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SUMMARY

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ARTIFICIAL INTELLIGENCE IN WRITING AND SCIENTIFIC PUBLICATION

The recent popularization of the use of artificial intelligence (AI) in writing and scientific publishing has generated controversial feelings in the academic community, ranging from enthusiasm for the facilities offered to concerns arising from its inappropriate use.

Scientific writing is essential for carrying out research and requires careful attention to detail, clarity of expression and alignment with recommended standards. The importance of quality scientific writing should not be underestimated since it involves a slow and arduous process (1).

Large Language Models (LLMs) are AI tools that have been developed to understand, produce, and manage textual language with impressive skill (2). LLMs are trained with a robust amount of text that allows them to perform various tasks such as answering several questions, translating, and writing (3). These skills, brought to the context of scientific writing, have the potential to provide efficiency to the manuscript production process and speed the editorial flow in the submission processes to scientific journals.

Nevertheless, all types of "new technologies" requires the evaluation of benefits and risks involved in addition to the future impacts produced on scientific literature, an important theoretical foundation for the entire decision-making process related to the diagnosis and treatment of our patients.

The most obvious benefit of AI assistance in the production of scientific articles is the increase in the efficiency of the writing process as a whole. The greater speed of AI in carrying out "repetition" activities that consume considerable time, such as text formatting and searching for bibliographic references, allows researchers to save plenty of time and effort, which can then be used in the creative process, making more motivated authors and increasing the final quality of the manuscript (4).

Another important aspect to be highlighted is the possibility of AI-assisted writing to increase the scientific engagement of authors, especially those students who are non-native English speakers. The development of scientific writing in English is a skill that should be encouraged during the training of all students in the biomedical field. The literature already has studies that prove that the use of AI tools is capable of improving the overall performance of Chinese and Pakistani students in writing the English language, as well as other specific skills such as coherence, cohesion, range of vocabulary, variety and grammatical precision. (5,6).

When it comes to the risks involved, a concern that emerged along with the widespread use of AI in academic writing was the potential for plagiarism to grow. As it is an algorithm fed by textual data, there is a risk that parts of the text generated in an AI such as ChatGPT are direct copies of an original source without the true authorship of the written manuscript being attributed. There is also a record, by some researchers, of the creation of non-existent bibliographic sources (7).

Even the definition of plagiarism has been widely discussed after the use of ChatGPT became popular. Plagiarism is a practice strictly prohibited in academia and defined as the use of ideas, words and concepts without due citation to the author. This also includes paraphrasing quotes and concepts from an author with no appropriated reference (8). Some authors, mainly postgraduate students, are being rightly accused of plagiarism, for having used AI in their scientific writing. Currently, the tools for detecting both plagiarism and the use of ChatGPT lack precision in detecting both situations.

Faced with all the ethical and operational issues present in this complex context, several questions arise, among them, the following stands out: will we be able to resolve the ethical issues involved with the use of AI in academic writing and evaluate scientific research impartially from an author who openly declares the use of AI, without stigmatizing it?

The role of academic institutions, whether educational institutions or scientific journals, will be extremely relevant in this future with so many challenging characteristics.

It will be up to academia to regulate the use of AI in the scientific writing process, keeping the human author as the main protagonist and relegating AI to the role of an auxiliary tool. To this end, it is necessary to improve AI in terms of adequate attribution of authorship of texts, as well as improving plagiarism detection and AI use tools. They may also contribute to greater safety for authors, reviewers and scientific editors by establishing an accessible and well-defined code of ethical conduct, as well as greater rigor in punishing cases of plagiarism.

The use of AI in scientific writing is a technological advance with the potential to significantly improve the quality and accessibility of scientific literature worldwide. It is up to us, members of the academic community, to ensure that well-established ethical principles guide its use.

TERESA CRISTINA PEREIRA DE OLIVEIRA
Editor-in-chief

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ORIGINAL ARTICLE

COMPARATIVE ANALYSIS OF THE MECHANICAL PROPERTIES OF TYPE K STAINLESS STEEL MANUAL INSTRUMENTS: A STUDY OF DIFFERENT BRANDS

ANÁLISE COMPARATIVA DAS CARACTERÍSTICAS MECÂNICAS DE INSTRUMENTOS MANUAIS DE AÇO INOXIDÁVEL TIPO K: UM ESTUDO DE DIFERENTES MARCAS

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ABSTRACT

The present study aimed to compare the geometric and mechanical characteristics of six different brands of type K stainless steel manual instruments. Instruments in sizes 15 and 0.20 were analyzed, through buckling and torsional resistance tests, following ISO 3630 standards. -1 and ANSI/ADA 101. Micromorphometry evaluated diameters and conicities at specific points (D0 and D3). The results indicated that the TDK 15 and Angelus 0.20 instruments presented greater resistance to buckling, while variations in diameter in D0 were observed mainly in the TDK 15 and Perfect 15 instruments. In relation to torsional resistance, the Maillefer 0.20 instruments stood out due to the greater angular deflection before fracture, suggesting greater flexibility. Thus, the TDK 15 and Angelus 0.20 instruments proved to be more suitable for negotiating atretic canals and endodontic retreatment, however variations in the diameter of the TDK 15 and Perfect 15 instruments may compromise the adaptation of cones during the obturation phase. The Maillefer 0.20 instruments, with greater flexibility, are more suitable for curved canals.

Keywords: Dental instruments, Stainless steel, Endodontics, Root canal preparation, Root canal treatment, Assessment of Mechanical Properties.

RESUMO

O presente estudo teve como objetivo comparar as características geométricas e mecânicas de seis marcas diferentes de instrumentos manuais de aço inoxidável tipo K. Foram analisados instrumentos nos tamanhos 15 e 0,20, por meio de testes de resistência à flambagem e torção, seguindo as normas ISO 3630-1 e ANSI/ADA 101. A micromorfometria avaliou diâmetros e conicidades em pontos específicos (D0 e D3). Os resultados indicaram que os instrumentos TDK 15 e Angelus 0,20 apresentaram maior resistência à flambagem, enquanto variações no diâmetro em D0 foram observadas principalmente nos instrumentos TDK 15 e Perfect 15. Em relação à torção, os instrumentos Maillefer 0,20 destacaram-se pela maior deflexão angular antes da fratura, sugerindo maior flexibilidade. Assim, os instrumentos TDK 15 e Angelus 0,20 mostraram-se mais adequados para a negociação de canais atrésicos e retratamento endodôntico, porém as variações no diâmetro dos instrumentos TDK 15 e Perfect 15 podem comprometer a adaptação de cones na fase de obturação. Já os instrumentos Maillefer 0,20, com maior flexibilidade, são mais indicados para canais curvos.

Palavras-chave: Instrumentos odontológicos, Aço inoxidável, Endodontia, Preparo de canal radicular, Tratamento de canal radicular, Avaliação de Propriedades Mecânicas.

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INTRODUCTION

Mechanical instrumentation plays a fundamental role in endodontics, directly influencing the success and long-term prognosis of endodontic treatments (1,2). The endodontic instruments used for this purpose should ideally be small and have mechanical resistance to twisting and buckling, in order to withstand the loads imposed on them during apical progression (3,4).

According to ISO (International Organization for Standardization), the working part of a Kerr (K) type instrument is 16 mm long and has a taper of 0.02 mm/mm (5). Instruments with adequate resistance to buckling can facilitate both the location of the canal orifices and access to the apical third. On the other hand, instruments with low buckling resistance may develop elastic or plastic deformations that hinder their apical progression (4,6,7). On the other hand, instruments with high buckling resistance may present greater stiffness than clinically necessary. The use of rigid instruments can result in some complications, such as steps and perforations during instrumentation, compromising the clinical result (8).

Since the introduction of mechanized nickel-titanium (NiTi) instruments in endodontics, there has been a tendency to replace manual stainless steel instruments (9,10). Though, one of the main disadvantages of NiTi instruments is the possibility of fracture without visible changes during clinical use (11). For this reason, stainless steel instruments continue to be widely used for recognizing and establishing the canal path before the use of mechanized instruments (12,13). This clinical step, known as glide-path, is recommended to avoid modeling errors and reduce the rate of instrument fracture in calcified and narrow canals (14,15).

Unlike NiTi instruments, which have been widely studied, there are few studies on the mechanical and physical characteristics of stainless steel instruments (16,17). Given the diversity of brands available on the market, it is likely that there will be variations in their physical properties, which may influence their clinical performance. With the emergence of new brands, it becomes essential to characterize and evaluate their mechanical properties.

This study aims to carry out a comparative analysis of the geometric and mechanical characteristics of six different brands of type K stainless steel manual instruments with a length of 25mm and dimensions 15 and 0.20, through micromorphometry, buckling and torsion tests.

METHODS

Stainless steel manual instruments measuring 25 mm in length were used from the manufacturers Angelus (Londrina, Brazil), TDK (Curitiba, Brazil), MK Life (Porto Alegre, Brazil), Perfect (Shenzhen, China), All Prime (Tan Huong, Pho Yen municipality, in Thai Nguyen Province, Vietnam) and Dentsply-Maillefer (Baillagues, Switzerland), with diameters of 15/0.02 and 0.20/0.02. The number of elements measured was established in accordance with item 6.3 of ANSI/ADA standard nº 101.

Buckling test

For the buckling test, a load was applied in the axial direction of each instrument using an EMIC DL 200MF universal testing machine (EMIC São José dos Pinhais, Brazil) (figure 1). The maximum resistance to buckling (lateral elastic deformation) was obtained according to previously published studies (7,18). A 20 N load cell was used. The rod of the instrument was fixed to the head of the universal testing machine by a mandrel, and the tip of the instrument was axially compressed against an aluminum plate with a rough surface. The test was performed at a speed of 1 mm/min, and the maximum force for lateral displacement was recorded.

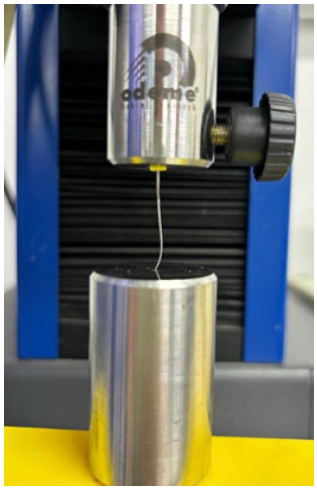

Figure 1: Photograph of the buckling test. After axial compression, the instrument presented lateral deformation.

Micromorphometric analysis

To perform micromorphometry, images of the instruments were captured using an Opticam stereoscopic magnifying glass coupled to a digital camera. Measurements were carried out using the TSView 7.2.1.7 software. The diameters of the instruments were determined from D0 to D5, with intervals of 1.0 mm between each measurement. The taper was calculated as specified in ANSI/ADA standard no. 101, item 6.3.3.2, using diameters D5 and D1. The taper was calculated using the formula: C=(D5-D1)/4, in which the difference between diameters is divided by the distance between them.

The diameters of the instruments were obtained by drawing tangent lines (red lines in Figure 2) to the upper and lower crests of the active part of the instruments.

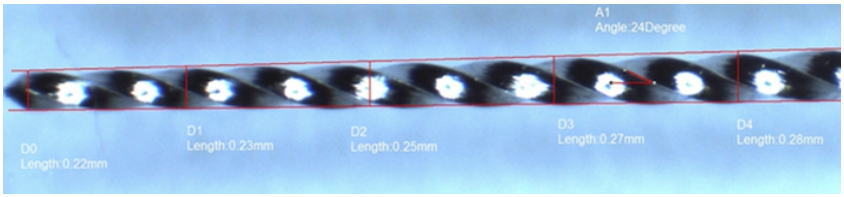

Figure 2: Micromorphometry photography. The diameters of the instruments.

Torsional Test

For the torsional test, each instrument was fixed 3 mm from the tip, using a vise coupled to a load cell with a torque sensor. The instrument shaft was fixed in an opposing mandrel, being driven by a motor (figure 3). To prevent the induction of axial compressive stress in the instrument during the torsional test, a "U-piece" was used, which allowed the vise to slide laterally, immobilizing the tip of the instrument. All instruments were driven clockwise at a speed of 2 rpm until fracture. The torque load (Ncm) and angular deflection (º) were continuously monitored using software on the TT100 torquemeter (Odeme, Luzerna, SC, Brazil). The maximum fracture torque and angular deflection were obtained by the torquemeter software (Odeme Analysis TT, Odeme).

Sample calculation

Three pilot tests were carried out to calculate the sample size using the G* Power 3.1.9.4 program (Franz Foul, University of Kiel, Germany). An effect size of 12 elements was estimated, two for each group. For greater reliability, and due to the availability of material, five tests were carried out per group, totaling 30 instruments.

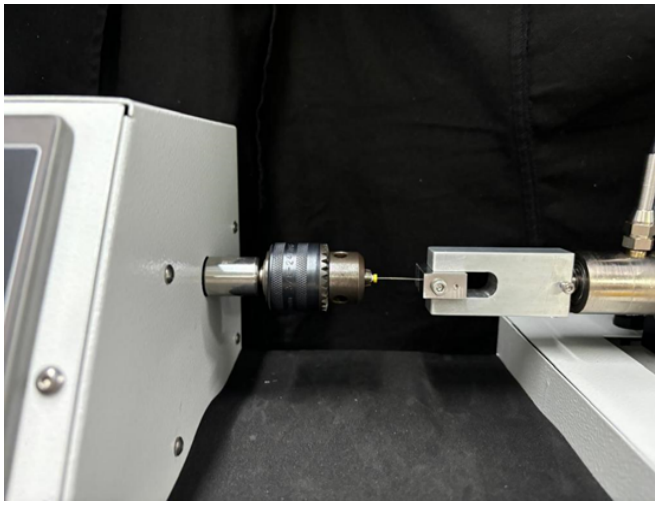

Figure 3: Photograph of the torsion test. Seizing the instrument to perform the torsional test on the left was a Jacob mandrel to which the handle was fixed and on the right was a vise that allowed the instrument to be fixed 3mm from the tip. It is also possible to observe the "U" device that allows the vise to slide, preventing normal tensions from causing the instrument to buckle.

Statistical analysis

Preliminary data analysis revealed a bell-shaped distribution, according to the Shapiro-Wilk test. For the normality test, the Minitab Student program was used. The hypothesis test selected was analysis of variance (ANOVA), complemented by the Student-Newman-Keuls post-hoc test. For hypothesis testing, the Primer of Biostatics version 6.0 program (McGraw-Hill, New York, NY, USA) was used. For all tests, the type α error was 5%.

RESULTS

The results obtained in the mechanical tests are presented in tables 1 and 2.

Buckling Test

For type 15 instruments, the Angelus brand had the lowest buckling resistance followed by the Maillefer brand, while TDK had the highest buckling resistance (P<0.05). No significant differences were observed in buckling resistance between the Perfect, MKLife and All Prime brands (P>0.05). For type 0.20 instruments, Angelus showed the highest buckling resistance, while Maillefer the lowest (P<0.05). No differences were observed in buckling resistance between the brands Perfect, TDK, MKLife and All Prime (P>0.05).

Torsional Test

In the evaluation of type 15 instruments, no differences were observed in the maximum fracture torque between the brands (P>0.05). Regarding type 0.20 instruments, the Maillefer brand presented the greatest resistance to angular deflection. The other brands had no significant difference (P>0.05). No differences were observed in torsional torque resistance between brands (P>0.05).

Table 1: Mean + SD (standard deviation) of mechanical tests carried out on instruments with a diameter of 0.15 mm. Different superscript letters indicate a statistically significant difference (p<0.05).

INSTRUMENT	BUCKLING (gf)	TORSIONAL(°)	TORSIONAL(N.mm)
MAILLEFER (MAI)	142+10.8^{A}	644.77+164.55^{A}	3.35+0.38^{A}
PERFECT (PER)	171+11.3^{B}	712.01+111.39^{A}	3.9+0.17^{A}
TDK	236+16.8^{C}	821.19+198.36^{A}	5.4+0.49^{A}
MKLIFE (MKL)	173+6.5^{B}	797.89+108.76^{A}	3.02+0.56^{A}
ANGELUS (ANG)	128+10.3^{E}	880.48+218.61^{A}	2.84+0.25^{A}
ALLPRIME (ALL)	161+12.4^{B}	742.14+101.40^{A}	3.07+0.76^{A}

Buckling resistance: TDK>PER=MKL=ALL>MAI>ANG
Torsional resistance (angle): MAI= ALL=ANG=MKL=PERF=TDK
Torsional resistance (torque): MAI= ALL=ANG=MKL=PERF=TDK

Table 2: Mean + SD of mechanical tests carried out on instruments with a diameter of 0.20 mm. Different superscript letters indicate a statistically significant difference (p<0.05).

INSTRUMENT	BUCKLING (gf)	TORSIONAL(°)	TORSIONAL(N.mm)
MAILLEFER (MAI)	239±10.2^{A}	1033.23±153.26^{A}	3.52±0.24^{A}
PERFECT (PER)	270±19.2^{B}	701.44±125.8^{B}	3.84±0.52^{A}
TDK	292±29.2^{B}	569.39±92.77^{B}	3.32±0.26^{A}
MKLIFE (MKL)	311±45.1^{B}	653.33±71.12^{B}	3.02±0.26^{A}
ANGELUS (ANG)	342±11.8^{E}	574.81±191.31^{B}	3.26±0.39^{A}
ALLPRIME (ALL)	267±13.4^{B}	751.12±194.00^{B}	3.46±0.41^{A}

Buckling resistance: ANG>MKL=TDK=PER=ALL>MAI
Torsional resistance (angle): MAI > ALL=ANG=MKL=PERF=TDK
Torsional resistance (torque): MAI=ALL=ANG=MKL=PERF=TDK

Micromorphometry Analysis

Tables 3 and 4 describe the results of the micromorphometric analysis showing the average diameter in D0 and average conicity of instruments 0.15 and 0.20.

The micromorphometric analysis of the instruments demonstrated that the 0.20 MK Life and TDK type instruments had an increased conicity of 0.03 mm/mm, while the type 15 instruments from all manufacturers met the standardization recommended by ANSI/ADA nº101.

In relation to D0, instruments 15 from the Maillefer and All Prime brands had a tip diameter smaller than that accepted by the tolerance. And the 0.15 Perfect and TDK instruments had a larger diameter than recommended. In K 0.20 instruments, only the Perfect brand met the standard's recommendation.

Table 3: Mean diameters in D0 and mean conicity of instruments 0.15.

INSTRUMENT	MAILLEFER	PERFECT	TDK	MKLIFE	ANGELUS	ALLPRIME
1	0.14	0.15	0.16	0.13	0.14	0.12
2	0.12	0.16	0.16	0.16	0.14	0.16
3	0.16	0.18	0.19	0.17	0.13	0.17
Mean D0	0.14	0.16	0.17	0.15	0.14	0.15
Mean conicity	0.02	0.02	0.02	0.02	0.02	0.02

Table 4: Mean diameters in D0 and mean conicity of instruments 0.20.

INSTRUMENT	MAILLEFER	PERFECT	TDK	MKLIFE	ANGELUS	ALLPRIME
1	0.19	0.2	0.15	0.17	0.19	0.15
2	0.22	0.21	0.19	0.14	0.18	0.2
3	0.17	0.22	0.2	0.15	0.17	0.22
Mean D0	0.19	0.21	0.18	0.15	0.18	0.21
Mean conicity	0.02	0.02	0.03	0.03	0.02	0.02

DISCUSSION

The glide-path is a protocol that ensures safe and efficient passage of NiTi instruments along the entire working length (19). Given the frequent exposure of these materials to bending and torsional stresses, it is essential to investigate their physical characteristics and composition.

The TDK type 15 and Angelus type 0.20 instruments, which are commonly used in the glide-path, demonstrated the highest buckling resistance. Clinically, this may be interesting for negotiating atretic canals and in cases of endodontic retreatment. However, both presented D0 values higher than those recommended by the clinical pattern, which could cause problems at the time of filling. The stop generated by the last instrument used may not properly anchor the main gutta-percha cones, resulting in material extrusion (5).

Instruments with greater metallic mass tend to present better resistance to twist and buckling, factors that can significantly influence canal negotiation procedures and the establishment of a glide-path for the apical region of the root canal (12). However, Angelus and Maillefer type 15 instruments and Maillefer type 0.20 instruments demonstrated reduced resistance to buckling loads, which corroborate with results of a previous study (13).

These specific instruments have a greater degree of flexibility, a critical attribute for their performance in endodontic procedures (13). Increased flexibility offers specific advantages, particularly in negotiating the curvature of the apical region. This feature is especially valuable during the recognition phase, minimizing the risk of accidents, such as broken instruments. Although advantageous in many scenarios, it is worth recognizing that increased flexibility and reduced buckling resistance can present challenges in fully negotiating constricted and calcified root canals (6).

The model used in the present study to perform micromorphometry was the same used by Ribeiro et al., 2016 (20), which consists of drawing tangent lines to the instruments' helices. In this way, the measurement simulates the shape of the instrument preparation in the root canal. According to item 4.2 of ANSI/ADA standard no. 101, instrument diameters have a tolerance of + 0.025 mm. The average conicity of all instruments evaluated for the study is within the standard recommended. Nevertheless, regarding D0, type 15 instruments from the Maillefer and All Prime brands had a smaller tip diameter than acceptable. The 0.15 Perfect and TDK instruments had a larger diameter than recommended. In K 0.20 instruments, only the Perfect brand met the standard's recommendation. This diameter is of great importance, as it represents the region of mechanical preparation that will define the stop for filling in the apical critical zone (21).

