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# PREVALENCE AND SELF-AWARENESS OF INFLAMMATION INDICATORS SUGGESTIVE OF PERIODONTAL DISEASE IN MILITARY PERSONNEL

## PREVALÊNCIA E AUTOCONHECIMENTO DE INDICADORES DE INFLAMAÇÃO SUGESTIVOS DE DOENÇA PERIODONTAL EM MILITARES

Ana Paula Porto Amorim Machado<sup>1,2</sup>, André Ricardo Araújo da Silva<sup>3</sup>, Licínio Esmeraldo da Silva<sup>3</sup>

### ABSTRACT

The objective of this study was to identify the prevalence and self-recognition for indicators of inflammation suggestive of periodontal disease in military personnel of both genders. The military personnel was recruited to conduct a dental census for the entire population of the Admiral Wandenkolk Training Center of the Brazilian Navy, totaling 409 volunteers. Two groups were formed for further analysis: Group 1- containing exclusively women and Group 2- containing exclusively men. A total of 409 clinical examinations were performed and the questionnaires were analyzed. The results showed that, regarding the military participants, 40.1% were female and 59.9% were male; 87% used dental floss, of which 56% used it daily; 77% brushed three times a day or more; 74.3% reported that they visited the dentist regularly, and the proportion of women who regularly visited the dentist significantly exceeded the proportion of men who did (C.I. 95%;  $p < 0.001$ ); 61.6% said they knew about periodontal disease. The professional evaluation verified the presence of inflammation indicators suggestive of periodontal disease in 45.2% of the participants, of which 37% were female and 63% were male, with no statistical difference between genders (95% CI,  $p = 0.2248$ ). The prevalence of inflammation indicators suggestive of periodontal disease was 45.2%; the self-knowledge of the military about the periodontal disease was low, only 19%; thus a statistical difference was found between the knowledge of females and males; and it was observed that most participants were within the correct frequency for return visits to the dentist.

**Keywords:** Periodontal disease. Patient Screening. Periodicity. Oral Hygiene. Military Health.

### RESUMO

O objetivo deste estudo foi identificar a prevalência e o autoconhecimento para indicadores de inflamação sugestivos de doença periodontal em militares de ambos os sexos. Os militares foram recrutados para realização de um censo odontológico para toda a população do Centro de Instrução Almirante Wandenkolk (CIAW) da Marinha do Brasil, totalizando 409 voluntários. Foram formados dois grupos para posterior análise: Grupo 1- contendo exclusivamente mulheres e Grupo 2- contendo exclusivamente homens. Foram realizados 409 exames clínicos e analisados 409 questionários. Os resultados demonstraram que, quanto aos participantes militares, 40,1% foram do sexo feminino e 59,9%, do sexo masculino; 87% faziam uso do fio dental, desses 56% usavam diariamente; 77% apresentaram frequência de escovação de três vezes ao dia ou mais; 74,3% relataram que visitam regularmente o dentista, e a proporção de mulheres que frequenta regularmente o dentista superou significativamente a proporção de homens que o fizeram (I.C. 95%;  $p < 0,001$ ); 61,6% afirmaram conhecer a doença periodontal. A avaliação profissional verificou a presença de indicadores de inflamação sugestivos de doença periodontal em 45,2% participantes, desses 37% eram do gênero feminino e 63%, do gênero masculino, não sendo observada diferença estatística entre os gêneros (I.C. 95%;  $p = 0,2248$ ). Concluiu-se que a prevalência de indicadores de inflamação sugestivos de doença periodontal encontrada foi de 45,2%; o autoconhecimento dos militares sobre doença periodontal foi baixo, apenas 19%; dessa forma foi verificada diferença estatística entre o conhecimento das mulheres e dos homens; e observou-se que a maioria dos participantes estava dentro da frequência correta para consulta de retorno ao dentista.

**Palavras-chave:** Doença Periodontal. Triagem de Pacientes. Periodicidade. Higiene Bucal. Saúde Militar.

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## INTRODUCTION

Epidemiological surveys are fundamental for establishing the diagnosis of certain diseases in a population, also important for verifying treatment needs in groups of individuals (1,2).

One of the main objectives of epidemiological research in periodontics is to provide data on the prevalence of periodontal disease in different populations, establishing the frequency of its occurrence and the severity of such conditions, elucidating aspects related to etiology and the determinants of development, and documenting the effectiveness of preventive and therapeutic measures (3).

