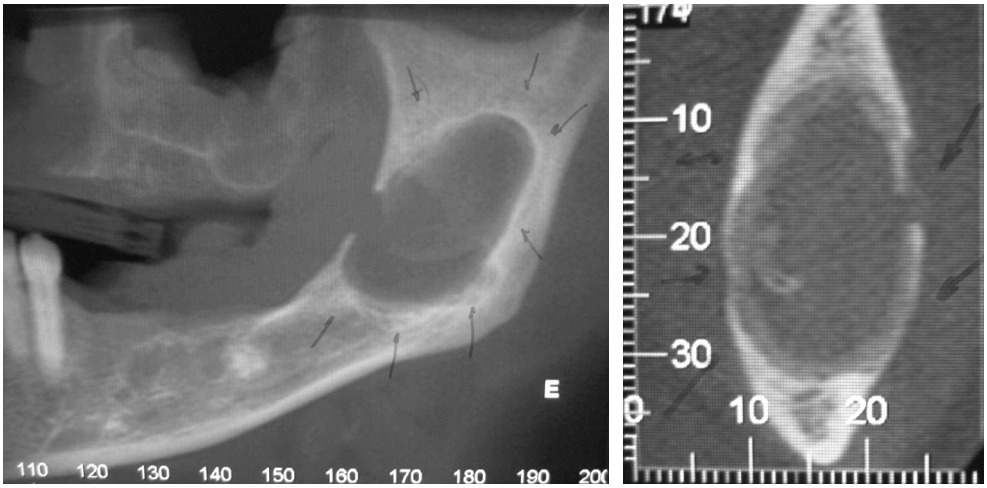

Figure 5 | **A**: Bone CT scan showing cortical rupture of the alveolar bone and a content with heterogeneous pattern. **B**: Parasagittal scan showing a heterogeneous aspect and the bone rupture of the anterior wall of the mandibular ramus.

After this treatment, the patient continued to be treated and there was no evidence of local recurrence for four years. However, after this period, the patient presented a new unilocular lesion in the same area (Figure 5). A new biopsy was performed and showed an ameloblastoma once more. Considering this result, a more aggressive approach of mandibular resection and reconstruction with iliac crest bone grafting was performed. The procedure was uneventful and the patient was released after two days. Currently, the patient is undergoing a postoperative period of four years with no signal of recurrence in the region.

DISCUSSION

The ameloblastoma is a locally invasive aggressive odontogenic tumour that can potentially present the behaviour of malignant lesions. Regarding treatment, many authors advocate resection with margins as model because of the high rates of recurrence and likelihood of distant metastasis.[5,6]

In cases of unilocular variant, these tumours can be classified into 3 variants, according to their histological appearance: luminal, intraluminal, and mural. Some authors suggest that the mural variant has a more aggressive behaviour and should be treated more amply.[7]

In addition to these histological variants, some authors have reported another classification of these neoplasias, called keratoameloblastoma. It differs from the others because it presents tumour islands characteristic of ameloblastoma with extensive keratinised areas.[8]

In a previous study, Whitt et al.[9] studied the clinical and histological characteristics of 13 cases of keratoameloblastomas. They showed that these lesions had extensive keratinisation in the ameloblastic components and smaller areas of keratocyst, as in the abovementioned case.

Neuman et al.[10] described a case of a hybrid tumour showing characteristics of both ameloblastoma and odontogenic keratocyst. These authors justified that these two tumours can develop in the same region because of the pluripotency of odontogenic epithelium.[11] Geng et al.[4] defined that, when keratinisation occurs on the cell surface and the dominant areas are keratocystic, these lesions should be classified as keratocyst with ameloblastic areas.

In this report, a case of recurrent unilocular ameloblastoma treated previously as odontogenic

keratocyst was presented. We believe this mistake in the diagnosis and treatment may have occurred because of some factors:

1. Removal of only a small fragment of the lesion in the first surgery (only required for placement of the decompression device). This specific area with keratinisation of epithelium may not represent the entire lesion.
2. Limited view of the lesion during surgery showing suggested keratin material. This occurred because of the small incision made in the region under local anaesthesia, with the sole purpose of putting the device without additional surgical manipulation.
3. Histopathological examination imitating odontogenic keratocyst in an ameloblastoma because of a keratinisation area (keratoameloblastoma).