Observing the D0 of the instruments used in the present study, the lack of precision during manufacturing became evident. Small diameter instruments may have dimensional variations due to the critical manufacturing process (22). The failure in the manufacture of instruments creates difficulties during instrumentation, when using instruments with larger diameters and when filling the canals, since the diameters found are not in accordance with recommendations. Thus, the calibrated cones used at the time of filling will not adjust to the preparation (23). Dias et al. when analyzing the morphometrics of type K files from the manufacturers Angelus and Maillefer found that none of them fully comply with ANSI standard 101 (5).

Although it is known that the minimum width of a glide-path should be size 0.10 (24), previous studies have described an initial preparation, generally with a small taper (0.02) and a size of at least 15 or 0.20 to avoid the instrument from blocking (25,26). Torsional stresses affecting shaping instruments have been reported to be reduced by creating a glide-path up to these apical sizes (25,27). To overcome the challenges inherent in performing glide-path procedures, an endodontic instrument must have great flexibility, high buckling resistance, and torque resistance with high angular deflection under torsional forces (28). Glide-path instruments do not always present the sum of these characteristics. For example, in general, the more flexible the instrument, the lower its resistance to buckling (19).

TDK type 15 instruments had the highest buckling resistance, while Angelus demonstrated the lowest. Clinically, high buckling resistance is preferred during root canal exploration, allowing the instrument to advance axially in the apical direction. However, there is an inverse relationship between flexibility and buckling resistance. Both mechanical properties are related to the geometry and alloy of the instrument. Furthermore, diameter and conicity have a strong influence on the buckling test (29). This explains why TDK has greater buckling resistance than the other instruments tested. Despite demonstrating conicity within the standards required by the pattern, it was the instrument that presented the largest diameter in D0, which implies greater structural rigidity and, consequently, greater resistance to buckling (18). On the other hand, the lower buckling resistance of Angelus type 15 instruments may be related to the smaller diameter in D0, which makes them more flexible and, consequently, less rigid within the other groups.

Exploring a constricted curved canal is often a challenge for the endodontist. Accidents such as protrusions and perforations can occur during the exploration of narrow curved canals, compromising the treatment outcome (1). The incidence of protrusion formation when using more flexible files is lower compared to more rigid files. The metallic memory of stainless steel to return to a straight position increases the tendency to carry or protrude a canal and eventually drill curved canals (30).

The TDK and Perfect type 15 instruments showed greater resistance to buckling. This property, theoretically, provides greater ability to negotiate narrow root canals, though, as they are more rigid, they are not indicated in cases of curved canals, such as molar canals. With the increased chance of the development of steps and deviations (19), the Angelus instrument appears to be the least suitable for this procedure.

Regarding type 0.20 instruments, the Angelus had the highest buckling resistance, while the Maillefer were less resistant. Although the Angelus do not have the largest diameter in D0 nor the largest conicity among the instruments evaluated, their greater resistance to buckling is possibly due to the composition of the instrument's alloy, as occurred with the Maillefer, also demonstrating conicity and size in D0 recommended by the pattern.

Torsional strength tests were performed as suggested by ISO 3630-1 and have been reported in previously published studies (31,32). For torsional tests, the immobilization point at D3 is the critical point at which the material will fail when shear stresses are applied (5). Two different properties were obtained from this test: the maximum torque and the angular deflection. The maximum torque is requested when an instrument is clamped inside the root canal and continues to be activated (11). The greater the touch for the fracture, the safer the instrument (24). In this regard, none of the tested brand stood out.

Instruments from different brands have similar transversal designs, diameters and conics, which favored equivalence in torsional properties. Interestingly, Maillefer type 0.20 instruments demonstrated greater angular deflection before fracture, as well as lower resistance to buckling, demonstrating greater flexibility of the instrument. Angular deflection works as a safety mechanism during the use of instruments, as the greater the plastic deformation, it can be seen more easily, allowing the affected instrument to be discarded (15). In our study, the 15 instruments showed no significant differences.

This mixture of mechanical properties makes these instruments less suitable for use as glide path instruments, especially in cases of narrow root canals. However, they are more suitable for curved canals, as they are more flexible (28). Instruments with characteristics such as greater conicity and larger diameters tend to be less flexible, more

resistant to buckling and end up withstanding greater torsional stress (33), which corroborates the findings of this study.

CONCLUSION

The TDK 15 and Angelus 0.20 instruments proved to be more suitable for negotiating atretic canals and endodontic retreatment, even though variations in the diameter of the TDK 15 and Perfect 15 instruments may compromise the adaptation of cones during the obturation phase. The Maillefer 0.20 instruments, with greater flexibility, are more suitable for curved canals. Further studies are needed to validate these data and explore new endodontic approaches.

The authors declare no conflicts of interest.

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ORIGINAL ARTICLE

IMPACT OF THE COVID-19 PANDEMIC ON THE INCREASE IN EMERGENCIES FOR TEMPOROMANDIBULAR DYSFUNCTIONS: A CROSS-SECTIONAL STUDY

IMPACTO DA PANDEMIA DE COVID-19 NO AUMENTO DAS URGÊNCIAS POR DISFUNÇÕES TEMPOROMANDIBULARES: UM ESTUDO TRANSVERSAL

Leonardo Vianna Machado[1], Kátia Rodrigues Reis[2]

ABSTRACT

COVID-19 is a disease that has a wide clinical spectrum that ranges from completely asymptomatic conditions to severe pulmonary infection. The social isolations recommended by health authorities, despite being necessary to prevent the spread of the disease, may had have a negative impact on the mental health of the population with an increase in the number of cases of anxiety, depression and other psychological disorders. In this context, temporomandibular dysfunction (TMD), a multifactorial disease that including the psychological factor, may have worsened after the start of the pandemic period. The aim of this study was to verify whether there was a worsening of TMD symptoms during the pandemic period and what they were. The research was carried out on patients treated at the TMD clinic of Odontoclínica Central da Marinha (OCM), located in the city of Rio de Janeiro-RJ, Brazil. A retrospective cross-sectional study was carried out by collecting data from 784 electronic medical records of patients aged of 12 and over, before the pandemic, in 2019, and during the pandemic, in 2020, according to the eligibility criteria. The results obtained through statistical analyses revealed a worsening of TMD symptoms during the pandemic period. There was an increase in emergency consultations and cases of muscle and join pain. The worsening of TMD symptoms might be associated with the negative impact of the pandemic on the mental health of OCM patients.

Keywords: COVID-19; Temporomandibular Joint Dysfunction Syndrome; facial pain.

RESUMO

A COVID-19 é uma doença que apresenta um largo espectro clínico que varia de quadros totalmente assintomáticos a quadros graves de infecção pulmonar. O isolamento social recomendado pelas autoridades sanitárias, apesar de necessário para impedir a disseminação da doença, pode ter repercutido negativamente na saúde mental da população, gerando aumento do número de casos de ansiedade, depressão e outros transtornos psicológicos. Neste contexto, a disfunção temporomandibular (DTM), uma doença de caráter multifatorial, entre eles o fator psicológico, pode ter sido agravada após o início da pandemia. O objetivo deste estudo foi verificar se houve ou não o agravamento dos sintomas de DTM no período de pandemia, e quais foram eles. A pesquisa foi realizada em pacientes atendidos na Clínica de DTM da Odontoclínica Central da Marinha (OCM), situada da cidade do Rio de Janeiro-RJ, Brasil. Foi realizado um estudo transversal retrospectivo através da coleta de dados em 784 prontuários eletrônicos, de pacientes a partir de 12 anos, antes da pandemia, em 2019, e durante a pandemia, em 2020, de acordo com os critérios de elegibilidade. Os resultados obtidos, através de análises estatísticas, revelaram agravamento dos sintomas de DTM no período pandêmico. Houve aumento em consultas de emergência e em quadros de dores musculoarticulares. Concluiu-se que o agravamento dos sintomas de DTM pode estar associado à repercussão negativa da pandemia na saúde mental dos pacientes da OCM.

Palavras-chave: COVID-19; Síndrome da Disfunção da Articulação Temporomandibular; bruxismo; dor facial.

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INTRODUCTION

Temporomandibular disorder (TMD) has a multifactorial etiology and may be associated with biological, social, emotional, and cognitive factors (1,2). It is estimated that they affect about 15% of the adult population aged 20 to 40 years, with a frequency three to five times higher in women. TMDs are the second leading cause of orofacial pain, behind only of pain of odontogenic origin; therefore, they have a significant impact on the physical and psychological health of individuals (5,6).

Among the most frequent symptoms, pain stands out, which can affect various regions such as the ear, eyes, throat, head, neck, and reverberate in more distant parts of the body (7). In addition, other physical factors such as inflammation, synovitis secondary to trauma, and infection may be found. TMD may also be associated with articular disc dysfunction, with or without reduction, as well as degenerative joint diseases, such as osteoarthritis and ankylosis (8).

The World Health Organization (WHO) was alerted in December 2019 about a new strain of coronavirus, which had never been identified in humans. Initially, the virus was temporarily named 2019-nCoV and, on February 11th, 2020, it was named SARS-CoV-2. In that year, the new coronavirus was causing many patients to develop severe cases of pneumonia in the city of Wuhan, China (9).

Due to the severity level, the WHO has defined COVID-19 as a pandemic disease. Thus, various measures were instituted by global health and sanitary entities, such as social isolation and the interruption of various services characterized as non-essential, which led to a radical change in the world's population lives. These changes on routine negatively impacted people's mental health, leading to an increase in psychological disorders, such as anxiety, fear, and depression (10).

The aim of this study was to evaluate if the pandemic period had an impact on the TMD symptoms of patients treated at the TMD Clinic of the Odontoclínica Central da Marinha (OCM), in Rio de Janeiro, Brazil.

METHODS

The present study was approved by the Ethics and Research Committee of the Clementino Fraga Filho Hospital, Rio de Janeiro-RJ, Brazil, (CAAE number 56027922.5.0000.5257, opinion 5.562.290) and by the Ethics and Research Committee of the Naval Hospital Marcílio Dias, Rio de Janeiro-RJ, Brazil (CAAE number 56027922.5.3001.5256, opinion 5.597.206). The research was conducted on patients treated at the Temporomandibular Dysfunction Clinic of the OCM, a reference center for specialized dental care of the Brazilian Navy. A retrospective cross-sectional study was conducted through data collection from 784 electronic medical records of patients aged 12 years and older, before and during the pandemic, according to eligibility criteria. The collected data covered the profile of the patients (gender and age group), the diagnosis, the main complaint (signs and symptoms), and the dental intervention performed at the TMD Clinic. The data were obtained from patients treated at the TMD Clinic from August 1st to September 30th, 2019, and in the same period in 2020.

Thus, all the extracted information defined two main groups: patients treated before the pandemic, in 2019 (G1); and, a second group of patients treated during the pandemic, in 2020 (G2). Not necessarily the same patients were evaluated in both samples. The data collected before and after the pandemic do not pertain to the same patients, but rather to the records of users who met the eligibility criteria and attended appointments within the analyzed period.

Data collection was carried out by an evaluator, based on the medical record evaluation instruments developed for the study (Charts 1 and 2).

Chart 1: 2020 medical records assessment tool.

Characteristics/Variables	Answer
(1) Date of consultation:	
(2) Gender:	( )Male ( )Female
(3) Date of Birth:	
(4) First consultation:	( )Yes ( )No
(5) Patient who was discharged and returned to the consultation after the start of the pandemic:	( )Yes ( )No
(6) Patient who was undergoing treatment before the interruption of elective services:	( )Yes ( )No
(7) Subsequent consultation:	( )Yes ( )No
(8) Type of service:	( )Urgency/Emergency ( ) Elective / Consultation
(9) Patient report:	
(10) Symptoms appeared after the start of the pandemic:	( )Yes ( )No( ) Not informed ( )Not applicable

[Continue...]

[Continuation:]

(11) Symptoms worsened after the start of the pandemic:	( )Yes ( )No ( )Not informed ( ) Not applicable
(12) Reports restriction of mouth opening/closing:	( )Yes ( )No ( )Not applicable
(13) Reports daytime/night time clenching:	( )Yes ( )No ( )Not applicable
(14) Reports bruxism:	( )Yes ( )No ( )Not applicable
(15) Reports some type of dental fracture or restoration:	( )Yes ( )No ( )Not applicable
(16) The reported pain is in the muscle or near the joint:	( )Muscular ( )Joint ( )Not informed ( ) Absence of pain ( ) Not applicable
(17) Diagnosis in this consultation:	
(18) Clinical intervention, medication, or both:	( )Clinic ( )Medication ( )None ( ) Both
(19) Which intervention?	
(20) Presents dental wear:	( )Yes ( )No ( )Not informed
(21) Scheduled for treatment sequence	( )Yes ( )No ( )Not informed
(22) Reason:	

Chart 2: 2019 medical records assessment tool.

Characteristics/Variables	Answers
(1) Date of consultation:	
(2) Gender:	( )Male ( )Female
(3) Date of Birth:	
	( )Sim ( )Não
(4) First consultation:	( )Yes ( )No
(5) Patient who was discharged and returned to the consultation:	( )Yes ( )No
(6) Subsequent consultation:	( )Yes ( )No
(7) Type of service:	( )Urgency/Emergency ( ) Elective / Consultation
(8) Patient report:	
(9) Reports restriction of mouth opening/closing:	( )Yes ( )No ( )Not applicable
(10) Reports daytime/night time clenching:	( )Yes ( )No ( )Not applicable
(11) Reports bruxism:	( )Yes ( )No ( )Not applicable
(12) Reports some type of dental fracture or restoration:	( )Yes ( )No ( )Not applicable
(13) The reported pain is in the muscle or near the joint:	( )Muscular ( )Joint ( )Not informed( ) Absence of pain ( ) Not applicable
(14) Diagnosis in this appointment:	
(15) Clinical intervention, medication, or both:	( )Clinic ( )Medication ( )None( ) Both
(16) Which intervention?	
(17) Presents dental wear:	( )Yes ( )No ( )Not informed
(18) Scheduled for treatment sequence	( )Yes ( )No ( )Not informed

These instruments were based on the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), which consists of a questionnaire that seeks to standardize examinations and diagnoses in TMD, translated into Portuguese in 2016 (11). The study instrument was divided into variables designed to detect changes in the severity or alteration of the signs and symptoms reported by patients before and during the pandemic.

The information that was not found in the electronic medical record to answer the questions of the instrument was filled in as "Not Informed" (N/I). The exclusion criteria for medical records were defined as: a second consultation on the same day at the TMD Clinic, to avoid data duplication, as well as records with inadequate information. Patients already with diagnosed joint-related diseases, related to the central nervous system, temporomandibular joint disorders, chronic mandibular hypomobility disorders, or growth disorders, were not included in the sample.

Furthermore, patients who were not clinically discharged before the interruption of elective care (variable 6 of chart 1) had variables related to patient reports and diagnosis excluded from the sample (variables 09 to 17 of chart 1), as these variables refer to patients with onset or worsening of symptoms after the start of the pandemic. In this case, the variables were defined as "Not Applicable" (N/A) in the medical record evaluation instrument. Data collection related to patient reports and diagnosis (variables 9 to 17 of chart 1; variables 8 to 14 of chart 2) was also not applied in cases of patients who returned for a second consultation within the months collected in the two years under analysis (variable 7 of chart 1; variable 6 of chart 2), as the patient had already been included in the sampling during the first consultation, with these variables also being defined as "Not Applicable" (N/A) in the medical record evaluation instrument (Figure 1).

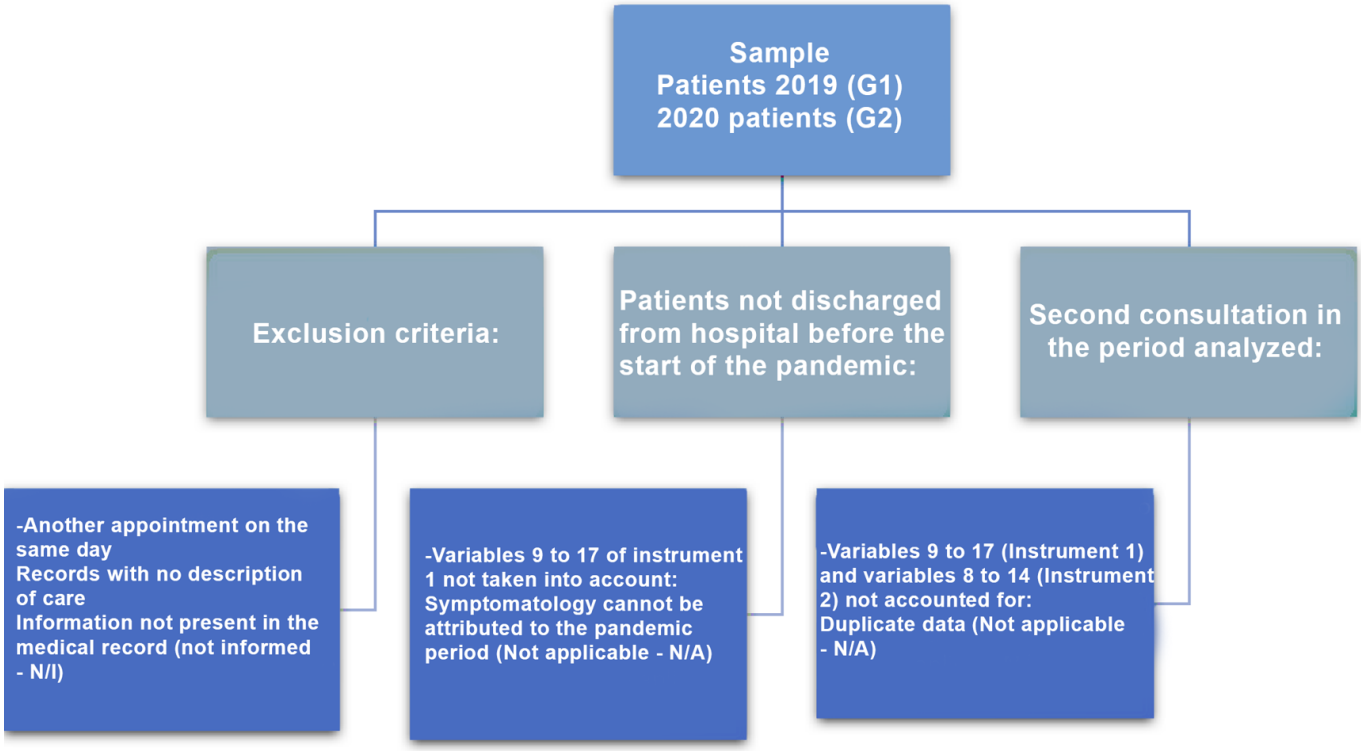

Figure 1. Flowchart representing the stages of the study methodology.

To verify if there was a worsening of cases possibly associated with the conditions of the pandemic, the following data were observed: the patient's first consultation at the TMD Clinic, or a patient with clinical discharge presenting some symptoms after the start of the pandemic, the onset of symptoms after the start of the pandemic and/or their worsening, the patient's report, and the professional's diagnosis. Patients whose clinical follow-up was interrupted due to the pandemic, or who were in a second consultation within the months analyzed, were not considered patients with symptoms possibly related to the COVID-19 pandemic.

In the 2019 evaluation (G1), the data used as a comparison to assess a possible worsening compared to 2020 were: first consultation following

the same characteristics mentioned above for the year 2020, and patients with clinical discharge who presented any complaint. The first consultation is characterized as the patient's first visit to the TMD Clinic recorded in the electronic medical record, regardless of the period analyzed.

The Statistical Package for the Social Sciences (SPSS 22, IBM Corporation, Armonk-NY, United States) was used to perform the statistical analyses. Descriptive analysis was performed based on frequency and cross-tabulations, between the periods of 2019 (G1) and 2020 (G2). A convenience sample was used with all electronic records available in the analyzed periods. For all analyses, a significance level of 5% (p=0.05) was considered. The Fisher's test and the chi-square test were used to assess the difference in dental consultations (first consultation, discharged patient, or second consultation) in relation to the two evaluated periods.

Additionally, in one of the logistic regression analyses aimed at determining the important factors in the association of factors related to pain during the pandemic, the presence or absence of muscle, joint, or both types of pain was defined as dependent variables, and the independent variables were: 'pandemic', 'gender', 'age', 'type of care', 'reports restriction of opening/closing', 'reports daytime/night time clenching', 'reports bruxism', and 'reports any type of dental or restoration fracture'. For this regression, a filter was applied for N/A and N/I in the dependent variable, presence of pain, which reduced the total number of cases to 353, as the purpose of this regression was to assess the presence of pain in relation to other variables.