Periodontal disease (PD), a major cause of tooth loss, is the sixth most prevalent human disease (4). PD is one of the two most important diseases affecting the oral cavity and contributes to the global burden of chronic conditions (5) affecting the population worldwide, with high prevalence rates, thus representing a public health problem (6).

The most prevalent PD are gingivitis and periodontitis, which affect the health of the lining and supporting tissues of the teeth (7-9). Although gingivitis and periodontitis are considered progressions of the same inflammatory process, it should be noted that many gingivitis lesions do not progress to periodontitis (7,8). The aim of this study was to identify the prevalence and self-knowledge of military personnel on inflammation indicators suggestive of periodontal disease, since the early detection and diagnosis of PD, as well as participation in a health maintenance program, after periodontal therapy, are essential in maintaining the oral health of affected individuals (10).

## METHODS

### *Study design*

This was a cross-sectional observational descriptive study involving a population of 409 participants including active duty militaries and veterans recruited by convenience through a dental census at the Division of Dentistry, Department of Health, Admiral Wandenkolk Training Center of the Brazilian Navy (CIAW), between November 2021 and March 2022.

### *Data Collection*

For the aforementioned audience, there was an explanation of the present work, and only after signing the consent form the standardized questionnaire was handed out and filled out. Participants were interviewed using the questionnaire

and examined for the presence or absence of clinical indicators of periodontal inflammation/disease (dental plaque, calculus, gingival edema) in the CIAW dental office. The professional evaluation (clinical examination) was by observing whether or not the gums were swollen, pink, or reddish, and whether or not there was apparent dental plaque, both soft plaque and calculus. In addition, the participant was asked if his teeth bleed when brushing or flossing.

The inclusion criteria were CIAW crewmembers and the exclusion criteria were CIAW crewmembers being treated for periodontal disease during the study period.

The variables collected were age, gender, time in the military force, flossing frequency, daily brushing frequency, regularity of visits to the dentist and date of last visit, self-awareness about signs/symptoms of periodontal disease (personal perception or self-perception) of the quality of their teeth and gums, and professional assessment of the presence or absence of clinical indicators of inflammation suggesting periodontal disease.

This work was approved under protocol number 5.071.494 on October 29th, 2021, under CAEE: 47037821.9.0000.5243, by the Ethics Committee of the Fluminense Federal University (UFF), and is in accordance with the ethical principles of the Declaration of Helsinki.

### *Statistical Analysis*

The data collected were compiled and then an analysis of the variables collected was performed. Three groups of answers were analyzed: a) answers related to demographic data; b) answers related to possible risk factors for acquiring periodontal disease; c) answers related to self-knowledge of periodontal disease. The presence or absence of clinical indicators of inflammation suggesting periodontal disease according to gender was related to the answers found in the interview phase and by clinical examination.

Continuous variables with non-normal distribution were expressed as mean and standard deviation and those with normal distribution were expressed as median and minimum and maximum values. Categorical variables were expressed as absolute values and percentages and analyzed using Fisher's exact test or Chi-square, and continuous variables were analyzed using the Mann-Whitney test. Comparison of two proportions was possible by the Z test. The Kolmogorov-Smirnov test was used to evaluate the degree of normality of the variables. Values of  $p < 0.05$  were considered significant. The statistical analyses were performed with the help of the IBM SPSS software version 18.0.

## RESULTS

A total of 409 military personnel participated in the survey, 164 (40.1%) female and 245 (59.9%) male, interviewed and examined between the months of November 2021 to April 2022. The age of the participants ranged from 19 to 71 years, with the average age of males being 28.7 and of females being 32 years. [The time was up to two years of military service for 300 participants.

The dental hygiene habits of the participants were analyzed and showed that 87% use dental floss, 56% use it daily; 77% answered that they brush their teeth 3x or more a day; 74.3% stated that go to the dentist regularly; and 265 participants reported that the last visit to the dentist was up to six months earlier.

Regarding to the regularity of going to the dentist, considering gender, 155 men go regularly and 90, do not go regularly, while 149 women visit and only 15 women do not go regularly.

Assuming randomness in the formation of the sample, the estimate of men attending the Division of Dentistry of the Health Department is 59.9% (95% C.I.: [55.1%;64.7%]) and the sex ratio of those attending is  $245/164 \cong 1.5$  (a ratio of 3:2 men to women).