In conclusion, this article reiterates the importance of carrying out a proper biopsy in suggested lesions of ameloblastomas and/or odontogenic keratocyst. This should be done by removing multiple specimens in various regions of the lesion. In addition, a histopathological examination should be conducted by professionals in the area of odontogenic tumours because of the possibility of atypical lesions occurring restricted to the head and neck region. By taking these precautions, professionals will avoid diagnostic errors and wrong treatments.

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Ameloblastic fibroma: a case report

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ABSTRACT | Ameloblastic fibroma is a rare benign odontogenic tumor in which both epithelial and ectomesenchymal components are neoplastic. A 24-year-old male patient was referred to the Stomatology Department with difficulty to chew and swelling in the right posterior region of the mandible. The panoramic radiograph showed a well-circumscribed, unilocular radiolucent lesion with partially radiopaque borders involving first and second unerupted molars. Computed tomography imaging presented a hypodense image with well-delimited isodense content, bulging and rupture of cortical bones. The patient underwent an incisional biopsy. Microscopically, the lesion was composed of many mesenchymal tissue cells in strand form, arranged in cords, islands and nests of odontogenic epithelium; the diagnostic was ameloblastic fibroma. The patient was referred to the hospital for enucleation and curettage of the lesion and extraction of the associated teeth. After 8 months of follow-up, no recurrence was observed. This case emphasizes the importance of differential diagnosis, anatomopathological exam, and both clinical and imaging follow-up, since this kind of tumor can recur and progress to malignancy.

DESCRIPTORS | Odontogenic Tumors; Oral Pathology; Ameloblastic Fibroma.

RESUMO | **Fibroma ameloblástico: um estudo de caso** • O fibroma ameloblástico é um tumor odontogênico benigno raro no qual os componentes epiteliais e ectomesenquimais são neoplásicos. Paciente de 24 anos de idade foi encaminhado à clínica de Estomatologia devido à dificuldade de mastigar e edema na região posterior direita da mandíbula. A radiografia panorâmica evidenciou uma lesão radiolúcida unilocular, circunscrita, com bordas parcialmente radiopacas envolvendo o primeiro e segundo molar não irrompidos. A tomografia computadorizada apresentou imagem hipodensa, com conteúdo isodenso, bem delimitada, com abaulamento e rompimento das corticais ósseas. O paciente foi submetido a uma biópsia incisional. Microscopicamente, a lesão foi composta por tecido mesenquimal rico em células, formando cordões, ilhas e ninhos de epitélio odontogênico, cujo diagnóstico foi de fibroma ameloblástico. O paciente foi encaminhado ao hospital para enucleação e curetagem da lesão com extração dos dentes associados. Após 8 meses de acompanhamento, não se observou recorrência. Este caso enfatiza a importância do diagnóstico diferencial, exame anatomopatológico, e acompanhamento clínico e radiográfico, uma vez que este tumor pode recidivar e evoluir para malignidade.

DESCRITORES | Tumores Odontogênicos; Patologia Oral; Fibroma Ameloblástico.

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INTRODUCTION

Ameloblastic fibroma (AF) is a rare benign odontogenic tumor, originating from the odontogenic epithelium and odontogenic mesenchyme,[1] and it is classified as a true mixed tumor.[2]

According to Barnes et al.,[2] mixed odontogenic tumors include: ameloblastic fibrodentinoma (AFD), ameloblastic fibro-odontoma (AFO), odontoma complex and compound, odontoameloblastoma, calcifying cystic odontogenic tumor, dentinogenic ghost cell tumor, and ameloblastic fibroma. To some authors, mixed odontogenic tumors are different developmental stages of the same lesion.[1]

The incidence of odontogenic tumors in a study by Nalabolu et al. was 2.17% of a total 7,400 oral biopsies. The AF corresponded to 0.6% of all odontogenic tumors.[3] The mean age was 14.8 years (ranging from 7 weeks to 62 years).[2] AF occurs more frequently in the mandible and the posterior region is more affected than the anterior region.[1,4]

Clinical and radiographic features of odontogenic tumors, as well as their prognosis and malignant transformation are conflicting.[1] The radiographic features include well-defined, uni- or multilocular radiolucency, and, in most cases, a radiopaque boundary.[2,4]

This case report describes the case of a young man affected by mandibular AF, associated with first and second molars on the right side.