In the second regression analysis, the dependent variables were the pre-pandemic periods (2019) and during the pandemic (2020), and their independent variables were: 'gender', 'age', 'first consultation', 'patient who was discharged and returned for consultation', 'second consultation in the period under analysis', 'type of care', 'reports restriction of mouth opening/closing', 'reports daytime/night time clenching', 'reports bruxism', 'reports any type of dental or restoration fracture', 'the reported pain is localized in the muscle or joint', and 'clinical intervention'. This regression used 734 records; 50 records were not used because such data were not provided in these variables (N/I). The aim was to compare the two periods analyzed, thus observing the changes that occurred from one year to the next.

RESULTS

Out of a total of 791 records, 784 were used in the analyses, with 544 and 240 occurring in 2019 and 2020, respectively. The exclusion of the 7 records occurred in the 2019 data due to incomplete information in the electronic record.

During the analyzed period, there was a predominance of dental consultations performed by female patients compared to male patients, with 339 in 2019 (62%) and 158 in 2020 (66%) (Table 1). In the age group assessment, an average of 45 (SD± 16.7) years was observed in 2019, and 47 (SD± 17.1) years in 2020 (Table 1).

Table 1: Demographic characteristics by age and gender of patients treated during the analyzed period.

	Total (n)	Age Group n (%)				Sex	
		12-19	20-59	60+	Mean (SD)	Female	Male
Before (2019)	554	36 (7%)	401 (74%)	105 (19%)	45.0 (± 16.7)	339 (62%)	205 (38%)
During (2020)	224	11 (5%)	160 (67%)	69 (29%)	47.0 (± 17.1)	158 (66%)	82 (34%)

SD – standard deviation

The results revealed a predominance of patients aged between 20 and 59 years, totaling 72% of the patients seen during the evaluation period, before and during the pandemic, indicating a very similar profile of the sample, both in gender and age group (Table 2). Furthermore, the regression analysis (Table 3) showed that the chance of reporting pain was 1.27 times higher in the age group of 20 to 59 years in 2020.

Table 2: Descriptive analysis of sex and age.

		Before (2019) n (%)	During (2020) n(%)	Total n(%)	p-value
Age group	12-19	36 (7%)	11(5%)	47(6%)	0.010 *
	20-59	401(74%)	160(67%)	561(72%)	
	60+	105(19%)	69(29%)	174(22%)	
Sex	Female	339(62%)	158(66%)	497(63%)	0.377
	Male	205(38%)	82(34%)	287(37%)	

Table 3: Logistic regression analysis to associate the presence or absence of pain during the pandemic period.

Variables	Categories	B	Standard error	Wald statistic	Significance	Odds ratios
Pandemic	2019 -pre-pandemic (ref)					
	2020 – pandemic	1.62	0.34	23.09	0.000 *	5.04
Sex	Woman (ref)					
	Man	-0.13	0.31	0.18	0.675	0.88
Age	12-19 (ref)					
	20-59	0.24	0.57	0.18	0.674	1.27
	60+	-0.10	0.62	0.03	0.874	0.91
Type of service	elective (ref)					
	urgency/emergency	0.53	0.78	0.46	0.497	1.70
Reports restriction of mouth opening/closing	No (ref)					
	Yes	3.00	1.12	7.15	0.008 *	20.15
Reports daytime/nighttime clenching	No (ref)					
	Yes	0.97	0.35	7.83	0.005 *	2.64
Reports bruxism	No (ref)					
	Yes	-1.17	0.35	11.17	0.001 *	0.31
Reports some type of dental or restoration fracture	No (ref)					
	Yes	-1.75	0.78	5.00	0.025 *	0.17
Clinical intervention	No medicines needed					
		2.30	1.07	4.63	0.031 *	9.96
	Clinical	0.62	0.44	1.98	0.160	1.87
	Both	3.99	0.73	29.99	0.000 *	53.85

*Dependent variable studied 1 = muscle and/or joint pain; 0 = no pain reported. (ref) = reference category. Nagelkerke R2 = 0.550; N = 353.

The average frequency of dental consultations performed by patients seen for the first time at the TMD Clinic was 33% and 42% of the total consultations that occurred at this clinic in 2019 and 2020 (p=0.015), respectively (Table 4). The comparison between the type of dental consultation (first consultation or second consultation), and the emergence of TMD symptoms revealed that 90% of the first consultations in 2020 were from patients who presented pain symptoms during the pandemic, compared to 36% who did not present pain symptoms (p<0.001) (Table 4). A frequency of 11% was observed in 2019 in the analysis among patients with clinical discharge and worsening symptoms, compared to 85% in 2020 (p<0.001) (Table 4).

Regarding the presence or absence of pain (muscular, joint, or both) and being the first consultation of patients in both periods, there was a significant increase (p=0.314) from 49% in 2019 to 84% in 2020. Furthermore, in the association between the presence of pain and being a returning patient with clinical discharge, there was also a significant increase (p=0.0169) from 38% in 2019 to 76% in 2020.

When observing the type of care (elective or emergency consultation), a 20% increase was revealed for emergency consultations during the pandemic period (62%) compared to the same period in 2019 (42%) (p<0.001) - Table 4. The chance of an emergency consultation occurring in relation to the elective consultation was approximately 2 times higher in the period of 2020 (Table 4).

Table 4: Descriptive analysis of the type of consultation and care; statistically significant (p<0.05).

		Before (2019)		During (2020)		Total		
		N	Percentage (%)	N	Percentage (%)	N	Percentage (%)	p-value
First consultation at the TMD clinic	No	365	67%	139	58%	504	64%	0,015 *
	Yes	179	33%	101	42%	280	36%	
(2019) Patient who was discharged and returned for consultation; (2020) Patient who was discharged and returned for consultation after the start of the pandemic.	No	483	89%	197	82%	680	87%	0,001 *
	Yes	61	11%	43	18%	104	13%	
Second consultation in the period under review:	No	246	45%	184	77%	430	55%	0,001 *
	Yes	298	55%	56	23%	354	45%	
Type of service	Elective	312	57%	82	34%	394	50%	0,001 *
	urgency/ emergency	231	42%	149	62%	380	48%	
	N/A	1	0%	9	4%	10	1%	

The frequency of reports of daytime or night time teeth clenching almost doubled (p<0.001) during the pandemic (23%) compared to the previous year (12%) – Table 5. Another important data point, seen in the regression analysis, was the 2.64 times greater chance in the relationship between clenching and the presence of pain, as well as in the association of pain with restricted mouth opening, with a 20 times greater chance of occurring in the 2020 analysis (Table 3).

The frequency of reporting muscle pain also showed a statistically significant increase (p<0.001) during the pandemic, from 13% to 35% in the year 2020 (Table 5), as well as a higher odds ratio between the periods of 2019 and 2020 (OR=5.57) - Table 3. Additionally, there was a 6.99 times higher chance of reporting dental fracture in 2020 (p<0.001) - Table 6.

Table 5: Descriptive analysis of patient reports and pain location; statistically significant (p<0.05).

		Antes (2019)		Durante (2020)		Total		
		Nª	Percentual (%)	Nº	Percentual (%)	Nº	Percentual (%)	p-value
Reports restriction of mouth opening/closing	No	225	41%	129	54%	354	45%	<0.001 *
	Yes	14	3%	14	6%	28	4%	
	N/A	304	56%	95	40%	399	51%	
	N/I	1	0%	2	1%	3	0%	
Reports daytime/night time clenching:	No	176	32%	88	37%	264	34%	<0.001 *
	Yes	63	12%	56	23%	119	15%	
	N/A	305	56%	95	40%	400	51%	
	N/I	0	0%	1	0%	1	0%	

[Continue...]

[Continuation:]

Reports bruxism:	No	179	33%	101	42%	280	36%	<0,001 *
	Yes	60	11%	43	18%	103	13%	
	N/A	305	56%	95	40%	400	51%	
	N/I	0	0%	1	0%	1	0%	
Reports some type of dental or restoration fracture:	No	234	43%	134	56%	368	47%	<0,001 *
	Yes	5	1%	10	4%	15	2%	
	N/A	305	56%	95	40%	400	51%	
	N/I	0	0%	1	0%	1	0%	
The reported pain is located in the muscle or near the joint:	Articular	24	4%	11	5%	35	4%	<0,001 *
	Muscular	71	13%	84	35%	155	20%	
	articular and muscular	9	2%	9	4%	18	2%	
	doesnt present	121	22%	24	10%	145	18%	
	N/A	310	57%	95	40%	405	52%	
	N/I	9	2%	17	7%	26	3%	

Table 6: Logistic regression analysis to associate the period before and during the pandemic.

Variables	Categories	B	Standard error	Wald statistic	p-value	Odds ratio
Sex	Female (ref)					
	Male	-0.061	0.204	0.091	0.763	0.94
Age group	12-19 (ref)					
	20-59	0.115	0.367	0.098	0.754	1.12
	60+	0.872	0.397	4.823	0.028 *	2.39
First consultation at the TMD clinic	No (ref)					
	Yes	-3.883	0.686	32.028	0.000 *	0.02
Controlled patient, but with symptoms (2020 - after the start of the pandemic)	No (ref)					
	Yes	-3.625	0.684	28.112	0.000 *	0.03
Subsequent consultation (after first consultation)	No (ref)					
	Yes	-3.092	0.396	60.836	0.000 *	0.05
Type of service	elective (ref)					
	urgency/emergency	0.726	0.577	1.582	0.209	2.07
Reports restriction of mouth opening/closing;	Not + N/A (ref)					
	Yes	-0.015	0.447	0.001	0.973	0.98
Reports daytime/night time clenching	Not + N/A (ref)					
	Yes	0.260	0.277	0.885	0.347	1.30
Reports bruxism	Not + N/A (ref)					
	Yes	0.362	0.307	1.395	0.238	1.44
Reports some type of dental or restoration fracture;	Not + N/A (ref)					
	Yes	1.944	0.712	7.449	0.006 *	6.99
The reported pain is located in the muscle or near the joint	does not present + N/A (ref)					
	Articulate	0.916	0.477	3.679	0.055	2.50
	Muscular	1.717	0.342	25.150	0.000 *	5.57
	articular and muscular	1.472	0.612	5.786	0.016 *	4.36
Clinical intervention	Not necessary + N/A (ref)					
	Medicinal	0.200	0.860	0.054	0.816	1.22
	Clinic	0.721	0.364	3.918	0.048 *	2.06
	Both	0.518	0.491	1.111	0.292	1.68

*N/A = Not applicable; N.S. = Not significant; (ref) = reference category Nagelkerke R = 0.473; N = 734

In dental consultations, patients' reports were often associated with pain complaints, clicks, or crepitus in the temporomandibular joint. Pain in function showed a 15% increase during the pandemic period (p<0.001). When comparing the data regarding the presence of pain, whether muscular, articular, or a combination of both, a significant increase (p<0.001) from 46% to 81% in 2020 was observed (Table 7). The logistic regression analysis (Table 3) showed that the chance of reporting pain in 2020 was 5.04 times higher than in 2019.

Table 7: Relationship between the presence of muscle pain, joint pain, or both, and the period before or during the pandemic; statistically significant (p<0.05); Exclusive NA/NI.

		Before (2019) p(%)	During (2020) p(%)	Total p(%)	p-value
Pain*	No	121(54%)	24(19%)	145(41%)	<0.001
	Yes	104(46%)	104(81%)	208(59%)	

When observing the characteristics of the interventions, the data indicate a 2 times greater chance of a clinical intervention occurring during the pandemic (Table 6). When relating the pain variable to the type of intervention, it was observed that if the patient reports pain, the chance of a clinical and medicinal intervention occurring increases by 53 times, and only medicinal intervention by 9.96 times during the pandemic, with no intervention as a reference (Table 6).

In the observation of clinical diagnoses, a predominance of complaints related to pain was revealed, mainly muscle pain in the masseter region, where a 16% increase was observed during the pandemic. The other diagnoses showed a smaller increase in frequency, such as cervical muscle pain (7%) and temporomandibular joint pain (3%), or maintained the same frequency, such as bruxism (10%) and clicks/crepitus in the temporomandibular joint (6%) (Table 5).

DISCUSSION

The relationship between TMD and patients' mental health has been previously established in the literature (12). During the pandemic, many people developed psychological disorders, whether due to fear, anxiety, changes in routine, or social isolation (13). Herein, there may have been a possible increase in the number of people who showed symptoms of TMD or who had their clinical condition worsened during the pandemic (14). This could be observed with the increase from 46% to 81% in the reporting of pain when comparing the periods before and during the pandemic. A previous study revealed results similar to the present study, as it found, through online questionnaires, the worsening of TMD and bruxism symptoms, associated with emotional stress during the pandemic period (15).

A predominance of the female gender was observed, with a frequency 60% higher compared to the male gender; furthermore, a greater relationship between the presence of pain and gender was observed in females, with males having a 12% lower chance of reporting pain (muscular, joint, or both). Melo Júnior *et al*. evaluated 1342 teenagers (10-17 years) and found a significantly relevant association (p=0.017) between TMD symptoms and female gender (16). The number of women was also higher in the present study, as both groups analyzed showed a similar percentage of females, which corroborates with other studies where a greater relationship between females and TMD was observed.

Regarding the age group, the results indicated a predominance of patients aged between 20 and 59 years (72%). The logistic regression analysis showed the discrepancy between ages, with a 2.39 times higher chance of attendance in the age group of 60 or more years when compared to the age group of 12 to 19 years. The results of this study corroborate with the literature review conducted by Yadav *et al*. who also identified a higher number of TMD cases in patients aged between 45 and 64 years, in studies conducted in Europe and the United States (17). The analysis of the relationship between age group and the presence of pain showed a higher report of pain in the age group between 20 and 59 years, with a 1.27 times greater chance of pain occurring in this age group compared to 12 and 19 years.

There was a higher number of first consultations during the pandemic period compared to the previous period, with almost 10% more in total attendances. This indicates that, possibly, there was a worsening of the triggering factors of TMD, with psychological health standing out, which had a strong adverse impact during this period. These data are corroborated by the fact that there was an observed increase in patients who were clinically discharged, meaning their condition was controlled, and returned with a new complaint. Another piece of data that corroborates this increase in the number of first consultations was the large reduction in second consultations in the same period, around 30%. In the relationship between dysfunctions and psychological disorders, Sójka *et al*. identified that one-third of their sample (n=324) showed more intense TMD symptoms

associated with psychological dysfunctions such as anxiety, stress, and depression (12).

In 2020, there was a 20% increase in emergency consultations, with a 2.07 times higher chance of occurring that year. This type of consultation showed a positive correlation with reports of pain, with a 1.7 times greater chance of occurring compared to elective care. The retrospective study in Alberta (Canada) evaluated the reason for seeking dental care (18) in community clinics and hospitals during the pandemic, and revealed that the main reasons for seeking care were infections, problems originating in the salivary glands, and TMDs, corroborating the data of the present study.

Another important data collected was the increase in the search for first-time care at the TMD Clinic, in the 2020 analysis, which indicates a patient with no history of the disease who started to present some clinical complaint. It is possible to identify a 90% match in being the first consultation with the onset of symptoms after the start of the pandemic. In the relationship between discharged patients who returned for care and with worsening symptoms, a correspondence of 85% between these variables could be observed. These data are of great importance and reveal how much the pandemic has intensified the appearance of TMD symptoms. A study conducted with 506 individuals also identified this increase with the pandemic, where 36% and 32.2% of the participants reported an increase in joint and facial muscle pain, respectively, and almost 50% experienced headaches and migraines more frequently (19). A systematic review in 2023 revealed that all evaluated studies showed a significant statistical correlation between TMD and COVID-19 (20).

Regarding complaints related to pain, there was a 5 times greater chance during the pandemic period; the report of muscle pain or its combination with joint pain also saw a 35% increase in 2020. This worsening can be explained by the intensification of stress, anxiety, and mental pathologies during the period (9). Furthermore, there was an 11% increase in reports of daytime or nighttime teeth clenching in 2020, and patients reporting pain were 2.64 times more likely to have a correlation between these two variables. The report of mouth opening/closing restriction increased by 3% during the pandemic and showed a 20 times greater chance in patients with pain in both periods analyzed. The assessment of the association between emotional symptoms and temporomandibular disorders in a group of young people in Asia resulted in the identification that stress and TMD constitute the greatest risks of symptom somatization (21).

Although an increase in the diagnosis of bruxism was expected between the two periods, there was no change in the periods analyzed (10%). Moreover, in the evaluation between bruxism and pain, there was a 69% decrease in this correspondence. Contrastingly, the research by Emodi-Perlman *et al*., in which questionnaires were applied in two countries (Israel and Poland), revealed a significant increase in TMD symptoms and bruxism during the pandemic period, associated with orofacial pain (14). Saczuk *et al*. also found, during the isolation period due to COVID-19, symptoms of TMD and bruxism in most of the individuals analyzed (22).

The clinical and medicinal procedures were mainly related to the relief of painful symptoms, which characterized most of the patients' complaints, highlighting the complaint of pain in function (speech, chewing, etc.) with a 15% increase in 2020. Another important piece of data was the evaluation between pain and the type of intervention, where it was observed that the chance of a clinical and medicinal intervention occurring was 53 times higher compared to not having undergone any intervention. With this, the worsening of the clinical condition of TMD during the pandemic is reinforced, which was also seen in the study by Moharrami *et al*. in Alberta (Canada), which had TMD as one of the main reasons for seeking emergency care during the lockdown period (18).

Another very interesting fact is the correlation between the presence of pain and the type of dental consultation. In the evaluation between the first consultation and pain, a correspondence of 49% was noted in 2019, while in 2020 this number rose to 84%. In the analysis between patients discharged and pain, a relationship of 38% was observed before the pandemic, and 76% after the pandemic. These data indicate the relevance of the pandemic period in the aspect of "onset of pain," which was also revealed in the study by Emodi-Perlman *et al*. conducted in two countries during the pandemic, which identified a worsening in TMD symptoms during the pandemic period (14).

The limitations of the present study include the absence of a control group to compare the prevalence of TMD between the two periods analyzed. Additionally, as it is a cross-sectional study, the data were collected only from an operating system used in the OCM, which results in information limited to that provided by the professionals who recorded in the electronic medical record, covering only a specific interval and a restricted population.

CONCLUSION

The conditions related to the pandemic period did not significantly influence the patient profile (gender and age) and the interventions performed by dentists in the TMD Clinic of OCM. However, they might have contributed to the increase in signs and symptoms of muscle and/or joint pain related to TMD, and the higher number of emergency consultations in patients of this specialized care unit.

The authors declare no conflicts of interest.

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CASE REPORT

GIANT OSTEOMA IN THE ASCENDING RAMUS OF THE MANDIBLE – RADIOGRAPHIC AND TOMOGRAPHIC ASPECTS OF A CASE

OSTEOMA GIGANTE EM RAMO ASCENDENTE DE MANDÍBULA – ASPECTOS RADIOGRÁFICOS E TOMOGRÁFICOS DE UM CASO

Lísia Daltro Borges Alves[1], Débora Lima Pereira[2], Débora Gorito Souto[2], Jeanne da Cunha Macedo[2]

ABSTRACT

Osteoma is an unusual benign tumor of bone origin characterized by proliferation of compact or medullary bone. It is most common in adults between the third and fifth decades of life, with no gender predilection and can be categorized as central, peripheral or extra-skeletal. This study aims to report the case of a patient who was seen at the Odontoclínica Central da Marinha with a final diagnosis of Osteoma with approximately 10 years of evolution. A 58-year-old black woman was referred complaining of pain when chewing on the left side and displacement of the jaw to the right side. On physical examination, facial asymmetry was observed with a well-defined swelling of firm consistency in the parotid region on the left side, in addition to a swollen palate. Radiographically, a rounded and well-defined radiopaque image was observed, affecting the ascending ramus of the mandible, extending to the condyle and coronoid process on the left side. On cone beam computed tomography, a hyperdense, multilobular, well-defined and corticalized image was noted, located on the left side of the mandible, involving the ascending ramus, breaking the lingual cortex and invading the cranial region of soft tissues. The patient underwent an incisional biopsy with a histopathological report compatible with osteoma. Giant osteomas are unusual, mainly in the jaw region. The dentist must be aware of this pathology due to the risk of involvement with syndromes, also because it affects the aesthetics and function of affected patients.

Keywords: Osteoma; Bone tumors; Bone pathology; Diagnosis; Cone beam computed tomography.

RESUMO

O osteoma é um tumor benigno incomum de origem óssea, caracterizado por proliferação de osso compacto ou medular. É mais comum em adultos entre trinta e cinquenta anos, sem predileção por gênero e pode ser categorizado como central, periférico ou extra-esquelético. Este estudo tem por objetivo relatar o caso de uma paciente que foi atendida na Odontoclínica Central da Marinha com diagnóstico final de Osteoma com cerca de 10 anos de evolução. Paciente mulher, 58 anos, melanoderma, encaminhada por queixa de dor à mastigação do lado esquerdo e desvio de mandíbula para o lado direito. Ao exame físico, observou-se assimetria facial com aumento de volume bem delimitado de consistência firme em região parotídea do lado esquerdo, além de abaulamento em palato. Radiograficamente, observou-se imagem radiopaca de formato arredondado e bem definida, acometendo ramo ascendente da mandíbula, estendendo-se para côndilo e processo coronoide do lado esquerdo. Na tomografia computadorizada de feixe cônico, notou-se imagem hiperdensa, multilobular, bem definida e corticalizada, localizada do lado esquerdo da mandíbula, envolvendo o ramo ascendente, rompendo a cortical lingual e invadindo a região craniana dos tecidos moles. A paciente foi submetida à biópsia incisional com laudo histopatológico compatível com osteoma. Osteomas gigantes são incomuns, principalmente, em região de maxilares. O cirurgião-dentista deve estar atento a essa patologia devido ao risco de envolvimento com síndromes, também por afetar estética e função dos pacientes afetados.