The proportion of women who regularly attend the dentist significantly exceeds the proportion of men who do so (chi-square test:  $\chi^2 = 39.185$ ; g.l. = 1;  $p < 0.001$ ).

Of the 409 participants, 11.5% (47 patients) believe they have gum disease, 61.6% (252 participants) think they know what gum disease is, and 21.5% (88 participants) reported that their teeth and/or gums bleed, of these only 39 (44.3%) stated that they think they have gum disease. Regarding the knowledge of what periodontal disease is, most of the interviewees reported knowing (252/409 - 61.6%).

The participants were asked about their self-perception of the quality of their teeth and gums. 22.7% responded excellent, 73.4% good, and 3.9% poor.

Based on the results, the overall prevalence of clinical indicators suggestive of inflammation/periodontal disease in the studied population was 45.2%.

Thus, we observed that among the 185 participants who presented the presence of clinical indicators of inflammation suggesting periodontal disease, 37% were female and 63% were male. No statistical difference was observed between genders, with a  $p = 0.2248$ .

The data for the absence of self-perception of periodontal disease and proved absence of the disease, verified by a dentist and categorized by sex, were 209 and 128 in men, respectively, versus 153 and 96 in women. A statistically significant difference,  $p < 0.0001$ , was observed between participants' self-

knowledge stating that they do not have PD and actual absence of PD.

## DISCUSSION

Most participants were young people under 32 years old, who theoretically should have a better health condition, since, according to the Ministry of Health, oral health problems increase with age. The most severe forms of PD appear most significantly in adults aged 35 - 44 years, with a prevalence of 19.4% (11).

From the point of view of gender, the majority of participants were male, about 60% of the sample size. This finding is due to the predominance in the Armed Forces of males over females. However, female participation in the military forces has been increasing. According to data from the Ministry of Defense in 2012, in the Navy women corresponded to 10% of the force, in the Air Force to 13.8% and in the Army, they represented only 3.2% of the personnel of the military force (12). Currently, the Brazilian Navy has more than 12.7%, the Air Force with 19.7% and the Army with 6.4% on March 8, 2022, counting with more than 35 thousand of military women (13).

With regard to the gender of the patients, there is still no predisposition between men and women for the development of periodontal diseases (14).

Military personnel with a short career period (up to 2 years) represented the majority of the participants, which perhaps could be a data point in favor of the higher number of participants with periodontal disease present.

It is known that the Unified Health System (SUS) is a universal health system that provides access to oral health care for all age groups, from early childhood to old age, at no direct cost to the population. The quality of public dental care has improved considerably since oral health was incorporated into SUS in 2004, through the "Smiling Brazil" project. However, it is still very precarious, and the levels of caries and periodontal disease are increasing and continue to be a major problem for public health in Brazil (15).

On the other hand, the overall percentage of inflammation indicators suggestive of PD was lower than that found in the Brazilian population as a whole, because the Brazilian Navy has its own Health System, called the Navy Health System, defined as the organized set of human, material, financial, technological, and information resources intended to provide health activities in the Brazilian Navy. Hospital Medical Care is provided to users of the health system in a regional, hierarchical, integrated manner, with objective actions for disease prevention, recovery, and health maintenance (16).

It is worth remembering that the primary care team initiates educational discussions with the patient, identifies his/her risks, provides preventive care, and then, in necessary cases, refers the patient to specialized treatment (17).

The control of PD through active patient participation is a crucial feature of treatment success. Therefore, professionals expect them to promote a daily routine of biofilm control through adequate oral hygiene (18).

Considering the habit of flossing, 356 participants answered that they use dental floss, and 229 use it daily, 87% and 56% of the studied population, respectively. This situation is completely opposite to the reality of oral health in Brazil, and perhaps even in the world. In the literature, it was stated that the use of dental floss is performed daily by only 10% of the population (19). The same author reports that while daily tooth brushing is well accepted, few individuals use dental floss. This high percentage of regular flossing can be attributed both to the level of education and hygiene awareness of the military due to the model of oral health care in the Nvy Health System, when compared to the Brazilian society in general since this system emphasizes actions of promotion and prevention of the patient's integral health (19).

A preventive approach requires early diagnosis, health education, and motivation of the patient to change his or her behavior, as well as greater responsibility of the patient for his or her own health under the guidance and support of professional staff (20).