CASE REPORT

A 24-year old male was referred to the Stomatology Department of the School of Dentistry, University of São Paulo, complaining of difficulty chewing and a progressive, asymptomatic increase in the size of his right mandible, which he noticed about 15 days before examination. The patient had no relevant medical history.

Extraoral examination revealed facial asymmetry, bulging of the right lower third of the face, intact skin, no palpable lymphonodes, and no paresthesia.

The intraoral examination revealed a tumor in the right mandible, with an ulcerated surface, a reddish color, well-defined borders, and measuring approximately 3 cm. Absence of the second premolar and the first and second molars was noted in the region of the tumor.

Figure 1 | Extraoral examination revealed facial asymmetry with bulging of the lower third of the face and intact skin, on the right side.

A panoramic radiograph (PR) revealed a unilocular, radiolucent lesion with a partially defined radiopaque boundary, associated to non-erupted first and second molars displaced towards the base of the mandible. Helicoidal computed tomography (HCT) soft window image revealed a hypodense image with isodense content, and cortical bulging with rupture of alveolar crest.

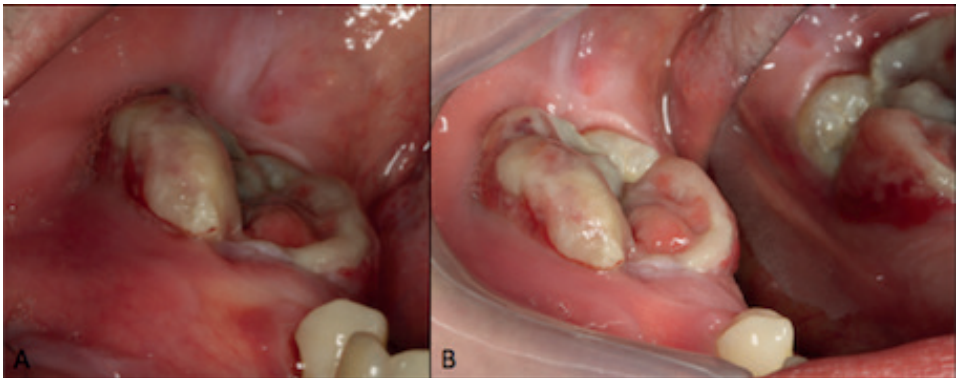

Figure 2 | **A,B**: An ulcerated tumor due to chewing, affecting the posterior right mandible and causing expansion of the cortical bone.