Palavras-chave: Osteoma; Tumores ósseos; Patologia óssea; Diagnóstico; Tomografia Computadorizada de Feixe Cônico.

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INTRODUCTION

The craniofacial osteoma is a rare benign tumor of bone origin, characterized by proliferation of compact or medullary bone (1,2). Although the literature presents a wide age range of individuals affected by this type of neoplasia, it is more common in adults between the third and fifth decades of life, with no sex predilection (2,3).

This pathology can be categorized as central, affecting the medullary region of the affected bone, peripheral, presenting as a pedunculated volume increase at the margin of the craniofacial bone, or extra-skeletal, involving its manifestation in soft tissues, such as muscles (3,4).

The craniofacial skeleton is the preferred site for the development of osteoma, being more common in paranasal sinuses (frontal, ethmoidal, and maxillary) and frontal bone (2,4). In jawbones, these lesions are rare and, when they occur, are more frequent in the posterior mandibular body and less frequent in the maxilla and mandibular condyle (2,4). Even though most cases are asymptomatic, there may be aesthetic complaints due to facial asymmetry, discomfort during chewing, difficulty using dental prostheses, opening the mouth, among others (2,5).

The diagnosis of osteoma is made through the correlation of clinical, imaging, and histopathological examination. Clinically, these lesions present as well-defined and hardened swellings. Regarding imaging exams, it is possible to initially use panoramic radiography, but computed tomography is considered essential for assessing the size, precise location, and anatomical relationship of the lesion with adjacent structures (1). In the exam, these lesions present as dense radiopacities or well-defined and corticated hyperdensities (3).

Osteoid osteoma, cementoblastoma, complex odontoma, ossifying fibroma, osteoblastoma, chondroma, osteosarcoma, Paget's disease, and even idiopathic osteosclerosis represent the main differential diagnoses for this tumor (1,6). It is also important to differentiate osteomas from exostoses and torus, as they can be very similar clinically, since they present as a hardened swelling in the maxillo-mandibular region (1).

Another relevant factor in the identification of osteomas in the craniofacial region is their relationship with Gardner's Syndrome, a genetic disease with a high predisposition to the development of malignant colorectal tumors (1,7). All cases should be investigated, especially if there is more than one bone lesion, as this may be the first warning sign for the diagnosis of this syndrome (4,7).

Histopathologically, there is a proliferation of compact or cancellous bone with a normal appearance, with bony trabeculae that may be permeated by fibroadipose marrow (2,3). Osteoblasts and osteoclasts are generally imperceptible, but some may contain areas similar to osteoblastoma, suggesting an active remodeling process, although this does not characterize a sign of tumor aggressiveness (3). According to this analysis, osteomas can also be classified as central or peripheral (3).

The treatment of osteoma is usually surgical and with rare recurrence (3). In more extensive cases, although it is a benign tumor, bone plasty may be indicated for aesthetic reasons. In this way, the aim of this study was to report the case of a large osteoma in the region of the ascending ramus of the mandible, detailing its main radiographic and tomographic findings.

CASE REPORT

This is a descriptive, retrospective case report study. The present study was approved by the responsible Research Ethics Committee (CAAE: 81171024.0.0000.5256, No. 6,939,705). The patient has read and signed the informed consent form.

A 58-year-old black woman, hypertensive and diabetic, with no habits of alcohol or tobacco consumption, attended the Odontoclínica Central da Marinha (OCM), in Brazil, referred in October 2022, by a primary care dentist with a complaint of pain during chewing on the left side of the palate and jaw deviation to the right side, with a reported evolution of approximately 10 years. She was referred to the Stomatology Clinic and, upon physical examination, facial asymmetry was observed with a well-defined firm consistency mass in the left parotid region, as well as swelling in the palate, extending to the retromolar region up to the tonsillar pillar on the same side (Figure 1). It was found that the upper prosthesis was in contact with the swollen palate, which justified the discomfort during chewing. The patient had a mandibular deviation to the right side and limitation in mouth opening movement.

Figure 1: Clinical aspect demonstrating extra-oral swelling in the parotid and intra-oral region.. **A** and **B**- front and side views, respectively, showing lump in the left parotid region; **C**- Swelling in the soft palate and left retromolar region.

When evaluating the previous medical record, it was found that an examination from 2013, almost 10 years earlier, already showed the lesion, although no treatment was proposed at that time (Figure 2A). A new panoramic radiograph was then requested, in which an image of radiopaque density with a rounded and well-defined shape was observed, affecting the ascending ramus of the mandible, extending to the mandibular condyle and coronoid process on the left side. An extension of the lesion beyond the posterior bone cortex of the mandible was also noted (Figure 2 B). At this moment, salivary gland tumor, such as pleomorphic adenoma due to its location, or bone pathology, including osteoma and benign fibro-osseous lesions, were suggested as diagnostic hypotheses. A cone beam computed tomography (CBCT) was requested to better clarify the extent of the lesion and the structures involved.

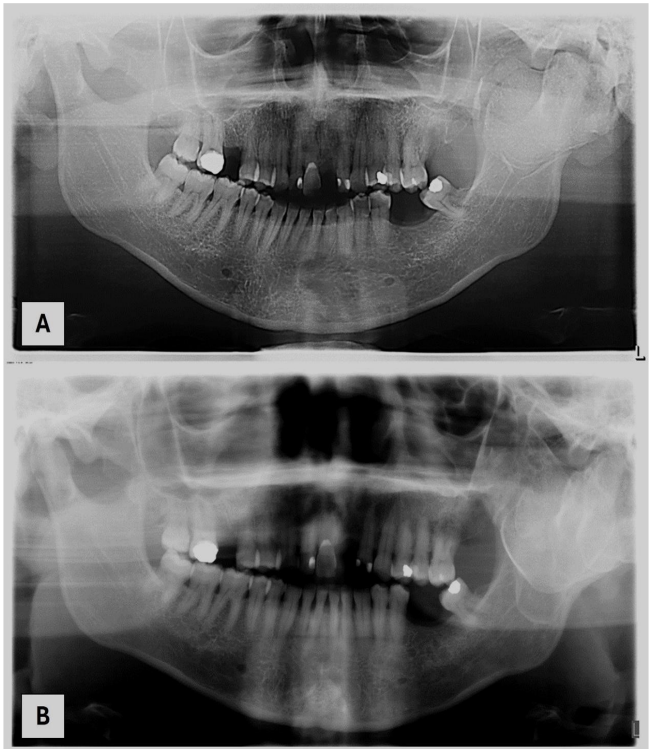

Figure 2: Panoramic radiographs showing the evolution of the lesion over approximately 10 years (**A** – 2013; **B** – 2022), with a multilobulated and corticated radiopaque image in the region of the ascending ramus of the mandible and the condyle.

Volumetric acquisition was performed using a cone beam X-ray on the i-CAT tomograph (Imaging Sciences 23 International, Hatfield, PA, USA), with a voxel of 0.2mm and subsequent multiplanar axial, sagittal, and coronal reconstruction with a thickness of 1mm by the software OnDemand3D. In the evaluation of the CT scan, a hyperdense, multilobular, well-defined, and corticalized image was observed, located on the left side of the mandible, involving the ascending ramus, breaking the lingual cortex and invading the cranial region of the soft tissues. In the craniocaudal direction, the lesion extended from the maxillary tuberosity to the ascending ramus of the mandible, while in the anteroposterior direction, the lesion affected the region from the maxillary tuberosity to the mastoid process. The measurements obtained were 54mm in the craniocaudal direction, 62.4mm in the antero-posterior direction, and 42.8mm in the vestibular-lingual direction. Interestingly, in a region of the ascending ramus of the mandible, in the upper third, vestibular cortex, the image did not show corticalization, becoming homogeneous with the bone trabeculae. The resorption of the mandibular edge, involvement and inferior displacement of the mandibular canal, rupture of the lingual cortex of the condyle, as well as resorption of the maxillary tuberosity and constriction of the left maxillary sinus were also evidenced (Figures 3-7). The observed images suggested a pattern of benign growth, tending towards fibro-osseous lesion as ossifying fibroma, or benign bone tumor.

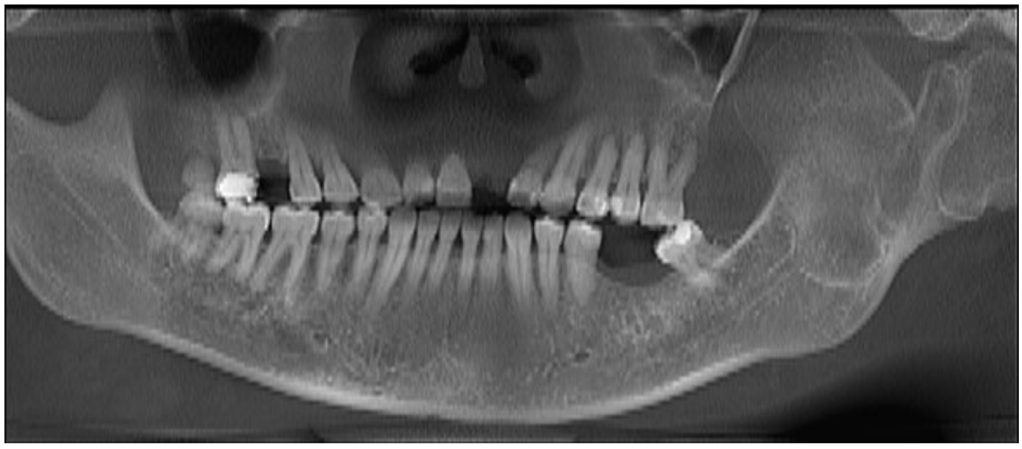

Figure 3: Panoramic reconstruction. Extensive lesion is observed in the region of the ascending ramus of the mandible and the condyle on the left side.

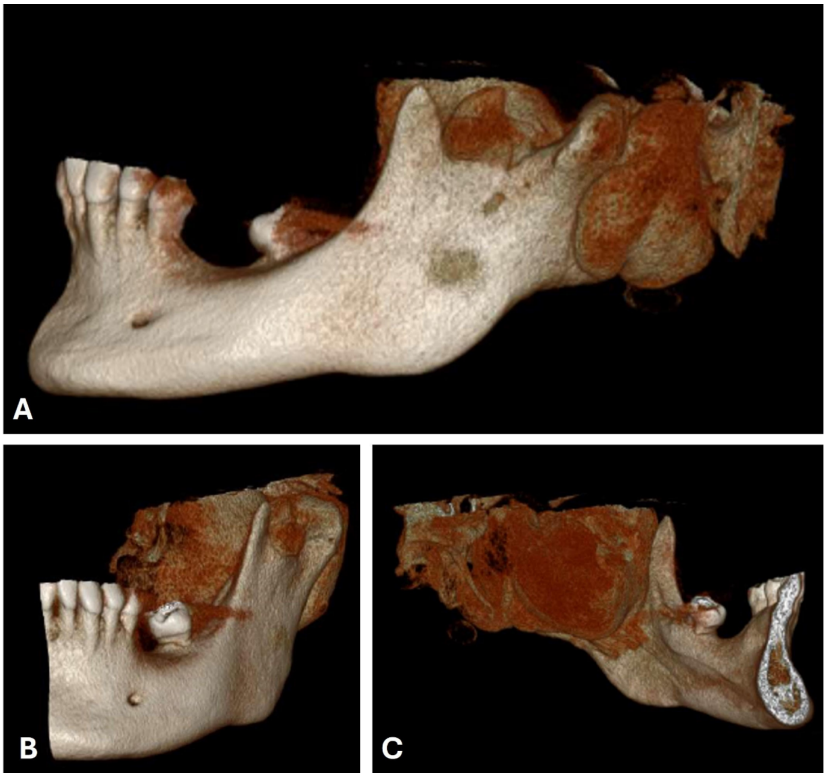

Figure 4: Three-dimensional volumetric reconstructionss (**A** – Lateral view; **B** – Front view; **C** – Lingual view).

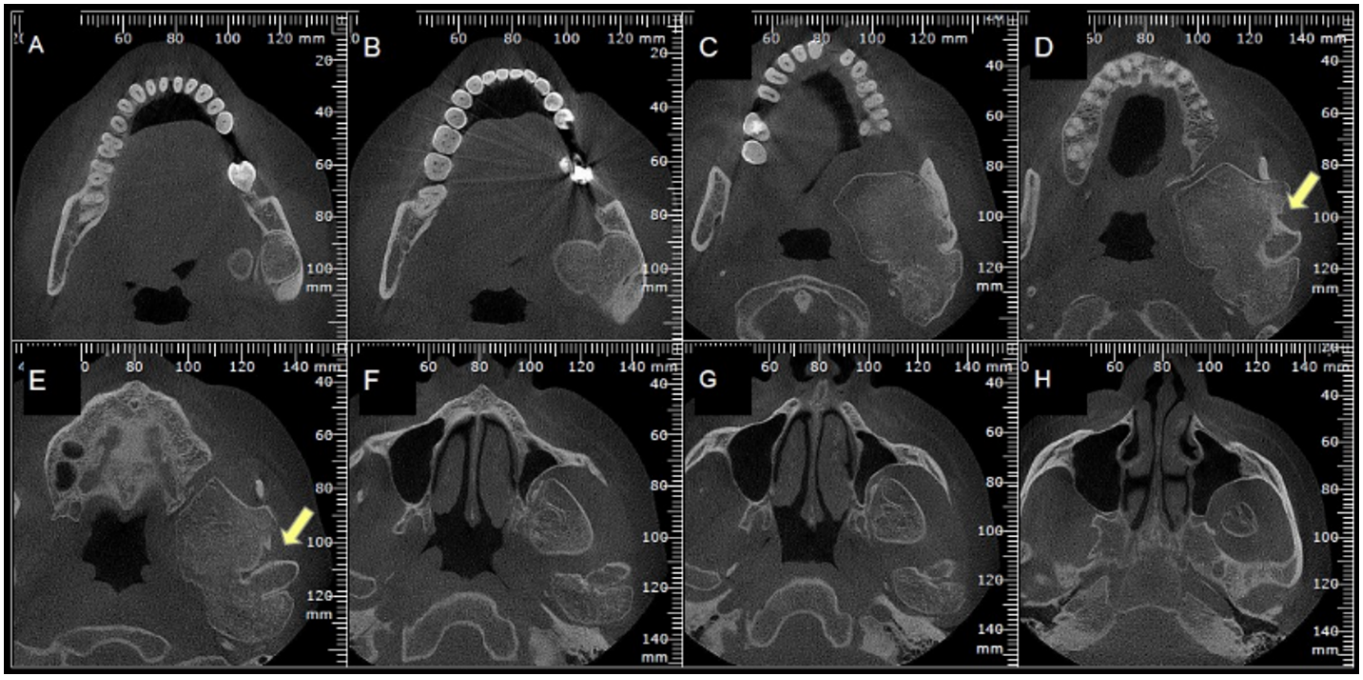

Figure 5: Axial reconstructions (craniocaudal direction) demonstrating the extension of the lesion from the body of the mandible to the cranial region of soft tissues. Note the mandibular condyle involved by the lesion (yellow arrow).

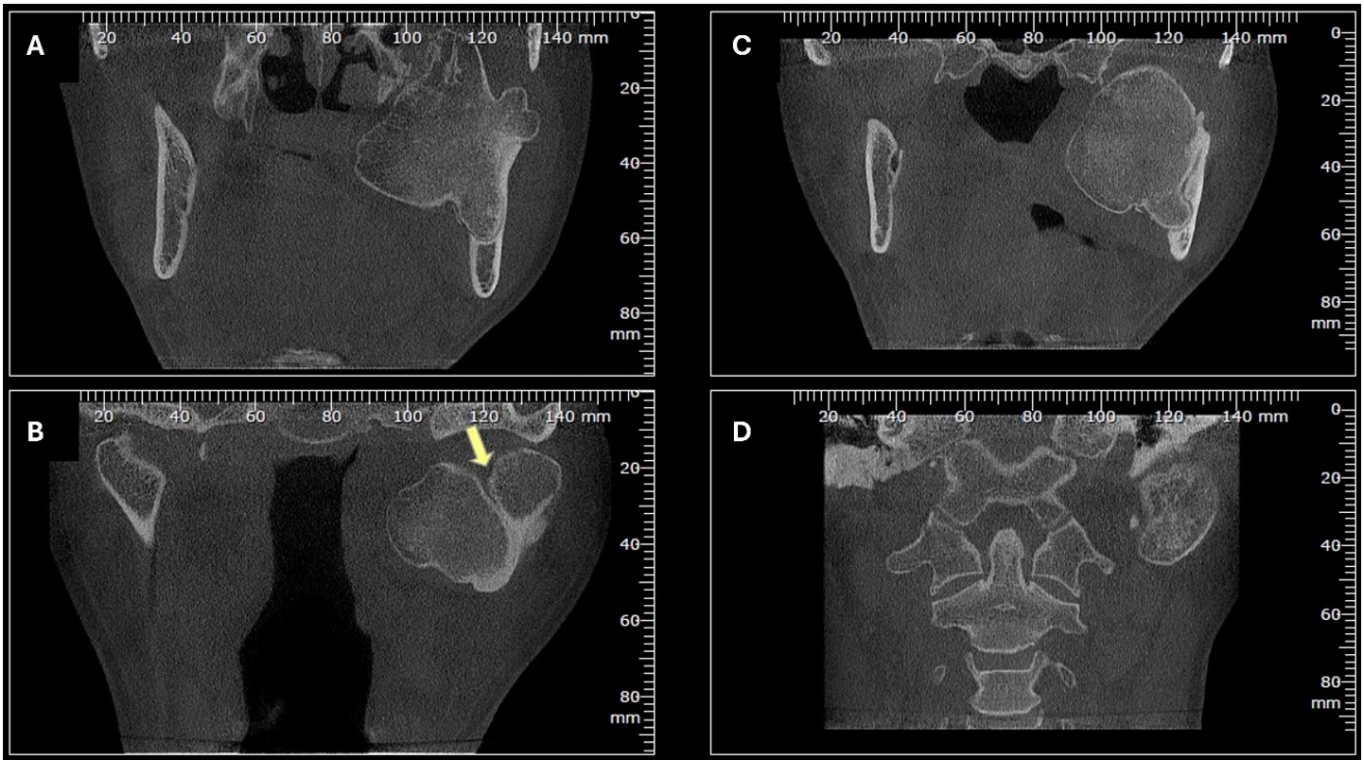

Figure 6: Coronal reconstructions (antero-posterior direction) showing the extent of the lesion, with thinning of the mandibular cortex and proximity to the mandibular condyle (yellow arrow).

Figure 7: Sagittal reconstructions showing lesion invasion into soft tissues, constriction of the mandibular canal (CM), and rupture of the bone cortex of the mandibular condyle (yellow arrow).

The patient underwent an incisional biopsy for diagnostic elucidation and subsequent therapeutic planning. The histopathological examination showed cortical and medullary bone tissue with fibroadipose marrow, compatible with osteoma. The patient was referred to the Oral and Maxillofacial Surgery clinic at the Hospital Naval Marcílio Dias, in Brazil, for surgical intervention. Until the time of this case report, the team was discussing the case, as the lesion is close to critical areas and requires a delicate approach, possibly needing multidisciplinary intervention. Currently, the patient has no pain complaints, but has aesthetic discomfort due to facial asymmetry.

DISCUSSION

Osteomas are rare tumors, mainly in the jaw region, as their preferred location is the paranasal sinuses (3). A study conducted in Turkey demonstrated the radiographic aspects of rare non-odontogenic lesions in the jaws, and after analyzing more than 8,000 computed tomography and magnetic resonance imaging scans, the authors found 19 cases of non-odontogenic tumors, among them only one osteoma, accounting for less than 0.01% of the sample (8). Another study, with a literature review of 69 cases of peripheral osteoma, showed only 7 occurrences in the ascending ramus of the mandible and 18 in the condyle (2). Considering the giant osteomas, Hasan conducted a literature review with 30 cases in the mandible, with only five in the ascending ramus of the mandible (9), corroborating the rarity of the lesion presented in this case report.

In terms of pathogenesis, there is still controversy in the literature. Some authors advocate the theory that trauma in the jaw region or even dental extractions could trigger the development of this type of lesion, although it does not justify all cases (5,10). Other possibilities include the development of true neoplasia, developmental anomalies, and endocrine changes (2). Many authors prefer, however, the mechanism that suggests that the trauma associated with muscle traction could cause small periosteal hemorrhages, elevating the periosteum and thus generating an osteogenic reaction, especially in cases of peripheral osteomas (2,4,10). The present case did not show evidence of trauma, the patient did not report any symptoms, and the lesion had existed for about 10 years, according to previous radiographic examinations, with slow and gradual progression.