Regarding the frequency of tooth brushing, 77% of the participants reported that they brush their teeth three or more times a day, which can be considered an excellent level of oral hygiene. The literature shows discrepant results according to the area included in the study. In the city of Porto Alegre, South of Brazil, the frequency of daily brushing in 471 patients was also high, with about 68.1% of the interviewees reporting a frequency higher than three times a day (21). When compared with the brushing pattern of European countries or the United States, the pattern described in the Brazilian study is higher. Studies conducted in Europe and the United States show that the most common daily brushing pattern is once to twice a day (22). In contrast, another study found that only 20.9% of patients brushed their teeth three times a day, and only 6.5% of patients brushed more than three times a day (23).

In the literature, a statistically significant association was observed between the frequency of brushing, flossing, and gender. This finding corroborates data from a previous epidemiological study, which also found that women have better

hygiene habits than men. This suggests that women have a better standard of oral hygiene, which may be one of the factors associated with the higher prevalence of periodontal disease associated with males, identified in previous studies. Moreover, the greater perception of women regarding the symptoms and physical signs of disease, the knowledge acquired in the performance of the role of the family caregiver, as well as the performance of more diagnostic tests by this group, may contribute to this higher prevalence (23).

The regularity of visits to the dentist was observed in both men and women, with a statistically significant difference in relation to the female gender, proving that, in this study, women were more concerned about oral health than men. There is ample evidence in the current literature showing that preventive habits are more common in women than in men (21). It is known that women use dental services more often than men (24).

There is still no consensus among the authors, nor a scientific basis for stating that the ideal interval for returning to the dentist is six months. Hence, there is a tendency to recommend the individual assessment of each patient, observing several criteria (25).

The perception of PD by the study population was low and calculated to be 11.5%, while the actual PD was 45.2%, and a statistically significant difference was found. Because of this difference in the PD's self-knowledge, it is clear that the subject needs to be worked on in the daily life of the military unit.

The self-assessment of the oral condition apparently contrasts with the clinical condition, as the individual had a positive view ("good" condition was the most considered answer), even with unsatisfactory clinical findings. This difference may be related to the fact that patients evaluate their oral condition with different criteria from the professional demonstrating the lack of more accurate knowledge that should be incorporated into the knowledge of these individuals. Chou, *et al.*, 2011 reported that self-assessment provides a rich contribution to identifying people or groups in vulnerable situations that need specific interventions, both clinical and informational (26). Similar results were observed in a study on patients' conceptions of quality of life, periodontal condition, tooth loss, and whether or not to use dentures (27).

The distorted perception that the population has about the oral condition by not easily identifying the disease can be explained, perhaps, by the fact that it is asymptomatic and chronic in nature because it is known that painful symptoms are the most recognized dental needs (28). Braga, *et al.*, (2020) also stated that most of the time, the reason for people not seeking dental care is the lack of perception regarding their needs.

Dental professionals should encourage patient attitudes toward achieving periodontal health. In addition, the patient should understand that adequate oral hygiene measures, such as dietary care, moderation of alcohol and smoking, along with stress control, can prevent disease progression. It is worth emphasizing the shared patient/professional responsibility for treatment should be assumed by the patient when establishing their self-care routine (29).

The presence of clinical indicators of inflammation suggesting periodontal disease was evaluated by the researcher, analyzing whether PD was present or absent. The results found were as expected, with a higher number of absences than the presence of the disease. The prevalence found of PD was lower than that reported in the literature in general (16).

The prevalence of “moderate to severe” periodontal disease in adult Brazilians was 15.3% and 5.8% for the “severe” condition, with considerable variation among municipalities (11). And the number of individuals with periodontal health progressively decreased among age groups with increasing age, showing a prevalence of periodontitis ranging from 57.1% to 75.4%, respectively, in individuals aged 34 years or less and 45 years or older (30).

A fundamental issue is to invest in oral health promotion programs, through an integrated approach, directed at the community, promoting well-being and minimizing the costly consequences to the public budget.

Finally, we recognize that there were limitations in our study. Although we interviewed the entire population, some aspects can be considered, such as the memory bias of the studied population regarding the visit to the dentist in the last six months and lack of knowledge regarding the presence of possible risk factors known for the acquisition of the periodontal disease. The study was limited to verifying the presence or not of clinical indicators of periodontal disease, not being possible to verify the indexes of visible plaque, gingival bleeding, and bleeding on probing or the community periodontal index in each participant; probing each dental site, in order to verify the clinical probing depth, gingival recession, and clinical insertion level; and to count the number of sites with relevant periodontal pockets, which could determine the severity or not of the present PD. We suggest further studies should evaluate these indices in this population, calibrating a team of evaluators.