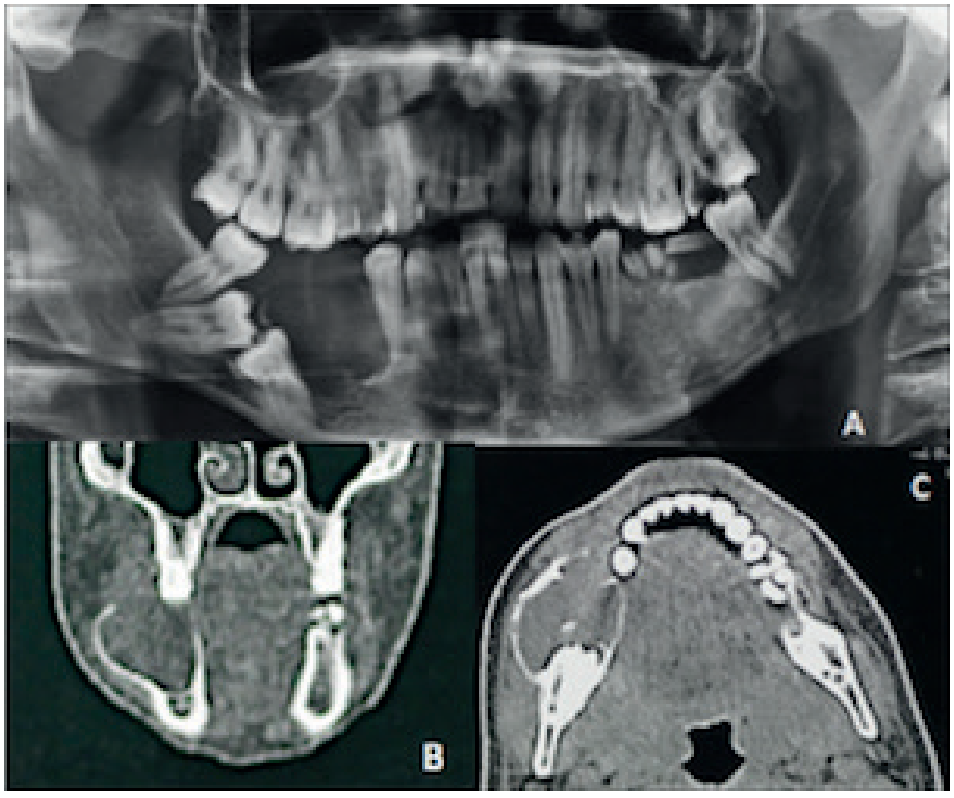

Figure 3 | **A**: A panoramic radiograph shows a well-delimited radiolucent lesion with partially radiopaque borders. **B, C**: HCT coronal and axial view of tissues shows a well-delimited, unilocular, hypodense lesion with isodense content, with cortical expansion and rupture, affecting the posterior right mandible.

INVESTIGATION, HISTOPATHOLOGY AND TREATMENT

The patient was submitted to an incisional biopsy under local anesthesia, and the tissue was sent for histopathological analysis. Microscopically, the tumor consisted of odontogenic epithelium lying in mesenchymal tissue resembling embryonic tooth pulp. The odontogenic epithelium consisted of short and long narrow cords or islands, usually two cells thick, with cuboidal or columnar cells sometimes in anastomosing arrangement. The final histopathological diagnosis was ameloblastic fibroma.

Therefore, surgery was indicated and performed under general anesthesia, with curettage of the lesion and tooth extraction (Figure 5). AF diagnosis was confirmed. A helicoidal tomography was performed 8 months after surgery (Figure 6). The patient has been followed-up with no evidence of recurrence, and has been asymptomatic ever since (Figure 7).

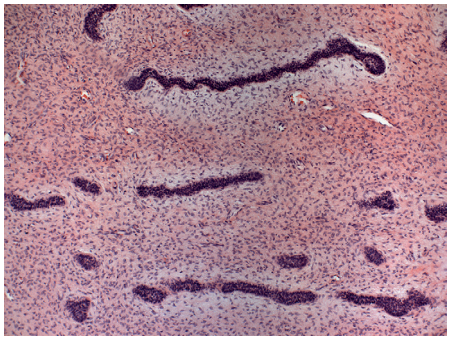

Figure 4 | Benign neoplasm consisting of mesenchymal tissue associated with odontogenic epithelium arranged in short and long, narrow cords or islands (H&E 200x).