Osteomas can affect patients across a wide age range, with reports from 16 to 74 years, but they are more common between 20 and 50 years of age,

which is consistent with the case presented here, because although the patient was 58 years old at the time of diagnosis, the lesion had already been present in radiographic findings for almost 10 years. Often, these cases may not be properly diagnosed because the lesion is asymptomatic and with a slow growing pattern. Gawande *et al*. reported a similar case, in which the patient was a 45-year-old woman with facial asymmetry, significant volume increase in the jaw, asymptomatic and with no prior history of trauma (2).

It is important to note that this bone neoplasm may be related to some syndromes, such as Gardner's syndrome, Haberland syndrome, Opitz G/BBB syndrome, and acromegaly (4). Gardner's syndrome is most frequently associated with osteoma, especially in cases of multiple bone tumors. This syndrome presents a mutation in the APC gene and predisposes the development of colorectal cancer in more than 90% of patients, in addition to the possibility of the emergence of other occasional tumors (11). The diagnosis of osteoma can occur in younger patients and in some cases assist in the early diagnosis of the syndrome, favoring the patient's prognosis, which draws particular attention to the proper understanding of this pathology (11). In the case presented here, the patient did not have other tumors or a history of colon cancer, which would rule out the possibility of Gardner's syndrome.

Clinically and radiographically, the osteoma can suggest several differential diagnoses, especially due to its highly variable presentation in shape and size. Among them, benign fibro-osseous lesions, complex odontoma, osteoblastoma, cementoblastoma, exostoses, idiopathic osteosclerosis, osteoid osteoma, among others (1,4,6). For this reason, clinical correlation, imaging, with radiographs and CT scans, with histopathological analysis becomes essential for the correct definition of diagnosis and treatment. The present case had as its main differential diagnosis the ossifying fibroma, due to its size and its relationship with the mandibular bone, which suggested the appearance of a tumor detachable from the affected bone, however, the histopathological analysis revealed an aspect compatible with the diagnosis of osteoma.

The osteoid osteoma, for example, is an entity that can cause diagnostic confusion with central osteomas. Nonetheless, this other tumor presents some particularities that aid in diagnosis, as it generally causes constant pain, with reports of worsening at night, and improves with the oral administration of acetylsalicylic acid (6,12). Osteoid osteoma presents radiographically as a well-defined radiopaque image with a radiolucent halo and is histologically differentiated from osteoma by having a highly vascularized substrate and osteogenic connective tissue associated with newly formed bone trabeculae (6). Kammoun *et al*. reported a case of osteoid osteoma where the lesion was osteolytic at the base of the mandible and was masked on the panoramic view by an overlap of the hyoid bone, due to poor patient positioning during the radiographic technique. After the extraction of a tooth and without resolution of the patient's complaint, a CBCT was requested which showed the lesion at the base of the mandible, being fundamental for the diagnosis and management of the case (12).

In terms of imaging diagnosis, panoramic radiography is the first examination requested and, often, can reveal osteomas as accidental radiographic findings. However, the X-ray is a two-dimensional exam and limits the determination of the actual dimensions of the lesion, in addition to presenting many areas of overlapping structures that can confuse the diagnosis (12). The case presented in this report had already shown a radiopaque image in the region of the ascending ramus of the mandible and condyle, but the patient did not undergo a diagnosis, as she had no complaints in the region. After the report of discomfort, a new panoramic X-ray and completion with CBCT were requested, which effectively directed the diagnosis.

CTCB is an imaging modality that ensures three-dimensional visualization of the maxillo-mandibular complex, being increasingly used in dentistry for various purposes (13,14). In the diagnosis of bone lesions, such as osteoma, tomography is the best choice for determining the size, location, and anatomical relationship of the lesion with adjacent structures (1). The present case evidenced, through CT scan, a large bone lesion with thinning of the cortices, invasion of soft tissue, and displacement of the mandibular canal. This type of detail provides crucial information for surgical planning and ensures that the treatment is carried out more safely and with a better prognosis for the patient in terms of recovery and recurrence of the lesion (14).

CONCLUSION

Giant osteomas are uncommon, especially in the jaw region. The dentist must be aware of this pathology due to the risk of involvement with syndromes, as well as affecting the aesthetics and function of affected patients. In this sense, the clinical, histopathological, and imaging diagnosis of this pathology is of great relevance.

The authors declare that there is no conflict of interest.

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CASE REPORT

GINGIVAL MARGIN ELEVATION AND INDIRECT RESTORATION IN MILLED COMPOSITE RESIN IN TOOTH WITH SUBGINGIVAL MARGIN: CASE REPORT

ELEVAÇÃO DE MARGEM GENGIVAL E RESTAURAÇÃO INDIRETA EM RESINA COMPOSTA FRESADA EM DENTE COM MARGEM SUBGENGIVAL: RELATO DE CASO

Débora Teresa Griebeler Carvalho Drebel[1], Silvana Pizzini Montenegro[1]

ABSTRACT

Currently, dentistry tends to be more conservative, preserving dental tissue. The use of direct restorations and indirect partial restorations in composite resin, associated with biomimetic protocols, are examples of minimally invasive procedures. Teeth with extensive cavities and subgingival marginal endings are challenges for clinical practice, and in the search for more conservative protocols, deep margin elevation (DME) may be indicated. This work aims to demonstrate, through a clinical case, the importance of DME associated with the milled indirect restoration in composite resin, using the CAD-CAM system, in a tooth with a margin located beyond the cement-enamel junction (CEJ). The present case report described the restorative treatment of the upper left second premolar, which initially presented extensive caries under a composite resin restoration on the occlusal and mesial surfaces; and, after its removal, had the cervical margin of the mesial surface allocated subgingivally. The treatment option was composite resin DME, followed by endodontic treatment, sealing of the canal entrances, composite resin core build-up, and final restoration type onlay, also in composite resin, produced through the digitally assisted design and manufacturing system (CAD-CAM). The proposed treatment demonstrated that DME allows for the perfect adaptation of the restoration directly to the tooth, eliminating the need for clinical crown lengthening (CCL). Thus, an effective, quick treatment with lower comorbidity and reduced financial cost to the patient was achieved. After four months, the clinical and radiographic evaluation of the restoration showed good marginal adaptation, pleasant aesthetics, good polishing, and gingival health, with no signs of inflammation.

Keywords: Composite resin, CAD-CAM, dental marginal adaptation, onlay dental, biomimetic.

RESUMO

A Odontologia atual almeja ser conservadora, preservando o tecido dental. O uso de restaurações diretas e parciais indiretas em resina composta, associado aos protocolos biomiméticos, são exemplos de procedimentos minimamente invasivos. Dentes com cavidades extensas e términos marginais subgengivais são desafios para a prática clínica, e na busca por protocolos mais conservadores, a elevação de margem gengival (DME) pode ser indicada. O objetivo deste trabalho é demonstrar, através de um caso clínico, a importância da DME associada à restauração indireta fresada em resina composta, utilizando o sistema CAD-CAM, em um dente com margem localizada além da junção cemento esmalte (JCE). O presente relato de caso descreveu o tratamento restaurador do segundo pré-molar superior esquerdo, que inicialmente apresentava cárie extensa sob uma restauração em resina composta nas faces oclusal e mesial; e, após sua remoção, teve a margem cervical da face mesial alocada subgengivalmente. A opção de tratamento foi a DME em resina composta, seguida do tratamento endodôntico, selamento da entrada dos condutos, núcleo de preenchimento de resina composta, e restauração final tipo onlay, também em resina composta, produzida através do sistema de design e fabricação assistida digitalmente (CAD-CAM). O tratamento proposto demonstrou que a DME possibilita a perfeita adaptação da restauração diretamente ao dente, eliminando a necessidade de aumento de coroa clínica (ACC). Assim, viabilizou-se um tratamento efetivo, rápido, de menor comorbidade e custo financeiro reduzido ao paciente. Após quatro meses, a avaliação clínica e radiográfica da restauração evidenciou boa adaptação marginal, estética agradável, bom polimento e saúde gengival, sem sinal inflamatório.

Palavras-chave: Resina composta, CAD-CAM, adaptação marginal dentária, onlay dental, biomimética.

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INTRODUCTION

In search of increasingly conservative and minimally invasive procedures, biomimetic dentistry has been refining concepts aiming to preserve dental structure and vitality, increasing the longevity of the tooth and rehabilitative treatments (1,2). Restoring teeth with subgingival margins is challenging for clinical practice, whether with direct or indirect restorations (3). Cavity preparations that go beyond the cement-enamel junction (CEJ) can bring some problems, such as proximity to the bifurcation area (4,5), difficulty in isolation with a rubber dam, in polishing and the adaptation of inadequate restorations, leading to gingival inflammation and compromised adhesion due to the absence of enamel at the margins (4).

Deep margin elevation (DME) is a minimally invasive procedure that uses biomimetic protocols. Described in 1998 by Dietschi and Spreafico, this technique assists in resolving cases with cavities with subgingival margins (3,4,6), repositioning the cervical margin to a more favorable position through composite resin restorations (6–9). This procedure may replace clinical crown lengthening (CCL) and orthodontic extrusion or complement them in treating teeth with extensive loss of dental tissue in the gingival direction (7,8,10,11). In addition to being a more economical and comfortable alternative compared to CCL surgery and orthodontic extrusion (3,4), DME is compatible with periodontal health (6), once the composite resin is properly polished, without excess, with good margin contour (4) and respecting biological distances (11).

To ensure adequate DME, it is essential to perform a periodontal assessment to ensure gingival health (6). The gingival sulcus has an average of 0.69 mm, while the supracrestal attachment tissue is 2.04 mm, of which 0.97 mm corresponds to the junctional epithelium and 1.07 mm to the connective tissue (4). It is crucial to preserve biological distances without invading the connective tissue (11,12) and to ensure that the tooth has a band of keratinized gingiva approximately 2 mm wide (12).

Following the biomimetic protocol, assessing the presence of bio-rim, bio-dome, cracks, intercuspidal isthmus, cavity depth, and cusp thickness is important. Absolute isolation facilitates the removal of caries, the verification of wall thickness, and the restorative decision (5). The more structure is preserved during preparation, the better the mechanical properties and the greater the fracture resistance of the remaining part after restoration (13).

In DME, the restorative material is applied directly over the dentin margin, which presents challenges in adhesion due to its high organic content, high permeability, and low surface energy (14). Practices such as immediate dentin sealing (IDS), the use of conventional three-step adhesive systems and two-step self-etching (6), dentin sandblasting with aluminum oxide (15), and cavity cleaning with chlorhexidine are essential to improve marginal integrity and adhesive strength in dentin (4,11). The IDS is performed by applying an adhesive system with or without filler, associated or not with a flowable resin (resin coating) (6,16–18). The resin coating should be applied over the entire surface of the prepared dentin, thus reinforcing the IDS (11,16,17,19,20).

Direct composite resin restorations can be indicated for teeth with subgingival margins, or that extend beyond the CEJ. However, the indication usually falls on inlays/onlays in the chairside (5,6) technique, which offers good durability, marginal adaptation, and benefits gingival health (21) due to their excellent polishing.

DME may or may not be associated with indirect restorations and involves complex procedures with high technical sensitivity that depend on the execution and skill of the dental surgeon. This work aims to describe a clinical case, highlighting the importance of DME associated with the milled indirect restoration in composite resin, using the CAD-CAM system, in a tooth with a margin located beyond the CEJ.

CASE REPORT

The case report was submitted to the Marcílio Dias Naval Hospital Research Ethics Committee and approved by opinion number 7,082,166. The patient signed the informed consent form (ICF) and was selected through clinical and radiographic evaluation at the Prosthetics Clinic of the Odontoclínica Central da Marinha (OCM), in Rio de Janeiro, Brazil.

A 45-year-old Caucasian man, with madical history of kidney stones and hypothyroidism, sought care at the OCM for dental evaluation, as they would participate in an internal selection process. During the clinical evaluation, he reported pain to cold and when chewing, with a slow decline in the second upper left premolar. The patient had a composite resin restoration on the occlusal and mesial surfaces and decay under the restoration. The radiographic examination revealed extensive caries under the restoration, with pulp proximity (figure 1A). The carious lesion was removed, and the endodontic access was performed. However, the endodontics were not completed in the same appointment. The cervical margin of the mesial proximal box was located subgingivally (figure 1B). Radiographically, it was observed the distance between the bone crest and the carious lesion was approximately 2 mm, which allowed for the DME with composite resin, eliminating the need for CCL (figure 1A).

The procedure began with gingival anesthesia using 2% lidocaine with 1:100,000 epinephrine – Alphacaine (DFL, Rio de Janeiro, Brazil) and absolute isolation with modified clamps 202 on the upper left first molar and and 206 on the upper left second premolar, Sanctuary rubber dam (KDent, Santa Catarina, Brazil) and Teflon tape strip (figure 2A and 2B). The provisional zinc oxide restoration was removed with a spherical diamond tip reference 1014 (KG Sorensen, São Paulo, Brazil); and, with the cavity clean (figure 2C), the canal entrance was sealed with a small ball of Teflon tape, preventing any moisture from coming from inside the canal (figure 2C). The remaining dental structure was evaluated, and only the mesial wall – which ended below the gingival level – needed to be elevated coronally. The other surrounding walls were filled to prevent wear of the dental structure during preparation for indirect restoration type onlay.

A 0.5 cm wide steel matrix was selected and trimmed to better fit the mesial face margin. Then, the matrix was fixed with two anatomical wooden wedges (TDV, Santa Catarina, Brazil) and inserted through the buccal and palatal surfaces (figure 2C). With the metal matrix in position, conditioning was performed with 37% phosphoric acid Attack Acid (Iodontosul, Rio Grande do Sul, Brazil) for 30 seconds on enamel and 15 seconds on dentin, rinsing with water and drying with an endodontic suction device. The Adper® Scotchbond® Multi-Purpose adhesive system (3M ESPE, Minnesota, United States) was used for the adhesive layer, according to the manufacturer's instructions and photopolymerized with the Valo® device (Ultradent, Utah, USA) for 60 seconds. The composite resin type flow Applic (Maquira, Paraná, Brazil) was used to perform the resin coating and photoactivated for 40 seconds, followed by incremental layers with 1 mm thickness of composite resin Forma® shade A1E (Ultradent, Utah, USA) for margin elevation on the mesial face and reinforcement of the surrounding walls. Each increment was photoactivated for 60 seconds with the Valo® device, maintaining access to the root canals through the occlusal and continuing the endodontic treatment.

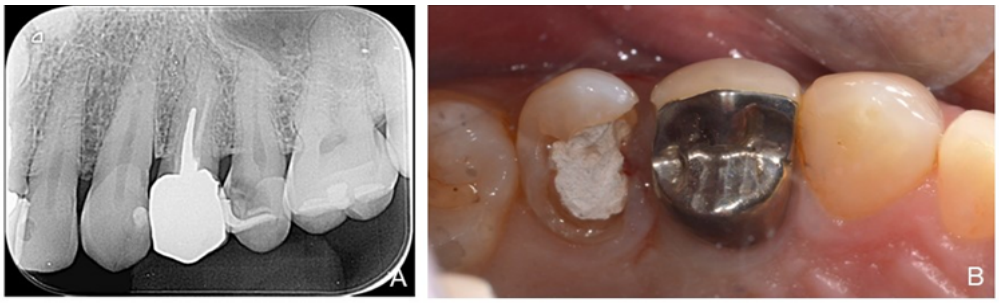

Figure 1: A) Initial X-ray; **B)** Initial assessment after removal of caries and pre-existing restoration. Observe the presence of the mesial subgingival margin.

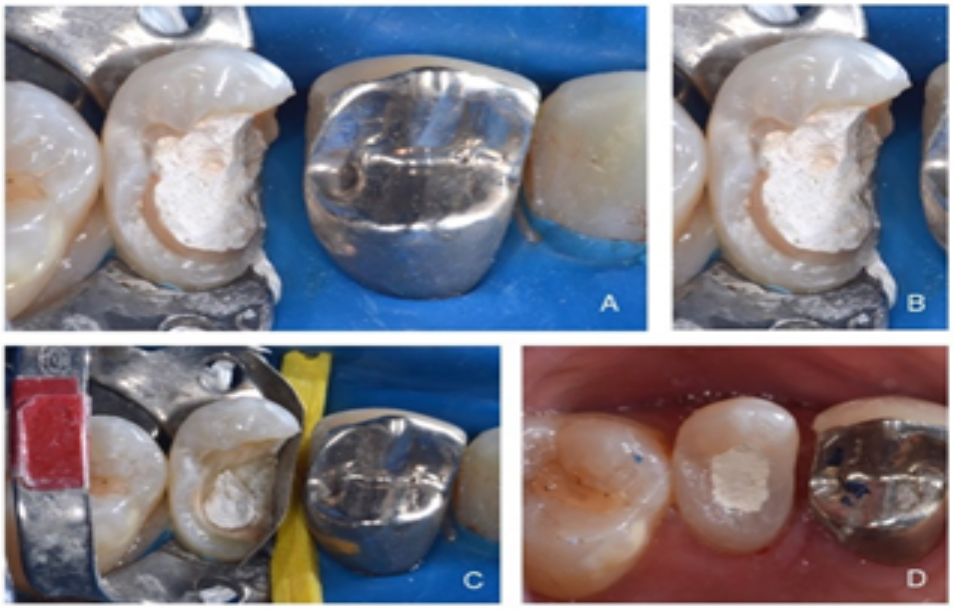

Figure 2: A) Absolute isolation installed. **B)** Detail of the isolation of the upper left second molar, with the insertion of Teflon tape to improve the adaptation of the rubber dam on the mesial surface of the tooth. **C)** After removing the dressing and cleaning the cavity, adaptation of the metal matrix and anatomical wooden wedge. Teflon tape placed at the mouth of the channel to prevent moisture. **D)** GME performed and sealing of the duct entrance with zinc oxide and eugenol cement.

The strand of Teflon tape was removed from the access to the ducts, which were irrigated with saline solution and dried with an endodontic suction device. Then, a delay dressing was applied with a cotton wick, tricresol, and provisional sealing with zinc oxide cement (figure 2D). For the external finishing of the DME, fine diamond tips, reference 2200F, and 1111F were used, in addition to red and orange Sof-Lex® Pop-on sanding discs and Sof-Lex® sanding strips (3M ESPE, Minnesota, United States).

The patient was referred to the clinic of Endodontics and underwent endodontic treatment in a single session. After two weeks, he returned to the Prosthetics Clinic to continue the restorative treatment. The digital periapical radiograph indicated compliance with the endodontic treatment and maintenance of the gingival margin elevation in composite resin previously performed (figure 3A).

Figure 3: **A)** Periapical radiograph after endodontic treatment, showing good adaptation of the mesial restoration for gingival margin elevation. **B)** Removal of the dressing and cleaning of the cavity after endodontic treatment. **C)** Filling completed. **D)** Tooth prepared for indirect restoration type onlay in milled composite resin.

The procedure was initiated with gingival anesthesia using 2% lidocaine with 1:100,000 epinephrine - Alphacaine (DFL, Rio de Janeiro, Brazil). Absolute isolation was performed with a rubber dam and modified clamp 206 on the upper left second molar, followed by made with glass ionomer cement. The cavity was cleaned with a conical trunk diamond tip, reference 4138F (KG Sorensen), maintaining the elevation of the mesial wall and the filling of the surrounding walls previously performed (figure 3B). Then, conditioning was done with 37% phosphoric acid (Attack Ácido, Iodontosul) for 1 minute on the resin and 15 seconds on the dentin, followed by washing with water and drying with an endodontic cannula. The adhesive system Adper® Scotchbond® Multi-Purpose (3M ESPE) was applied according to the manufacturer's instructions and light-cured for 60 seconds. After that, the flow Applic resin (Maquira) was applied, followed by the Forma® composite resin color A1E (Ultradent) for the filling core in horizontal increments of approximately 1 mm thickness, photopolymerized for 60 seconds (figure 3C).