## CONCLUSION

Although the prevalence of 45.2% of clinical indicators of inflammation suggestive of periodontal disease was high in the studied population, these

results suggest that the Brazilian Navy personnel has better oral health conditions than the total Brazilian population. The military personnel’s self-knowledge about PD was low. When comparing the military’s knowledge of PD according to gender, we could observe that there is a statistical difference between the knowledge of women and men. Also, most of the participants were within the frequency of return visits to the dentist. Moreover, the proportion of women who regularly attend the dentist significantly exceeded the proportion of men who did.

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## CASE REPORT

# FRONTAL BONE CRANIOPLASTY USING CUSTOMIZED IMPLANTS THROUGH A 3D PROTOTYPE: CASE REPORT

## CRANIOPLASTIA DO OSSO FRONTAL COM A UTILIZAÇÃO DE IMPLANTES CUSTOMIZADOS ATRAVÉS DE PROTÓTIPO 3D: RELATO DE CASO

Erick Estrela Maia<sup>1</sup>, Bruno Turéli<sup>2</sup>, Guilherme Pivatto Louzada<sup>3</sup>

### ABSTRACT

Cranioplasty for the treatment of cranial bone defects has as its main objective the three-dimensional and functional reconstruction of the skull. Computer-assisted surgeries (CAS) have been used since the 1990s efficiently and bring improvements and optimization in reconstructive craniofacial surgical approaches, especially in large bone defects. This clinical case report addresses virtual planning and CAD/CAM technology in secondary craniofacial reconstruction using polymethylmethacrylate (PMMA). A 48-year-old male patient had two bone defects in the frontal region with skin dehiscence into the frontal sinus. A computed tomography was performed with 1mm slices and converted into a 3D model of the frontal bone and in the mold of the bone defect in real size. To address the bone defects, a neurosurgeon was involved in the treatment of dura mater, cranialization of the frontal sinus, and obliteration of the nasofrontal duct, and was completed by the oral and maxillofacial surgery team. After the surgery, a tomographic exam was performed, and a perfect adaptation between the prosthesis and the bone contours and a great anatomical contour of the frontal bone were observed, making it satisfactory to the initial surgical planning. The use of virtual planning and the CAD/CAM system resulted in greater predictability and greater safety for the craniofacial reconstruction procedure, as well as a reduction in the perioperative time. The material used, PMMA, presented itself as a material of easy manipulation, low cost, and with perfect adaptation to bone contours.

**Keywords:** PMMA, Bone transplantation, Maxillofacial Prosthesis, Cranioplasty, Customized implants.

### RESUMO

A cranioplastia para os tratamentos de defeitos ósseos cranianos tem como o seu principal objetivo a reconstrução tridimensional e funcional da calota craniana. As cirurgias assistidas por computador (CAS) vem sendo utilizadas desde os anos 90 de forma eficiente e trazendo melhorias e otimização nas abordagens cirúrgicas craniofaciais reconstrutivas, principalmente em grandes defeitos ósseos. Este relato de caso clínico aborda o planejamento virtual e de tecnologia CAD/CAM na reconstrução craniofacial secundária com a utilização de polimetilmetacrilato (PMMA). Paciente de sexo masculino, 48 anos, apresentava dois defeitos ósseos em região frontal com deiscência da pele para dentro do seio frontal. Foi realizada uma tomografia computadorizada com cortes de 1mm e convertidos em um modelo 3D do osso frontal e no molde do defeito ósseo em tamanho real. Para abordagem dos defeitos ósseos, houve a participação de um neurocirurgião para o tratamento em dura-máter, cranialização do seio frontal e obliteração do ducto naso-frontal, sendo finalizada pela equipe de cirurgia bucomaxilofacial. Após a cirurgia, foi realizado um exame tomográfico sendo observados uma perfeita adaptação entre a prótese e os contornos ósseos e um ótimo contorno anatômico do osso frontal, tornando-se satisfatório ao planejamento cirúrgico inicial. A utilização de um planejamento virtual e do sistema CAD/CAM resultou em uma maior previsibilidade e maior segurança ao procedimento de reconstrução craniofacial além de redução do tempo transoperatório. O material utilizado, o PMMA, apresentou-se como um material de fácil manipulação, baixo custo e com perfeita adaptação aos contornos ósseos.