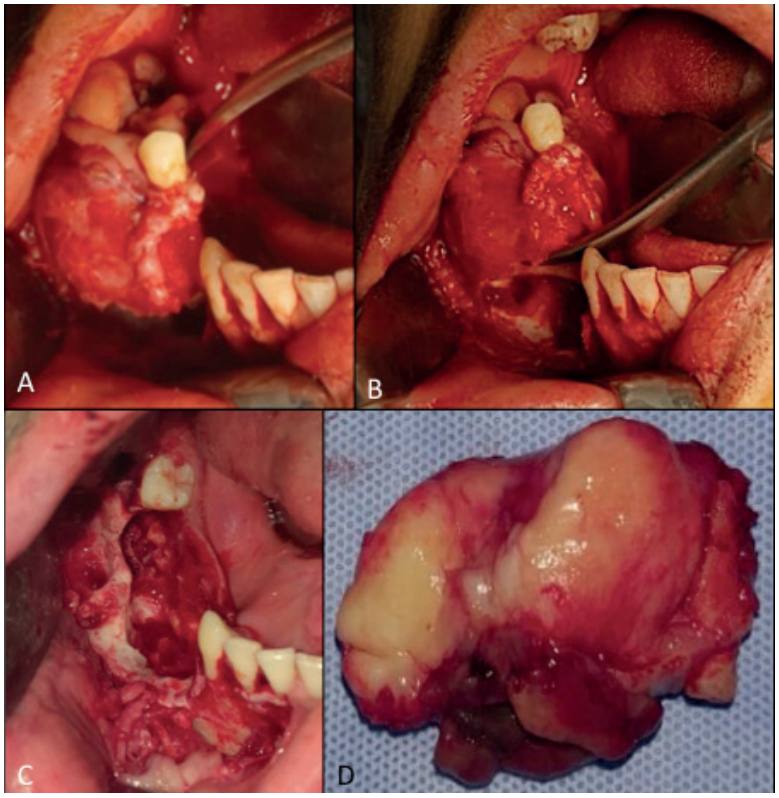

Figure 5 | **A-C**: Trans-surgical procedure: enucleation with curettage of the surrounding bone and removal of the affected tooth. **D**: An extracted specimen.

Figure 6 | **A**: Five months after surgery, the patient presented symmetry. **B, C**: Intraoral examination revealed normal alveolar ridge and intact surface.

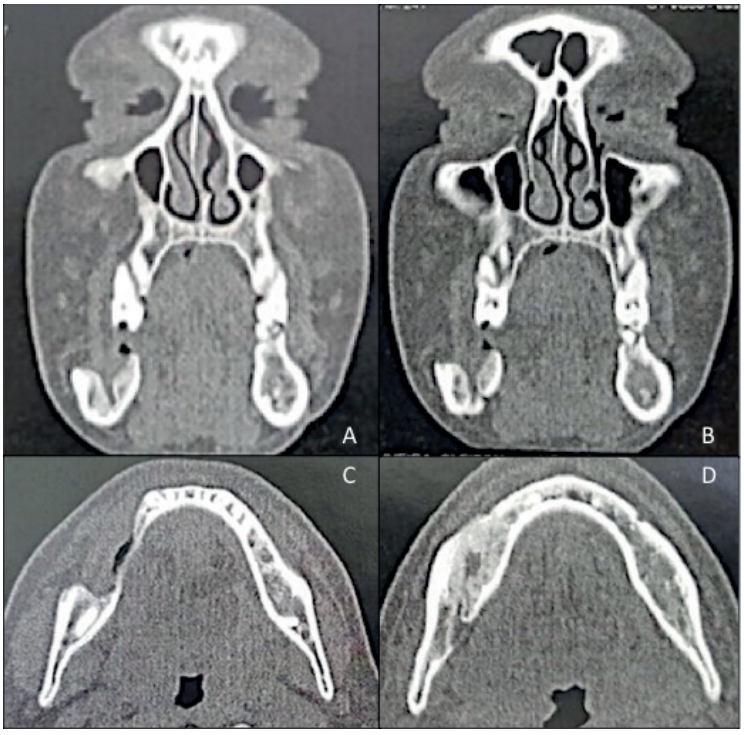

Figure 7 | **A, B**: HCT coronal view shows an area of bone defect from surgery, with no evidence of lesion. **C, D**: HCT axial view shows a hyperdense area, suggesting a process of bone repair in the right mandible.