Removed the absolute isolation, the tooth was prepared for an indirect restoration type onlay in milled composite resin. The mesial wall, where the elevation of the margin in composite resin was performed, received a partial preparation, maintaining the cavity finish in composite resin. The occlusal surface was reduced by approximately 2 mm, while the distal and buccal surfaces did not need to be reduced, as they were more than 2 mm thick (22). All preparation margins were kept in enamel, except on the mesial surface, where it was kept in composite resin, using diamond burs, reference 4138, 2131, and 4138F (KG Sorensen). The preparation was scanned on the CEREC Omnicam device (Dentsply Sirona, Charlotte, United States) (figure 4A). The

indirect restoration was designed in the CEREC 4.6.2 Software (Dentsply Sirona) on the virtual model (figures 4B, 4C, and 4D), and the Grandio Blocs 14L A3 LT shade nanohybrid resin block (VOCO, Cuxhaven, Germany) was milled in the InLab MCXL equipment (Dentsply Sirona, Bensheim, Germany). The milled part was polished with silicone tips

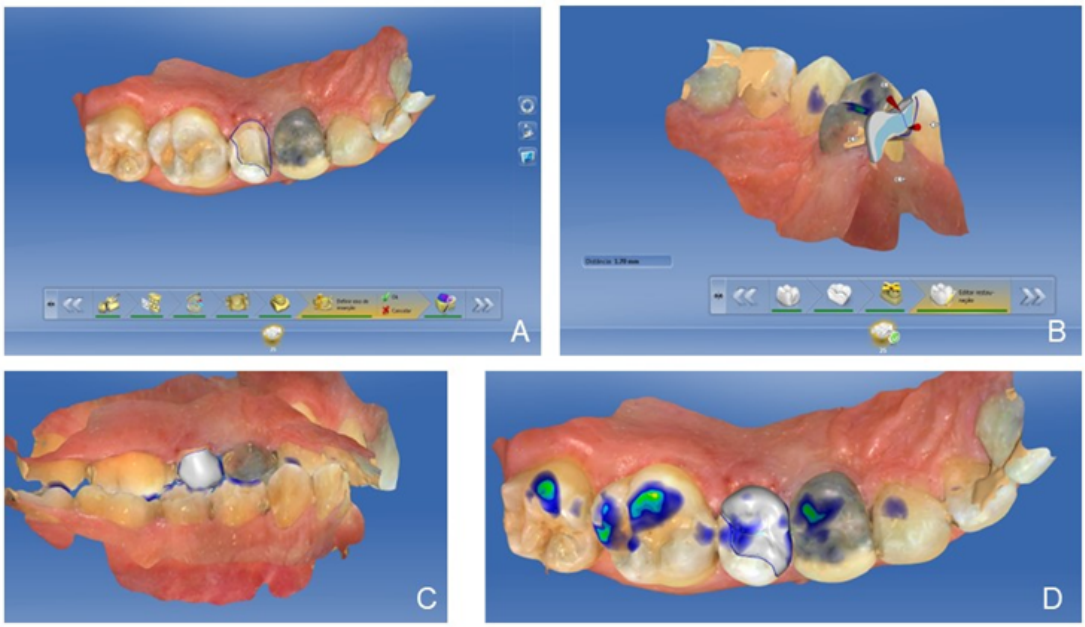

Figure 4: A) Image of the tooth after scanning with CEREC Omnicam and viewing through the CEREC 4.6.2 software. **B)** Evaluation of the thickness of the part after drawing. **C)** Evaluation of the part in lingual view. **D)** Evaluation of the piece in occlusal view.

impregnated with silica PPU 20 and PU30 (DhPro, Paraná, Brazil) and then taken for a trial in the mouth. After testing and verifying the marginal adaptation and proximal contacts, gingival anesthesia of the upper left first molar was performed to install absolute isolation. A rubber dam (Madeitex, São Paulo, Brazil) was used from the upper left first molar to the upper left canine, with the modified clamp 202 applied to the upper left first molar and a ligature with dental floss on the upper left second molar, aiming to adequately expose the cervical margin of the preparation (Figure 5A). Then, another test of the part was carried out to verify

Figure 5: A) IInstallation of absolute isolation for resin cementation of the indirect resin restoration. **B)** Cemented restoration, before finishing. **C)** After occlusal adjustment, finishing, polishing, and removal of the rubber dam. **D)** Vestibular view of the upper left second molar after final restoration.

the absence of interferences from the absolute isolation.

The part was prepared by roughening the internal surface with a diamond tip reference 4138F (KG Sorensen). Then, cleaning was done with 70% alcohol and the application of silane (Angelus, Paraná, Brazil) with the aid of a micro brush (KG Sorensen) for 60 seconds and dried with air jets. The 37% phosphoric acid (Attack Acid, Iodontosul) was applied for 30 seconds on the enamel and composite resin, followed by washing with water and drying with an endodontic cannula and gentle air jets. The bond of the Adper® Scotchbond® Multi-Purpose system (3M ESPE) was applied according to the manufacturer's instructions and polymerized with the Valo® device (Ultradent) for 60 seconds. The dual-cure resin cement AllCem® color A2 (FGM, Santa Catarina, Brazil) was applied with a mixing tip on the previously prepared piece and seated on the tooth. After removing the marginal excesses of the resin cement with brushes and dental floss, the piece was photoactivated with the Valo® device (Ultradent) for 2 minutes on each side (figure 5B).

Removed the absolute isolation, the occlusal adjustment was performed with Arti-Check 40mm carbon (Bausch, Cologne, Germany) and fine diamond tips reference 3118F and 2200F (KG Sorensen). The polishing was achieved using sequential abrasive rubber tips impregnated with Jiffy® silica (Ultradent, Utah, United States), Opal-L polishing paste no. 520-0001 (Renfert, Hilzingen, Germany), and a goat hair brush (American Burrs, USA) (figure 5C and 5D).

The tooth was re-evaluated clinically and radiographically after four months (Figures 6A and 6B) showing a good marginal adaptation and a healthy appearance of the gum, with slight bleeding after several probings at the mesial margin.

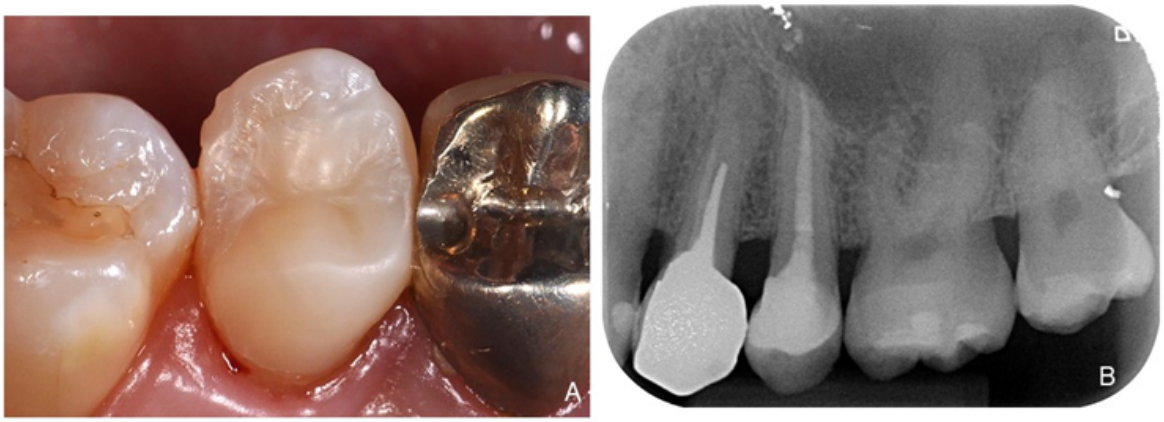

Figure 6: **A)** Clinical evaluation after 4 months. **B)** Radiographic evaluation.

DISCUSSION

The present case report described the restorative treatment of the upper left premolar, which initially presented extensive caries under a composite resin restoration on the occlusal and mesial surfaces. After removing the restoration, the cervical margin of the mesial face extended subgingivally. The treatment option was DME with composite resin, followed by endodontic treatment, sealing of the canal entrances, composite resin core build-up, and finally, the final restoration type onlay, also in composite resin, produced through the digitally assisted design and manufacturing system (CAD-CAM).

The case planning was developed after a thorough clinical and periodontal evaluation of the remaining dental structure. Periodontal assessment is essential to ensure gingival health (6). Three therapeutic approaches are suggested based on the distance between the cervical margin of the preparation and the connective insertion or bone level, in addition to the possibility of adequately isolating the tooth in a classification for restorations with subgingival margins (23,24). This is divided as follows: grade I, when it is possible to install the rubber dam in the gingival sulcus, and the margin can be completely visualized, DME is performed with approximately 1.5 mm thickness associated with the indirect restoration; grade II, when the rubber dam is not sufficient to retract the gingiva but the biological space is respected, surgical exposure of the preparation margin, DME, and indirect restoration are performed; grade III, when there is invasion of the biological space, CCL is necessary, followed by DME and indirect restoration (23,24).

The described case was classified as grade I since the sulcular probing identified 2 mm between the free gingival margin and the alveolar bone. Absolute isolation was sufficient to expose the preparation margin, adapt the metal matrix, and raise the margin with composite resin by approximately 1.5 mm. After adequate restoration and polishing, the gum reattaches to the tooth, forming a long junctional epithelium (4,7). A rigorous support therapy is of utmost importance for the success of the treatment,

with scheduled follow-ups and good oral hygiene, including the use of dental floss and interdental brush in the DME area (6,10,25). A study by Muscholl et al. concluded no increase in gingival or periodontal inflammation after three years of follow-up in patients using an interdental brush in the area where the DME was performed (10).

After the periodontal evaluation, the analysis of the dental structure allows for better utilization of the remaining part, avoiding unnecessary wear of the tooth. The cohesive strength of the dentin-enamel junction (DEJ) is 51.5 MPa, being an important structure to be preserved during cavity preparations. This force alters the direction of occlusal forces and prevents the formation and propagation of cracks in the dentin, minimizing dentinal stresses (26,27). The protective enamel dome, associated with the DEJ and dentin, forms the bio-dome on the occlusal surface of the tooth (28). When the bio-dome is lost, the tooth becomes weakened and may fail, commonly in the form of an oblique fracture, leading to the loss of the cusp (28). Like the bio-dome, the bio-ring reinforces the cervical region of the tooth or below the dental equator, where the enamel, the DEJ, and the dentin function as a support belt (28). When the bio-rim is preserved, as in preparation for onlay, the risks of tooth fracture are reduced, compared to the installation of a full crown, which requires the removal of this supporting structure. (28).

The thickness of the cusps should also be carefully evaluated to prevent fractures. For non-vital teeth, the minimum thickness of the working cusp wall should be 3 mm, while the other walls can be up to 2 mm thick (22). Forster et al. demonstrated that mesio-occluso-distal (MOD) cavities with up to 3 mm depth can be restored with composite resin, acquiring fracture resistance similar to that of a healthy tooth, regardless of the thickness of the walls (13). On the other hand, cavities with 5 mm or more in-depth, whether the teeth are vital or not, do not show the same resistance to fracture after direct restoration with composite resin, requiring indirect restoration (13). In the case of the reported upper left second premolar, the palatal wall was already fractured before the restorative treatment, possibly due to its reduced thickness (less than 2 mm), the depth of the cavity (approximately 5 mm), and the endodontic access performed.

The need for endodontic treatment should be assessed during the structural analysis of the tooth and treatment planning. Whenever possible, immediate dentin sealing (IDS) should be performed before endodontic treatment, as the irrigating solutions used can cause changes in the physical and chemical properties of dentin, affecting its hardness (29,30) and, consequently, the interaction of restorative materials with dentin (30). The most used irrigating solution, sodium hypochlorite, acts as a proteolytic agent that solubilizes the organic matrix of the dentin wall, causing a reduction in the bond strength of adhesive systems on exposed dentin, in addition to having a residual effect by releasing oxygen-inhibiting resin polymerization (31,32). In turn, the EDTA has a chelating effect, which causes the dentin's demineralization, the dentinal tubules' widening, and increased demineralization depth (29,32). In this way, the adhesive systems may not adequately penetrate the entire extent of the demineralized matrix, impairing adhesion.

These data reinforce the decision to perform IDS, DME, and the reinforcement of the buccal, palatal, and distal walls before the endodontic treatment in this case report. Although the tooth already had endodontic access, the cavity was cleaned again under absolute isolation; the remaining tooth structure was evaluated and then followed by the IDS, the resin coating, the DME, and the filling with composite resin, maintaining access to the root canal system. The filling with composite resin reinforced the existing dental structure, avoiding unnecessary structural wear. Furthermore, it facilitated absolute isolation for endodontic treatment, reduced the risk of dental fracture, and improved the adhesion of composites to dentin (5, 19).

To start the DME, the rubber sheet must be well adapted to avoid interference with the restoration (5,6). A metal matrix, whether steel or copper, can be applied partially or circumferentially from the cervical margin (5). The matrix must be larger than the level you want to raise the margin but narrow enough to reach the subgingival area without deforming (5). The matrix must be adequately stabilized using wedges, wedjets, rings, and even increments of composite resin (6). When it is impossible to adapt the matrix adequately, the DME should not be attempted due to the risk of microleakage and recurrent caries at the margins (6).

As the margins of the cavity extended beyond the CEJ, the adhesion of the DME occurred in the dentin, which contains more organic matter and fewer minerals than the enamel. A cohesive force of the magnitude found in the DEJ should be the goal of current adhesive systems about dentin (6,27). IDS reproduces DEJ by applying an adhesive system with or without filler and can be associated with a flowable resin (resin coating) (6,16-18). IDS reduces bacterial infiltration, the formation of gaps, and dentin hypersensitivity, as well as increases bond strength and reinforces the tooth structure. The resin coating interacts with the resin/resin cement that will be applied during cementation, reducing adhesive permeability, increasing the adaptation of

these cements, also of indirect restorations, besides to promoting higher micro tensile values of onlay-type restorations onlay. A study in vitro by Murata et al. on adhesive strength and types of fracture demonstrated that the fracture of ceramic onlay restorations occurred only at the interface between the cement and the dentin in the group where IDS was not applied, thus highlighting its effectiveness.

The selection of material for DME is relevant for the survival and performance of the restoration, especially regarding marginal adaptation and adequate continuity between the tooth and the restorative material. (7,14). Various materials have been indicated, including conventional composite resin, flow resin, bulk-type resin, glass ionomer cement, and glass ionomer-modified resins (8). In the reported case, the materials chosen for the IDS, DME, and resin core build-up were selected based on availability in the clinic. The good clinical performance of the composite resin (Forma - Ultradent), combined with the conventional three-step adhesive system (Scotchbond Multiuso - 3M ESPE), provides reliable adhesive results.

An in vitro study by Spreafico et al. compared the DME using nanohybrid composite resin (Filtek Supreme XTE – 3M ESPE) and flow resin (Filtek Supreme XTE Flowable – 3M ESPE). The results showed no significant difference between the groups before or after thermocycling, and the adaptation of resin or ceramic crowns on the DME was also similar (35). However, other authors indicate that fluid composites are more susceptible to degradation, although they have superior sealing compared to nanohybrid composites (6,8,14). For this reason, they are contraindicated for DME. A study in vitro by Bresser, Carvalho, and Naves revealed a higher incidence of catastrophic fractures when the DME was not used on ceramic inlays (21).

After the DME and the filling of the endodontic access, it was decided to use an onlay type restoration in composite resin manufactured using CAD-CAM technology. The use of indirect composite resin restorations, whether produced conventionally or by CAD-CAM, allows all stresses to be relieved before the cementation of the pieces, especially benefiting marginal adaptation. (11,23). Although glass ceramics, such as lithium disilicate and feldspathic ceramic, exhibit excellent mechanical and optical properties, they are brittle, crack under load and chip, are difficult to repair, and wear down the opposing tooth (2).

CAD-CAM type indirect resins have advantageous characteristics, such as modulus of elasticity and flexibility similar to dentin, aesthetic stability, better absorption of masticatory forces, less tendency to marginal fracture, lower cost, no need for firing in a special oven, and easy intraoral repair compared to ceramics. (36). These materials present a less sensitive and predictable technique, as they are more homogeneous and have fewer internal flaws. This results in greater reliability, good marginal adaptation, and superior clinical longevity compared to direct composite resin restorations (20,36). Besides these factors, the choice for indirect restoration assisted by CAD-CAM technology in this study aimed to optimize time, allowing the treatment to be completed in a single appointment without needing molding, provisional restoration, or external laboratory assistance.

A clinical study by Souza et al. demonstrated that ceramic and resin onlays showed no statistical differences in aesthetics, function, and biological properties after one year of function (36). Both materials exhibited marginal degradation, but this degradation was significant only for ceramics in terms of gloss, color matching, and translucency (36). Another study followed indirect restorations in composite resin and ceramic on DME for 10 to 12 years, revealing success rates of 80 and 88%, respectively (11). This study indicated a greater marginal degradation in indirect resin restorations (11). Elmoselhy et al. study followed indirect partial restorations of nano-hybrid resin and milled lithium disilicate (37). They evaluated the restorations' marginal adaptation, discoloration, and fracture. After six months, there was a better marginal adaptation of the resin, but at the 12 and 24-month follow-ups, no significant differences were found between the groups (37). This similarity can be attributed to the fact that the composite piece and the resin cement wear out at similar rates, allowing for a good adaptation (37). Ceramic restorations, on the other hand, are more brittle and present a higher risk of small marginal fractures (37).

There are few longitudinal studies on DME, mostly in vitro studies and case reports (4). When used in conjunction with indirect restorations, DME shows a higher survival rate than when CCL is performed, especially in non-vital teeth and indirect composite resin restorations (5). Among the main observed failures, marginal discoloration, caries infiltration (5,6), and fractures in both the tooth and the restoration stand out; however, there is no change in periodontal health (5). It is suggested that the operator's skill and execution technique significantly impact clinical success more than the restorative material used (6). Long-term, multicenter, and standardized clinical studies can provide valuable data that improves public health. Expanding evidence on DME can change the working philosophy of many dentists and increase the survival of extensively destroyed teeth.

CONCLUSION

The proposed treatment demonstrated that DME allows perfect adaptation of the restoration directly to the tooth, eliminating the need for CCL. Moreover, it favors the fabrication and adaptation of the indirect restoration to dental preparation. The restoration type onlay in composite resin on the DME contributed to preserving the remaining dental structure and distributing forces through the resin structure, reducing the risk of dental fracture. Thus, an effective, quick treatment with lower comorbidity and reduced financial cost was made possible for the patient. In the clinical and radiographic evaluation of the restoration, carried out after four months, good marginal adaptation, pleasant aesthetics, good polishing, and gingival health were observed, with no inflammatory signs.

The authors declare no conflicts of interest.

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CASE REPORT

DISSEMINATED HISTOPLASMOSIS WITH ORAL MANIFESTATION IN A PATIENT WITH CROHN'S DISEASE

HISTOPLASMOSE DISSEMINADA COM MANIFESTAÇÃO ORAL EM PACIENTE COM DOENÇA DE CROHN

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ABSTRACT

Histoplasmosis and Crohn's Disease (CD) can resemble each other in clinical characteristics, thus complicating the diagnosis by the doctor or dentist. Through a clinical case, this work aims to demonstrate the diagnostic challenge of a single histoplasmosis lesion in the oral cavity in a patient with chronic granulomatous disease. The histopathological examination found it to be an oral lesion resulting from a specific granulomatous process, subsequently diagnosed as histoplasmosis after microbiological culture of the lesion. The systemic medical evaluation did not identify lesions compatible with histoplasmosis in other organs. After appropriate therapy, the fungal infection was remission, and therapeutic follow-up of the autoimmune disease was performed. The co-occurrence of histoplasmosis in patients with CD is a possibility to be considered, especially due to the potential state of immunosuppression associated with this condition. Although the anatomopathological examination may not detect the microorganism in the tissue sample, this case demonstrated that microbiological culture should be considered an essential complementary examination for diagnosing deep mycoses.

Keywords: Histoplasmosis, Disseminated fungal infection, Oral diseases, Autoimmune disease, Crohn's disease.

RESUMO

A Histoplasmose e a Doença de Crohn (DC) são enfermidades que podem se assemelhar em características clínicas e, assim, dificultar o diagnóstico por parte do médico ou cirurgião-dentista. O objetivo deste trabalho é demonstrar, através de um caso clínico, o desafio diagnóstico de uma lesão única de histoplasmose na cavidade oral em paciente com doença crônica granulomatosa. No exame histopatológico, verificou tratar-se de lesão oral decorrente de processo granulomatoso específico, diagnosticado em seguida como histoplasmose mediante cultura. A avaliação médica sistêmica não identificou lesões compatíveis com histoplasmose em outros órgãos. Após terapia apropriada, houve a remissão da infecção fúngica e o seguimento terapêutico da doença autoimune. A co-ocorrência de histoplasmose em pacientes com Doença de Crohn é uma possibilidade a ser considerada, especialmente em virtude do potencial estado de imunossupressão associado a essa condição. Este caso demonstrou que, embora o exame anatomopatológico possa não detectar o microrganismo na amostra de tecido, a cultura microbiológica deve ser considerada um exame complementar essencial para o diagnóstico de micoses profundas.

Palavras-chave: Histoplasmose, Infecção fúngica disseminada, Doenças bucais, Doença Autoimune, Doença de Crohn.

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INTRODUÇÃO

Crohn's Disease (CD) is a chronic inflammatory and granulomatous condition widely affecting the gastrointestinal system. Its etiology is not fully understood, but it is believed to involve an immunologically mediated hypersensitivity, influenced by environmental factors such as smoking, in genetically susceptible individuals (1-7).

The pathophysiology of the disease is associated with abnormalities in helper-T cells, which differentiate into Th1 and Th17 lymphocytes. These anomalies trigger the overproduction of cytokines, such as IL-12, interferon-gamma, and tumor necrosis factor-alpha (8). The probable disease-associated antigens include enteric bacteria and/or autoantigens of the intestinal tract, which may be targets of an autoimmune response. This response compromises the affected tissues, causing changes, remodeling, and forming inflammatory granulomas (9-11). The disease can affect the entire gastrointestinal tract, with a higher incidence in the terminal ileum and colon. However, about 50% of affected individuals may present non-intestinal manifestations before the appearance of enteric lesions in areas such as skin, eyes, mouth, joints, and lungs (12). The signs and symptoms of the disease are diverse and include abdominal pain, diarrhea, fever, renal bleeding, intestinal lumen stenosis, peptic ulcers, diverticulitis, abscesses with fistulae, vomiting, weight loss, loss of appetite, enterorrhagia, occasional nasal obstruction, and epistaxis (13).