**Palavras-chave:** PMMA, Transplante ósseo, Prótese Maxilofacial, Cranioplastia, implantes customizados.

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## INTRODUCTION

The traumatic and non-traumatic injuries that affect the maxillofacial region often become a real challenge for treatment due to their complexity. In these cases, it is extremely important that the surgeon is able to perform a three-dimensional anatomical reconstruction of the affected areas so that eventual sequelae are minimized (1). These facial injuries can vary greatly depending on the region, economic condition, and culture of the patients. For example, an exponential increase in traumatic injuries is observed due to the increase in violence and different types of transports. On the other hand, there are non-traumatic injuries that may be associated with bone defects caused by tumors, infections in the cranial region, and brain decompression (1,2,3).

Cranioplasty, for the treatment of cranial bone defects, has as its main objective the three-dimensional and functional reconstruction of the skull. In addition, cranioplasty is indicated to prevent changes in cerebrospinal fluid dynamics, improve cerebral blood flow, prevent neurological disorders, and serve as cranial protection (4). There are different materials that can be used to correct these bone defects and they are divided into two major groups: bone grafts, which are found in different origins such as autogenous, allogeneous, xenograft, and alloplastic grafts (4,5).

From the group of alloplastic materials, the main ones we can mention are Titanium, porous polyethylene, hydroxyapatite, and polymethylmethacrylate (PMMA). In the cranioplasty procedure, PMMA's main advantages are low cost, little inflammatory reaction, easy and quick availability, and a great adaptation, besides good long-term stability (6,7,8). The main disadvantages of this material are high bacterial adhesion, low tolerance to infection, and low osteoconduction (7,9).

The stages of treatment for the correction of bone defects can be divided into 3 phases: virtual planning, the printing of prototypes/modeling of the biomaterial, and the surgical phase. Virtual surgical planning uses software that interprets the images obtained by Cone-Beam Computed Tomography (CBCT), which are recorded in DICOM (Digital Imaging and Communications in Medicine) format and converted to STL (Standard Triangle Language) format, which allows its manipulation for the creation of surgical guide prototypes, customized parts or even biomodels from the association with CAD-CAM (computer-aided design/computer aided manufacturing) technology. In the modeling phase, surgical guides are fabricated to be used perioperatively, with the aim of restoring three-dimensional anatomy. At this point, the alloplastic implants are prefabricated using CAD-CAM. After

printing, they will be tested and adapted to the bone defects pre-surgically in prototyped models. Once the biomodels are correctly made according to the virtual planning, they will be taken to sterilization to be used in the surgical procedure (10,11). In the last phase, which is the surgical stage, bone reconstruction occurs with alloplastic implants.

The main advantage of computer-assisted surgeries (CAS) consists in their predictability of outcome, reduction of operative time, and the reduction of sequelae since the entire procedure can be visualized by preoperative virtual surgical planning (10,11,5,12).

The objective of case report is to show a secondary craniofacial reconstruction using PMMA, with virtual planning and CAD/CAM technology.

## CASE REPORT

A 48-year-old male was referred to the emergency department of the Adão Pereira Nunes Hospital, in the city of Duque de Caxias (Rio de Janeiro), Brazil, presenting myiasis, which caused a cavitory infestation on the anterior wall of the frontal sinus by Diptera larvae, associated with a gasoline burn in the region. The burns were caused by the application of gasoline, by the patient himself, in an attempt to eliminate the myiasis that was present inside the defect in the frontal region.

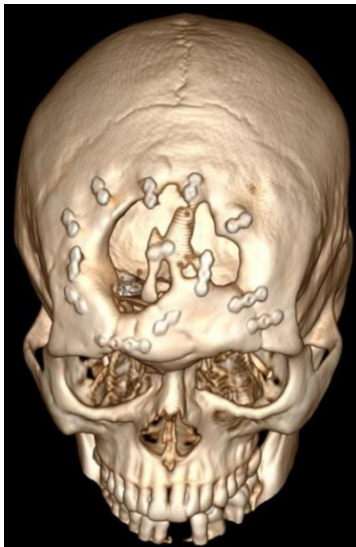
At the first moment, the case was approached by the neurosurgery (NS) and oral and maxillofacial surgery team to stabilize the condition, in an attempt to preserve the bone of the structures present and to debride the necrotic tissue caused by the inflammatory reaction process caused by the presence of the larvae. This case was described after approval by the Research Ethics Committee of the Carlos Chagas Institute with protocol number 68259523.4.0000.0251 and the patient's signing of an informed consent form.