DISCUSSION

Ameloblastic fibroma of the jaw is a benign, relatively rare, mixed odontogenic tumor, whose epithelial and mesenchymal components are neoplastic.[2,4] This tumor is usually diagnosed in the first and second decades of life (72.4%), when odontogenesis is complete (80% of cases), and affects mainly the mandible.[1,4] In this case, the lesion was diagnosed in the third decade of life, and occurred in the posterior region of the mandible. However, some cases of AF in the maxilla have also been reported.[1,5]

AF does not have a specific sign or symptom, and it is often observed in a routine radiograph, in the form of cysts and other odontogenic tumors.[2] In this case, the patient never complained about the absence of his right lower molars. His chief complaint was just difficulty chewing due to the large mass of tissue in this region.

Most cases of AF present painless swelling, or are discovered due to disturbances of tooth eruption. Radiographically, the tumor presents a well-demarcated radiolucency, often associated with a malpositioned tooth.[2] In addition, a multilocular pattern often characterizes larger tumors (75% of the cases), and a unilocular pattern is more common in smaller lesions (up to 4 cm),[6] as was this case. Differential diagnosis of AF lesions must be made, distinguishing ameloblastoma, odontogenic myxoma, dentigerous cysts, odontogenic keratocysts, central giant cell granuloma, and histocytosis.[7]

Histological examination of AF showed strands, cords, and islands of odontogenic epithelium in a primitive connective tissue stroma closely resembling the dental papilla. No hard tooth structures were detected in any of the primary tumors.[4] Tumors with AF histomorphology may form dysplastic dentin; in this case, they are called ameloblastic fibrodentinoma.[2] Some authors state that AF is a separate, specific neoplastic entity that does not develop into a more differentiated odontogenic tumor.[2]

Another study asserts that there are two variants of ameloblastic fibroma: neoplastic and hamartomatous. Lesions in patients aged >22 years are considered true neoplasms, whereas those occurring in younger patients may be either true neoplasms or odontomas. Asymptomatic, small unilocular lesions with no or minimal bone expansion in young individuals are likely to be developing odontomas, whereas large, expansive lesions with bone destruction are neoplasms. Since the histopathology of these two variants is indistinguishable, they may be distinguished by clinical and radiological features.[1] It is important to emphasize that this case was classified as a neoplasm.

The ectomesenchymal component of AF presents relatively scanty stellate reticulum in smaller follicles, compared to ameloblastoma. These histological characteristics help distinguish the pathologies.[7]

AF may rarely present ghost cell differentiation and calcification in the epithelial component. Recently, a study addressing an association between AF and calcifying odontogenic cyst (COC) with ghost cell differentiation was published. Interestingly, all cases of COC with ghost cell differentiation were observed in the epithelial lining. AF components existed in the cystic wall and some solid areas. Luo et al. described a case of AF that had ghost cell differentiation and calcifications in some of the neoplastic epithelial islands, but did not present any histological characteristics of COC in the cystic wall. Most lesions were cystic-solid, comprised of odontogenic epithelial strands, islands, and ectomesenchymal myxoid component. The behavior of ghost cell differentiation in AF remains unclear.[8]

The epithelial component of AF consists of branching and anastomosing epithelial strands of different size, which form knots. Mitotic figures both in epithelial and mesenchymal components may occur; if present, they should raise concern about the benign nature of the case.[8] AF may rarely progress to malignancy (ameloblastic fibrosarcoma – AFS).

In this case, AFS presents a benign epithelial and a malignant ectomesenchymal component.[2,9] An overexpression of Ki-67 immunoexpression (a proliferative nuclear cell marker) and Bcl-2 proteins in AFS, in association with histopathological features, may be useful markers to identify malignancy.[9]

Regarding the nature and biological behavior of tumors, the treatment for AF in 90% of the cases initially consists of a conservative surgical approach, and in 10% of the cases, radical surgery.[4] The most appropriate treatment for AF is still unclear. In this case, a conservative technique was proposed, especially because the patient was young, as corroborated by the literature. The patient's follow-up time is short to detect recurrences, however, a regular follow-up is maintained.

CONCLUSION

Although rare, ameloblastic fibroma may recur and progress to malignancy. The objective of this case report was to highlight the challenge involved in its correct diagnosis and treatment, considering AF lesion behavior, and emphasizes the importance of clinical and radiographic follow-up, which should be for long periods for early detection of possible recurrences.

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