The diagnosis of CD is based on a combination of clinical and histopathological findings. Among the clinical findings, the physical examination performed by the healthcare professional stands out, identifying typical signs and symptoms of the disease (13-14). Complementary exams include endoscopy, imaging, and laboratory tests. Among the laboratory tests are the complete blood count, C-reactive protein, erythrocyte sedimentation rate, albumin dosage, IgG and IgA antibody testing against *Saccharomyces cerevisiae*, and the detection of anti-neutrophil cytoplasmic antibodies (13,15-16). From the histopathological point of view, the biopsy of the lesions by CD is important. In particular, in gastrointestinal lesions, non-necrotizing granulomas are expected to be found on microscopic examination (1). The definitive diagnosis is usually established after excluding other diseases and conditions that can cause similar granulomatous inflammation, such as tuberculosis, sarcoidosis, and fungal diseases (14).

Treating CD generally involves using drugs from the following classes: glucocorticoids, immunomodulators, biologics, and elemental diets. These treatments aim to control the adverse manifestations of the disease, reduce inflammation, and improve patients' quality of life (17). Among the frequently used drugs are aminosalicylates, prednisolone, mercaptopurine, azathioprine, thiopurines, and methotrexate (18). In addition to drug therapy, nutritional control plays an important role in treatment, and dietary supplementation may be necessary (7,19-20). In some cases, surgical procedures may be necessary, especially during disease exacerbation, such as in cases of intestinal obstruction with abscesses and fistulas (21). Maintaining an excellent quality of life is essential to minimize the adverse effects of the disease and treatment. This includes following a balanced diet and regular physical activity (17,19,22-23).

In the differential diagnosis of CD, it is essential to consider histoplasmosis, a severe fungal infection that can present similar symptoms. It occurs endemically in the Americas and is caused by the fungus *Histoplasma capsulatum*. The disease mainly develops in moist soils rich in bird and bat droppings, from where the spores are carried by the air and inhaled into the lungs (24). The disseminated form of the disease is characterized by spreading to extrapulmonary sites, such as the spleen, liver, and gastrointestinal tract. In the oral cavity, the tongue is the most frequently affected site. This form of the disease tends to affect immunosuppressed individuals, the elderly, and AIDS virus carriers more severely. If not treated properly, the disseminated form becomes fatal (25). Usually, the diagnosis of Histoplasmosis is made through a histopathological examination resulting from an incisional biopsy of the lesion, which shows a non-caseating chronic granulomatous inflammatory lesion (26), similar to the microscopy of CD and other diseases, in addition to performing histochemical assays with special stains such as PAS and Grocott-Gomori methenamine silver to highlight the fungal yeasts (27). The performance of fungal cultures and serological tests also contributes to the diagnosis. This work aims to demonstrate the diagnostic challenge of a single histoplasmosis lesion in the oral cavity in a patient with chronic granulomatous disease through a clinical case.

CASE REPORT

A 59-year-old man, caucasian, asymptomatic, attended the stomatology clinic at the Dental School of the Federal University of Uberlândia, complaining about the appearance of a lesion on the tongue that originated after the placement of a titanium osseointegrated implant in the region of the first lower left molar, with one month of evolution, and which bothered him especially during speech and

chewing. According to the patient, after the dental surgery, their tongue touched a part of the exposed metal component of the implant, triggering the injury. During the anamnesis, the patient showed some difficulty in articulating words due to the mentioned tongue alteration and reported having had CD for twelve years, initially with manifestations of colitis and proctitis, under periodic medical follow-up and with the autoimmune disease under control. He reported being a resident of an urban area and not having contact with rural or forested regions. Routinely, the patient used the immunosuppressants adalimumab and mesalazine to control CD, which his gastroenterologist doctor prescribed. A week prior, the same professional also prescribed the ointment for topical administration on the tongue lesion. The ointment AdMuc 100mg - an extract of *Chamomilla recutita*- was indicated for various oral conditions. The patient carried various laboratory tests, including a complete blood count, lipid parameters, sodium, potassium, liver transaminases, renal function indicators, vitamin B12, C-reactive protein, and erythrocyte sedimentation rate (ESR). Among all verified, only the ESR was elevated (46 mm - 60 minutes). According to the patient, it was an expected and frequent finding in their routine exams, given the inflammatory condition typical of CD.

In the extraoral examination, there was nothing noteworthy. However, in the oroscopy, good overall oral hygiene was identified and a relatively well-defined lesion, approximately 2.5 cm in diameter, with erythematous and white fibrinoid exudative areas, showing central ulceration, located on the left anterior lateral border of the tongue, with a generally increased volume (Figure 1A, 1B). Some diagnostic hypotheses were considered after the clinical examination was completed, the main one being an oral manifestation related to CD; the secondary ones included a traumatic ulcer resulting from trauma to the recently performed implant, a lesion from some granulomatous infection, or even a possible squamous cell carcinoma. Thus, an incisional biopsy was performed in the same session for a conclusive diagnosis and to institute appropriate treatment, removing three small lesional fragments from distinct areas. After a week, the patient returned with the lesion showing a greater increase, with an aspect of worsening (Figure 2). The histological fragments stained with hematoxylin and eosin showed a tissue fragment characterized by extensive fibrinoid necrosis associated with vascular neoformation, mixed mononuclear and polymorphonuclear inflammatory infiltrate, and discrete neofibrogenesis. The conclusion after microscopy was fibrinoid necrosis of connective tissue and granulation reaction, with findings inconclusive for the hypothesis of CD or squamous cell carcinoma. Given the obtained anatomopathological report, the stomatologist responsible for the case informed the patient and contacted the involved gastroenterologist, reporting the findings and suggesting that the lingual lesion was possibly a nonspecific oral lesion resulting from the autoimmune hypersensitivity that characterizes CD. Thus, the doctor decided to suspend the use of Adalimumab for thirty days, understanding that the medication, potentially immunosuppressive, could delay the healing process of the ongoing lesion. In addition, the stomatologist prescribed two new topical medications: the betamethasone elixir 0.5 mg/5ml for rinsing two to three times a day and the triamcinolone acetonide ointment 1mg/g once a day, both corticosteroids, in daily alternation with the AdMuc 100 mg already in previous use, while the lesion was present. After another week, an improvement in the appearance of the lesion was noted, and the patient continued with the same medications and care regarding the lesion, with weekly follow-up at the stomatology clinic. After another two months of follow-up, the patient remained asymptomatic, but the lesion showed some morphological changes that justified the need for a new investigative incisional biopsy. The microscopy of the second biopsy was compatible with stratified squamous epithelium with pseudocarcinomatous hyperplasia, permeated by varying degrees of spongiosis and leukocytic exocytosis, forming occasional microabscesses. In the lamina propria and submucosa, a mononuclear inflammatory infiltrate was also noted, predominantly histiocytic, with multinucleated giant macrophages, lymphocytes, plasma cells, eosinophils, and neutrophils, characterizing a chronic granulomatous sarcoid-type inflammatory infiltrate, suggesting a specific CD lesion (Figure 3).

It is also important to highlight that histochemical stains PAS, Ziehl-Neelsen, and Grocott's methenamine silver, performed in the evaluation of the first and second microscopy, did not show any signs of fungal or bacterial parasites in the intra or extracellular inflammatory environment, with the pathologist noting that the definitive exclusion of the possibility of infectious diseases would require further evaluations, such as culture from the lesion tissue and serology for specific microbial antigens.

The patient continued clinical follow-up with the stomatology team, which decided to use low-power laser therapy. The established protocol was following the manufacturer through 100mW of power, with 1J every 10 seconds on each of the six chosen points on the lingual lesion, for two weeks and with two weekly sessions, using the Therapy XT device from DMC (Figure 4). Simultaneously, in conjunction with the gastroenterology medical team, it was decided

to perform a culture for microbiological purposes with samples from the oral lesion to confirm the absence of microorganisms, as indicated by previous histochemical stains. The culture revealed the growth of the fungus *Histoplasma capsulatum*, the causative agent of histoplasmosis. Based on this result, the patient was referred to the infectious disease department of the same hospital. During a 9-day hospitalization, he received treatment with Amphotericin B, prescribed at a dose of 3 mg/kg per day. After discharge, the treatment was adjusted to Itraconazole, initially with 200 mg every 8 hours for three days, later changed to every 12 hours. Three years later, the patient continues to use Itraconazole prophylactically and is being monitored by the infectious disease team. Chest imaging exams did not show pulmonary involvement, and 20 days after the start of antifungal treatment, the lingual lesion showed complete remission (Figure 5).

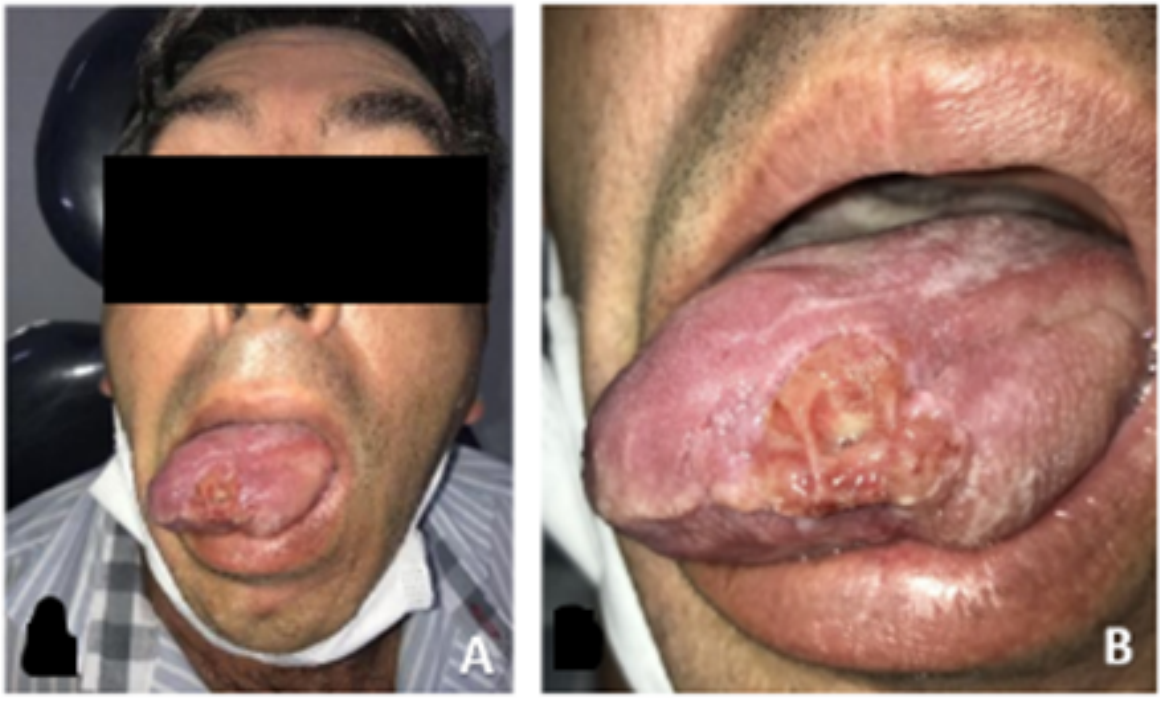

Figure 1: **A**- Frontal view of the patient exposing the tongue with the lesion. **B**- Granulomatous and ulcerated lesion approximately 2.5 cm in length on edematous tongue.

Figure 2: The aspect of the tongue after the incisional biopsy showed a modified appearance and general volume increase.

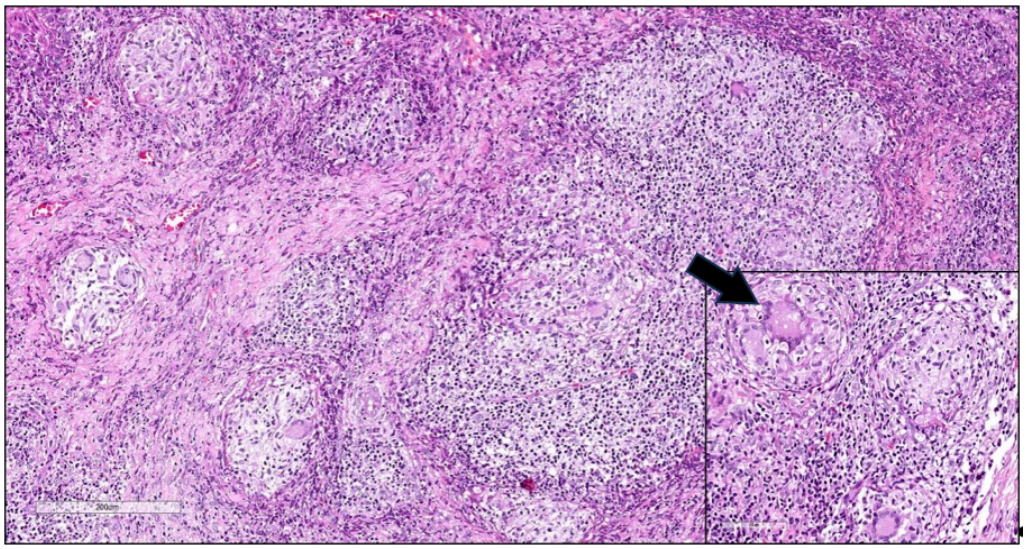

Figure 3: Histopathology revealed diffuse granulomatous inflammation, well-defined non-necrotizing granulomas, and numerous Langhans giant cells. Some of these cells showed vacuoles (uncertain), but no inclusion bodies or infectious agents were found. (Hematoxylin-eosin staining).

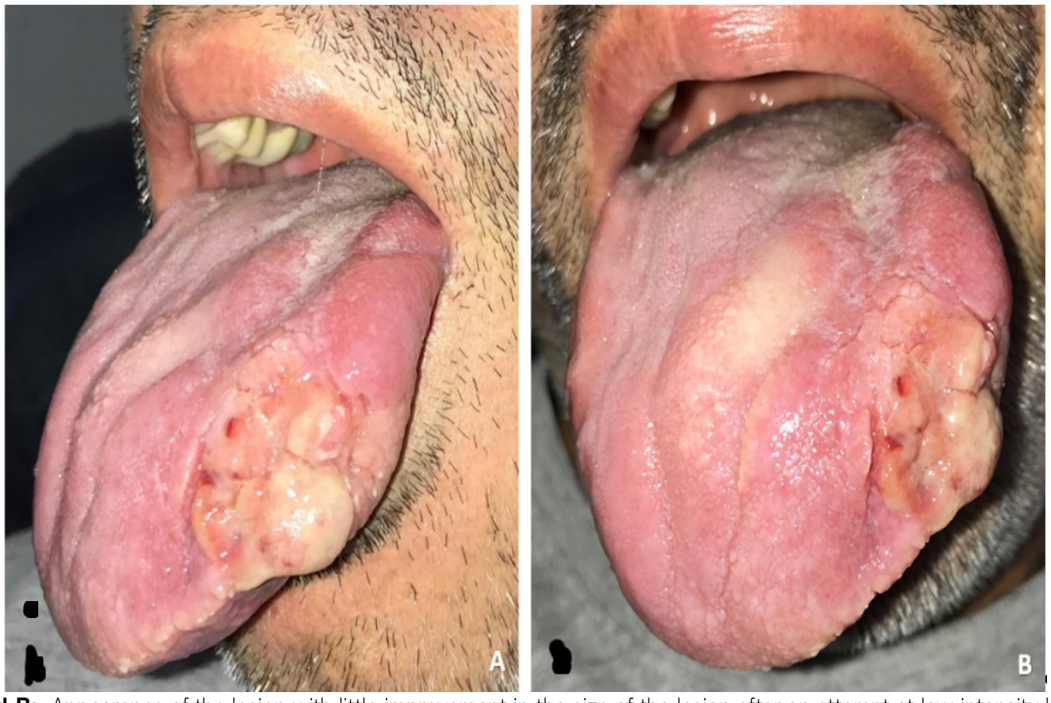

Figure 4 A and B: Appearance of the lesion with little improvement in the size of the lesion after an attempt at low-intensity laser therapy.

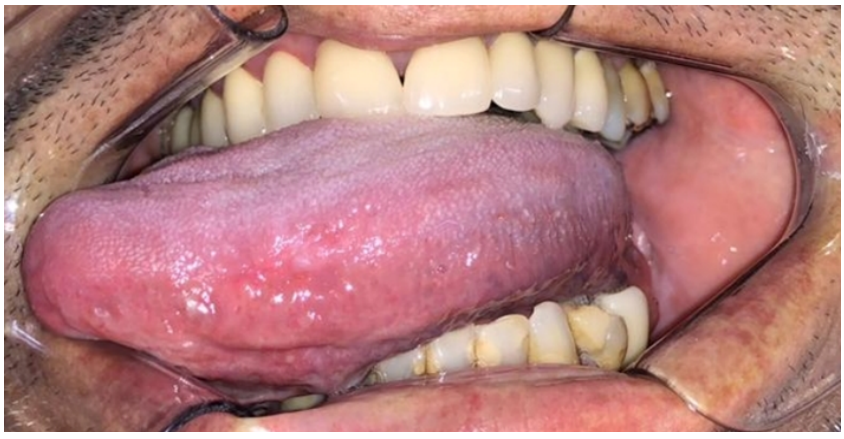

Figure 5: The final appearance of the tongue with total remission of the lesion.

DISCUSSION

The CD is currently understood as a type IV autoimmune hypersensitivity, characterized by a large infiltration of TH1 and TH17 lymphocytes in association with an overproduction of local cytokines, such as tumor necrosis factor, interleukin 12, and gamma interferon, which act on the tissues remodeling them in favor of the constitution of local granulomas (10). Clinically, it is a disease with inflammatory intestinal manifestations located in various sites, such as the ileum, ascending colon, transverse colon, descending colon, and sigmoid colon, triggering cases of intestinal diverticulitis, abscesses that may eventually fistulize, and a series of possible signs and symptoms, including diarrhea, abdominal pain, skin ulcers, and oral lesions (23,28).

The oral manifestations of CD are characterized by sporadic non-intestinal involvement in patients but are of great importance in the course of the disease (23). The case of a patient with CD for 12 years was evidenced, without intestinal manifestations due to a successful ongoing treatment, who developed a granulomatous oral lesion, initially suggestive of an oral manifestation of the disease. Specific histochemical stains were performed on the biopsied specimen, with no identification of microorganisms in the lesion. Nevertheless, subsequent tissue cultures revealed the presence of the fungus *Histoplasma capsulatum* in the tissue. This changed the initial hypothesis of an oral manifestation of CD to disseminated histoplasmosis with oral involvement. The disseminated form of histoplasmosis is the one that most affects the oral cavity, and the oral lesion may be the first manifestation of the disease, as evidenced in this case. Furthermore, oral manifestations of histoplasmosis can resemble malignant neoplasms, a feature also observed in this report.

Histoplasmosis is a relatively common fungal disease in immunocompromised individuals that usually shows a significant state of organic debility in this group (29). Commonly, the Disseminated variant of the disease has an extrapulmonary systemic repercussion, with the oral cavity being a possible site of involvement, with a higher incidence on the tongue (30). For various reasons, immunocompromised patients are most commonly affected by the Disseminated variant of Histoplasmosis. The patient affected by CD presents an unequivocal immunological imbalance because, even though the chronic autoimmune disease is under control, there is a daily need for immunomodulatory drugs. The use of drugs for controlling CD for more than a decade by the patient in the case now reported possibly made him susceptible to fungal colonization by *Histoplasma capsulatum*, determining the coexistence of two concomitant pathological entities, CD and Histoplasmosis.

Interestingly, this case report raises challenging questions regarding the sequence of events. Would there have been a fungal colonization after the histopathological analysis that would justify that microorganisms were not identified in the histochemical stains? Would the lingual lesion be an oral manifestation of CD that was later colonized by *Histoplasma capsulatum*? Would this be a case of opportunistic Disseminated Histoplasmosis in an immunocompromised patient due to an ongoing CD for 12 years? These are all intriguing questions from the study, and it is understood that the best characterization of the case is the advent of an oral manifestation of Disseminated Histoplasmosis in a patient with immunologically unbalanced CD due to long-term therapy. It is noteworthy that both nosological entities pose life-threatening risks and that, in addition to the fact that CD still does not have a definitive cure and thus requires continuous therapeutic control, Disseminated Histoplasmosis often requires patient hospitalization and long intravenous and oral antifungal treatments.

CONCLUSION

The management of oral manifestations of CD requires the dentist to perform a differential diagnosis with various lesions, including deep mycoses, which demands a comprehensive and detailed approach. The manifestation of histoplasmosis in patients with CD is a relevant possibility, considering the potential immunosuppression of these patients, and should always be considered in the diagnosis. Furthermore, this case demonstrates that although the anatomopathological examination may not detect the microorganism in the tissue sample, the microbiological culture should be considered an essential complementary examination for diagnosing deep mycoses.