After discharge by the NS, the patient was admitted to the oral and maxillofacial surgery unit. He was conscious, all vital signs were within normal patterns, airways were preserved, there were no comorbidities, and his general condition was stable. On physical examination, it was observed two bone defects in the frontal region with dehiscence of the skin into the frontal sinus. Interestingly, the lack of protection of the brain in the frontal region was observed and, consequently, it was possible to visualize the pulsating dura mater (Figure 1). During the consultation, the patient reported that he had undergone a post-trauma osteosynthesis of the frontal bone 8 years earlier and, 2 months postoperatively, dehiscence of the skin wound occurred, remaining open for years, until he received the new surgical approach.



**Figure 1** - Initial clinical image showing the bone defects.

On computed tomography (CT) examination, with axial, sagittal, and coronal sections and 3D tomographic reconstruction, the large bone defect of the anterior wall and posterior wall of the frontal bone with plate and screw debris from the previous surgery was assessed (Figure 2).



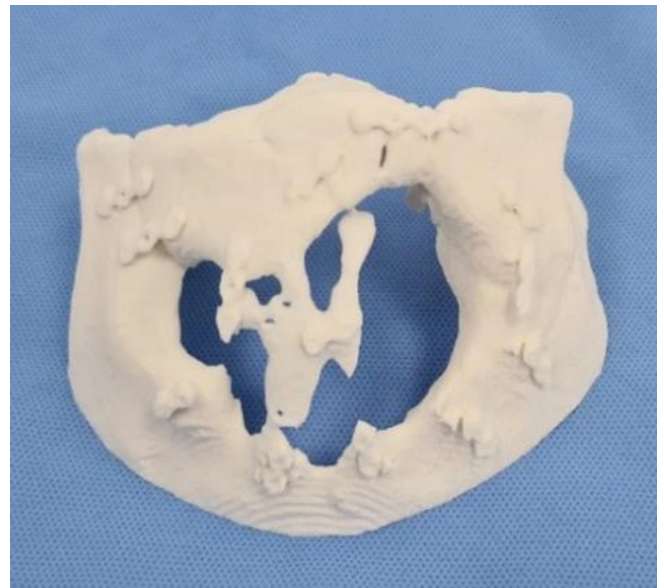
**Figure 2** - Clinical aspect after tooth preparation and adhesive procedure

This surgery was performed with the main objective of reconstructing and bringing back the anatomical skull contour from previous unsatisfactory surgery, protecting the encephalon by means of a bulkhead, replacing the bone defect, and avoiding new cases of myiasis.

*Clinical management to obtain the individualized prototype*

During preoperative planning, a CT scan with 1mm slices was obtained and this data was recorded

in DICOM format, converted to STL format, and sent to a 3D reconstruction printer (Sethi3D S4X) at the Renato Archer Institute. This printer has the function of taking the records in STL format and converting them into a 3D model of the frontal bone and the full-size resin mold of the bone defect. It is important to note that linear and objective measurements are collected from the CT scan for calibration in the printer software itself for conversion of the images into real size. The pieces were delivered to Hospital Adão Pereira Nunes 90 days after sending the CT data and sent moments before for sterilization (autoclave-saturated steam under pressure) to be used in the perioperative phase (Figures 3 and 4).



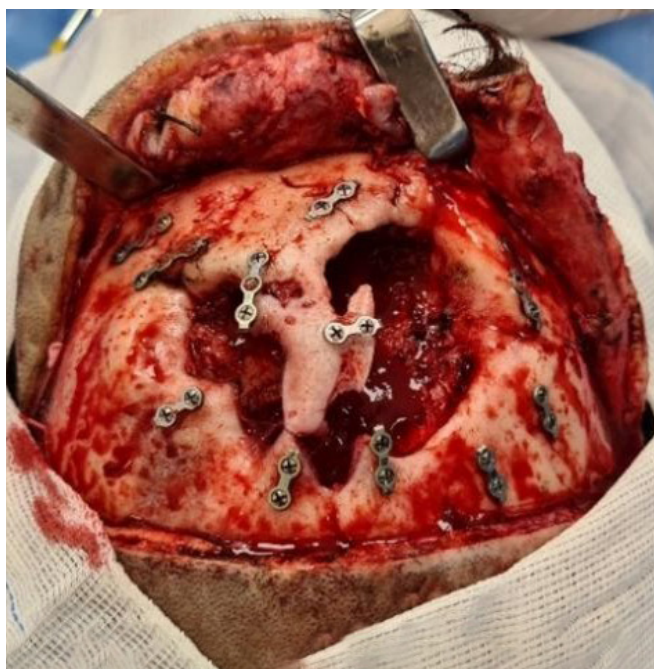
**Figure 3** - Image of the individualized prototype