The authors declare no conflicts of interest.

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LITERATURE REVIEW

ORAL MELANOMA: WHAT DOES THE DENTIST NEED TO KNOW?

MELANOMA ORAL: O QUE O DENTISTA PRECISA SABER?

Gabriel Bassan Marinho Maciel[1], Taline Laura Guse[2]

ABSTRACT

Oral melanoma is a malignant neoplasm of melanocytes, characterized by aggressive behavior and an extremely poor prognosis. Melanomas in the oral cavity are rare and are usually diagnosed at an advanced stage, reducing patient survival. The aim of this narrative literature review is to compile the essential aspects of oral melanoma and other pigmentations to guide early diagnosis by the dentist. Comprehensive searches were conducted in the PubMed, Embase, Lilacs, and Cochrane databases. Oral melanoma typically presents as a macule or nodule, brown or black in color, and may show variations in color and even depigmentation. It has a predilection for the palate and maxillary gingiva, is usually asymptomatic, and affects slightly more males, especially between the 4th and 7th decades of life. Although they share similar clinical characteristics with cutaneous melanoma, they are considered distinct variants. Dentists must be aware of the main clinical characteristics of oral melanoma and other pigmentations of the oral cavity to make an early diagnosis of the neoplasm and manage the case appropriately.

Keywords: Melanoma; Neoplasms; Pathology, Oral; Diagnosis.

RESUMO

O melanoma oral é uma neoplasia maligna de melanócitos, caracterizada por um comportamento agressivo e prognóstico extremamente reservado. Melanomas na cavidade oral são raros e geralmente são diagnosticados em estágio avançado, reduzindo a sobrevida dos pacientes. O objetivo desta revisão narrativa de literatura é compilar os aspectos essenciais do melanoma oral e demais pigmentações para orientar o diagnóstico precoce pelo cirurgião-dentista. Realizou-se uma pesquisa nas bases de dados Pubmed, Embase, Lilacs e Cochrane. O melanoma oral apresenta-se como uma mácula ou nódulo, de coloração castanha ou preta, podendo demonstrar variações na cor e até mesmo despigmentações. Ele tem predileção pelo palato e pela gengiva maxilar, usualmente é assintomático, e aparenta acometer ligeiramente mais o sexo masculino, especialmente entre a 4ª e 7ª décadas de vida. Apesar de possuir características clínicas similares com o melanoma cutâneo, são consideradas variantes distintas. O cirurgião-dentista deve conhecer as principais características clínicas do melanoma oral e demais pigmentações da cavidade oral a fim de realizar o diagnóstico precoce da neoplasia e conduzir o caso adequadamente.

Palavras-chave: Melanoma; Neoplasias; Patologia Bucal; Diagnóstico.

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INTRODUCTION

Melanoma is a malignant tumor of melanocytes, which are melanin-producing cells found in the basal layer of the epidermis. This neoplasm is characterized by very aggressive behavior, and it can occur in the skin, uvea, and mucous membranes (1,3). Oral melanoma (OM) is extremely rare, accounting for 0.5% of all oral malignant tumors (1,4). However, it is more invasive than cutaneous melanoma (CM), as well as being associated with a higher likelihood of spreading to other parts of the body, and higher recurrence rates after treatment (5), presenting an extremely reserved prognosis (6).

Usually, the OM does not present symptoms, which delays the search for specialized care (7). Furthermore, as there are several benign entities with a clinical appearance similar to early-stage melanoma – such as nevus, melanocytic macule, and melanoacanthoma – the lesion may be misdiagnosed (8). Considering that the dentist plays a central role in the early identification of OM, this narrative literature review aims to compile the clinical, differential, histological, and management aspects of this malignant neoplasm.

LITERATURE REVIEW

Methodology

A search strategy was developed by combining the mesh term "Melanoma" with its respective entry terms "Melanomas" OR "Malignant Melanoma" OR "Melanoma, Malignant"; the mesh term "Mouth" with its entry terms "Oral Cavity" OR "Cavity, Oral"; and the mesh term "Neoplasms" with its entry terms "Tumor" OR "Neoplasm" OR "Cancer." The free terms "pigmented lesions" OR "diagnosis" OR "nevus" OR "biopsy" were added to the search strategy, which was adapted for the different databases Pubmed, Embase, Lilacs, and Cochrane. The inclusion criteria were observational studies, clinical studies, narrative and systematic reviews; articles in English, Portuguese, or Spanish; and published in the last twenty years. The exclusion criteria consisted of animal studies, letters, conference abstracts, and theses. Additional searches were conducted in the reference lists of the included articles. The clinical, differential, histological, and management characteristics of the OM were extracted from the selected references.

Classification

Melanoma is responsible for about 1.7% of global cancer diagnoses and for more than 80% of skin cancer deaths (2). Melanomas are classified as *cutaneous*, which account for 90% of cases; and as *non-cutaneous*, which include uveal melanoma and mucosal melanoma (3). The mucous type (1%), first described in 1859 (9), affects various body surfaces, and, being more aggressive, has a worse prognosis compared to CM (3). In addition to the oral cavity, it can develop in the nasal cavity, paranasal sinuses, nasopharynx, oropharynx, hypopharynx, and larynx (10), as summarized in Figure 1.

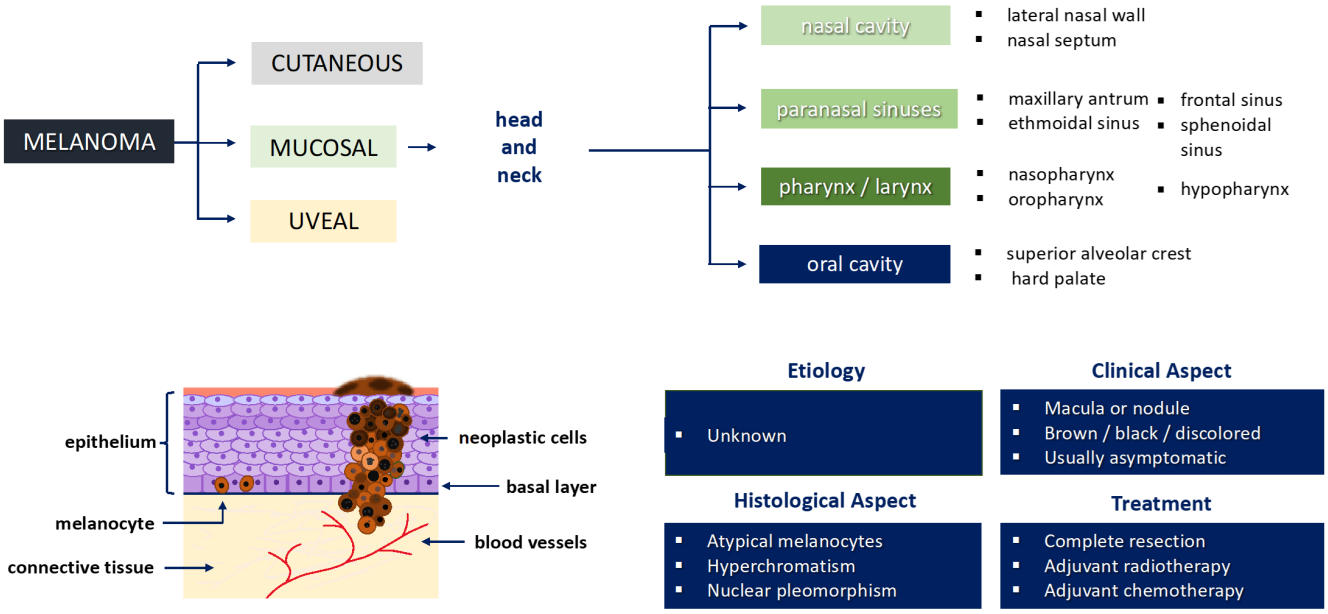

Figure 1: Classification of melanoma types and reported locations in the head and neck with their respective most affected sites (above); Diagram of the histological aspect of OM and summary of the main points on etiology, clinical aspect, histological and treatment of the lesion (below).

Pathogenesis and risk factors

Melanoma is characterized by proliferation of melanocytes. In the skin, melanin is transferred to keratinocytes and acts as a barrier against solar ultraviolet radiation, the main risk factor associated with CM (1,11). In the oral cavity, solar radiation does not influence the pathogenesis of melanoma, for which no clear risk factor has been identified (10,12). Notwithstanding, smoking, alcohol, chronic irritations caused by dental prostheses, and exposure to formaldehyde have been proposed in the etiopathogenesis of the lesion, while viral association with papillomavirus, herpes, and polyomavirus seems unlikely (8,13). Genetic factors are involved (7), and the Asian population is more affected, for reasons still unknown (14). Most cases of OM recur in normal mucosa, while approximately 30 to 37% arise from pre-existing pigmentation for several months or even years (7).

Clinical Aspect

The OM has a predilection for the palate and the upper gingiva, where it is described as a macule or nodule, with brown or black coloring, with irregular margins (1,15). It can show color variation, with black, brown, gray, purple, and red shades (7), as well as adjacent satellite lesions can be seen (10). The amelanotic form of melanoma has little pigmentation and occurs in 30% of cases, being characterized as a flat or nodular and erythematous lesion (16). Other possible locations of OM are the lower gingiva, the buccal mucosa, and the floor of the mouth (17). The OM is usually an asymptomatic lesion, especially in the early stage, in which it is very similar to a nevus or melanocytic macule; however, as the OM grows, it presents ulceration, bleeding, and pain may be the last manifestation (10,17). Men seem to be slightly more affected than women (1,7,15), especially between the fourth and seventh decades of life, with an average age of 60 years (7).

Differential Diagnosis

The oral cavity may present pigmented lesions of completely different nature, which can be disseminated or focal, as summarized in Figure 2.

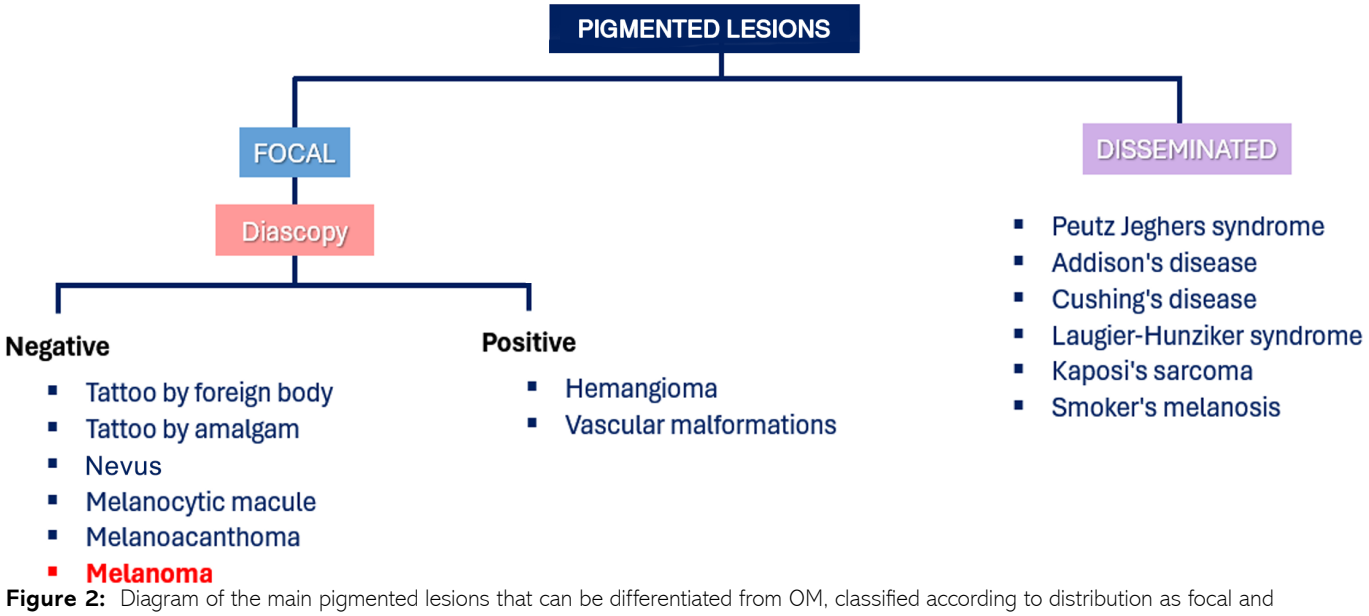

Figure 2: Diagram of the main pigmented lesions that can be differentiated from OM, classified according to distribution as focal and disseminated, and in relation to the diascopy as negative or positive.

Focal pigmentations make a differential diagnosis with melanoma in its early stages (18). On the other hand, disseminated pigmentations may be associated with physiological pigmentation or systemic conditions that manifest from childhood or in adulthood. Peutz-Jeghers Syndrome, for example, is a rare genetic disease linked to mutations in the STK11 tumor suppressor gene that manifests early in childhood. Brown or black pigmentations are noticeable in the perioral region, also affecting the oral mucosa and the skin of the hands. In Addison's Disease, there is destruction of the adrenal cortex leading to insufficient corticosteroid hormones, resulting in diffuse macular pigmentation mainly on the buccal mucosa, palate, lips, and gingiva. Tests evaluating plasma levels of ACTH (adrenocorticotropic hormone) and serum levels of cortisol are useful in diagnosing this disease (19).

Pigmentations in Addison's Disease are similar to those in Cushing's Disease (18), which is caused

by a pathological pituitary activation that raises serum corticosteroid levels (20). Kaposi's sarcoma in its early stage is a vascular endothelial neoplasm associated with HHV-8 (human herpesvirus 8) most frequently found in patients with AIDS and its oral lesions are flat or slightly raised, with a color ranging from brown to purple, usually bilateral (21). Furthermore, it is important to recognize smoker's melanosis, an excessive production of melanin in response to the toxic substances of tobacco smoke, which primarily affects the anterior lower gingiva, but also the oral mucosa, the lip, the hard palate, and the tongue (19). Focal pigmentations, contrastingly, can be differentiated during diascopy examination being either positive or negative. The diascopy technique, or vitropression, consists of applying pressure with a glass slide on the lesion and, if ischemia is observed at the site, there is an indication of a vascular origin. Positive diascopy is observed in cases of hemangioma, a benign proliferation of blood vessels associated with childhood; and in vascular malformations, which are defects of vascular morphogenesis. The clinical aspect of these two pathologies is similar and consists of macules, papules, or nodules that vary from red to purple, with a smooth or lobulated surface (22).

Lesions that are negative for diascopy include foreign body tattoos, such as amalgam and graphite, and melanocytic lesions, such as nevus, melanocytic macule, and melanoacanthoma (20). Nevi are proliferations of small, ovoid nevus cells, common on the skin but rare in the oral cavity, where they mainly affect the palate (19). The nevus variant called Spitz nevus, or benign juvenile melanoma, is a lesion that shares some histopathological aspects with melanoma but is not malignant, with a higher occurrence in childhood (22). The melanocytic macule, or focal melanosis, is a lesion resulting from increased melanin production with occasional elevation in the number of melanocytes, where there is a predilection for women and the most affected site is the vermilion of the lower lip. In turn, melanoacanthoma is a proliferation of dendritic melanocytes with a predilection for black women in the third and fourth decades of life, with the buccal mucosa being the most affected region (19,21).

Considering that the clinical aspect of melanocytic lesions can be indistinguishable from early-stage melanoma, biopsy is essential. Large lesions should undergo incisional biopsy at their thickest portion, while smaller lesions can be addressed by excisional biopsy, if the appearance does not suggest malignancy (23). Sometimes, the OM may be widespread, and its staging follows the TNM classification (tumor, node, metastasis) (10), with the aid of ultrasound or computed tomography of the head, neck, and thoracoabdominal regions for diagnostic definition (23).

Histopathological Aspect

The OM is a neoplasm with varied histological characteristics (24). Epithelioid, spindle-shaped, or plasmacytoid melanocytes with large vesicular nuclei and prominent nucleoli are observed in the epithelium and at the junction with the connective tissue (25). Most melanomas contain melanin, with hyperpigmentation of the basal layer, and few cases are amelanotic. The microscopic pattern of pagetoid spread is usually observed in any type of melanoma, in which isolated melanocytes or in groups infiltrate the layers above the basal cells of the epithelium (27). The immunohistochemical exam is a complementary diagnostic technique that employs three main biomarkers most of the time, with the S-100 protein demonstrating reactivity in 97% of cases, the HMB-45 in 71%, and the MART-1 (Melan-A) in 74% (26).

Treatment and Prognosis

OM is treated with wide surgical resection of the tumor (28), performed without considering the Breslow index, which is the thickness of the lesion, from the most superficial layer to the deepest reached by tumor cells (4). Dissection of cervical lymph nodes is performed in patients with clinically evident regional metastases (4). Local or distant recurrences are common and lead many patients to death, being associated with tumor size, vascular invasion, and non-radical resections of the lesion (28). The most prevalent sites of metastases are the lungs, liver, brain, bones, and lymph nodes (16). Radiotherapy can assist in local disease control, especially when surgery does not achieve negative margins. Compared to adjuvant chemotherapy and radiochemotherapy, the three modalities demonstrate a similar 5-year survival rate. However, the prognosis of OM is generally poor, regardless of the type of treatment used (29).

DISCUSSION

Melanoma is a neoplasm with aggressive behavior, and its incidence is expected to increase in the coming decades (2). The OM, which accounts for 2 to 8% of all melanomas (12), represents a challenge in terms of diagnosis and management for the dental surgeon. The OM and the CM are currently considered distinct variants from each other, both molecularly (28) and in behavior (7), since the OM is more invasive than the skin variant (5,8), in addition to being rarer (1). Besides, it is established in the literature that the pathogenesis of CM is strongly associated with solar

radiation, being modulated by genetic factors (2). On the other hand, the development mechanism of the oral variant is still unknown (10); the recent systematic review by Thuaire *et al*. (4) did not identify any defined risk factor for MO. Herein, the need for future research is highlighted in order to fill this gap in understanding the etiopathogenesis of OM.

The diagnosis of OM is complex considering that its clinical appearance, especially in the early stages, can be similar to other benign focal pigmented lesions, such as nevus, melanocytic macule, and melanoacanthoma. Moreover, OM is usually asymptomatic and progresses unnoticed by the patient, delaying its diagnosis (7,15,30). Particularly, the clinical recognition of the amelanotic form of OM is challenging due to the lack of pigmentation (16). It worth to highlight that in face of a pigmented oral lesion, the dentist should initially rule out the possibility of any systemic disease or syndrome that could cause oral pigmentation. For this, in addition to the multiple injury framework, complementary laboratory tests may be necessary, such as measurement of corticosteroid hormones or identification of infectious agents.

Once disseminated lesions are ruled out, the next step in the diagnostic reasoning is to check for a possible vascular origin of the focal pigmentation through the diascopy, in which the hypotheses of hemangioma and vascular malformation can be excluded if the result is negative. When there is suspicion of amalgam tattoo, radiographic exams can be useful in demonstrating metallic fragments in the mucosa. The ABCDE system is traditionally used to differentiate CM from benign pigmentations, with each letter representing a characteristic associated with the malignant lesion: A, Asymmetry; B, irregular Borders; C, heterogeneous Coloring, with shades of red, white, and blue; D, Diameter greater than 6 mm, and E, Evolution over time, that is, changes in size, shape, coloring, or symptoms (17,31). Despite its usefulness in the early detection of CM, it does not correlate as well with OM, but it can serve as a basis for its evaluation, considering that many of the characteristics of CM have already been observed in the oral lesion (31). In the same way, the Clark and Breslow classification for CM also has no reliable correlation for OM (16). In cases where the origin of focal pigmentation cannot be determined, a biopsy should be performed to exclude the possibility of OM, especially when the lesion is located on the palate or maxillary gingiva, the areas of greatest predilection for the disease.

The management of patients with melanoma requires a multidisciplinary approach (17), with the basis of OM treatment being the complete resection of the tumor (32). The major difficulty, however, lies in obtaining wide and defined excision margins (16). The use of radiotherapy after surgery is associated with a reduction in the possibility of local recurrence, but this issue is still controversial and a subject of debate. In CM, genetic mutations are known, including BRAF V600E, NRAS mutations, and TERT promoter mutations (4,34,35). The knowledge of these mutations allowed the creation of adjuvant systemic therapies for CM: immunotherapy is indicated for patients with a high risk of tumor recurrence and employs anti-CTLA-4 and anti-PD-1 antibodies, being applied alone or combined with targeted therapy, which uses BRAF and MEK inhibitors. However, the rarity of OM makes it difficult to conduct research with a high level of evidence and to develop specific systemic therapies as is the case for CM (28).

Even with progress in melanoma treatment, the 5-year survival rate for advanced cases remains low (36), a fact that underscores the importance of rigorous investigation of any pigmented lesion for early diagnosis of OM. The dentist should regularly inspect the oral cavity for changes, inform and encourage the patient's self-examination (7).

CONCLUSION

Melanoma in the oral cavity is a rare disease with a poor prognosis. Considering that the lesion is generally asymptomatic until advanced stages, and can be clinically similar to benign pigmented entities, early diagnosis by the dental surgeon is essential for reducing mortality. In this sense, any unexplained pigmentation in the oral cavity should be evaluated with rigor and precision.

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