**Figure 4** - Image of the mold of the bone defects

## Surgical technique

To address the bone defects of this patient, a neurosurgeon was involved in the treatment of dura mater, cranialization of the frontal sinus, and obliteration of the nasofrontal duct with the use of periosteum, being finalized by the oral and maxillofacial surgery team. The surgical approach was through general anesthesia, orotracheal intubation, trichotomy, asepsis, and antisepsis of the operative field and bi-coronal surgical access. After exposure of the bone boundaries, removal of the residual plates and screws from the first surgery (Figure 5) and intervention in the frontal sinus by the NS were performed. Powder and liquid methylmethacrylate (Biomecânica Brasil) were manipulated and placed in the mold. After polymerization of the material, the PMMA prostheses were installed in the bone defects of the frontal bone and fixed with 2 straight plates of the 1.5 system and 10 screws 1.5x6mm (KM Materiais Médicos, Rio de Janeiro, Brazil) (Figure 6). A Blake 19fr drain (Drenoset, São Paulo, Brazil) was installed and the suture of the access was performed by internal planes with vycril 4-0 (Ethicon, Johnson & Johnson MedTech) and nylon 3-0 (Technofio, Goiânia, Brazil) in the skin region. For the skin defect in the frontal region, curettage of the edges and simple suture with 4-0 nylon (Technofio, Goiânia, Brazil) were chosen (Figure 7).



**Figure 5** - Residual plates and screws from the first surgery



**Figure 6** - Fixing the PMMA prostheses



**Figure 7** - Immediate postoperative image

After surgery, a CT scan was performed to evaluate the prostheses (Figure 8). It was observed a perfect adaptation between the prosthesis and the bone contour and a great anatomical contour of the frontal bone, satisfying the initial surgical planning. The patient remained hospitalized and was followed up until his discharge by the oral and maxillofacial surgery team.

After hospital discharge, the patient followed a monthly outpatient follow-up, during the first 10 months postoperatively, with the plastic surgery team to evaluate the healing of the skin tissues that cover

the frontal bone prosthesis, since rotation techniques of surgical flaps were used to enable the closure in the first intention of the tissues of the region.



Figure 8 - 3D CT reconstruction performed postoperatively.

## DISCUSSION

In the hospital environment, there are many etiologies that cause bone defects requiring reconstruction in daily oral and maxillofacial surgery, predominantly caused by high-energy trauma, with sports accidents, physical aggression, and motorcycle accidents as the main etiological agents (13). These etiologies may require more complex reconstruction techniques, without renouncing autogenous grafts or biomaterials. In the case of this patient, we opted for the PMMA prosthesis due to the surgical practice of the oral and maxillofacial surgery team, and also due to the ease of handling, low cost, and execution of the procedure.

To treat the defects in this patient, the cranioplasty technique was used to establish anatomy, aesthetics, and protection of the neural tissue (2,7,13,14,15,16). Currently, alloplastic materials have become more popular and are used more frequently than autogenous grafts. Interestingly, despite the large frontal bone defect, the NS team evaluated the patient, and no neurological impairment was observed.

Among the alloplastic materials, titanium is highly biocompatible, with no risk of hypersensitivity or allergic reactions, has great resistance to corrosion, and promotes rapid three-dimensional restoration of the skull, but has a high cost compared to PMMA (14,17). There are also other materials, such as hydroxyapatite cement, which is a bioactive material, with a great capacity for osteoconduction and with potential to interact with the tissue where it was implanted, being chemically similar to the bone, which allows its biocompatibility (14,17,18). However, this material has a relatively high cost compared to PMMA.

The use of PMMA in cranioplasty has numerous advantages, among them ease of handling, non-degradable, low thermal conductivity, radiopaque, can be used with antibiotics such as gentamicin or tobramycin, impermeable, formation of a fibrous capsule occurs, and is not able to incorporate into the tissue (15,17,18). Gonzalez *et al.* and Cheng *et al.* consider PMMA to be the best alloplastic material for cranioplasty surgery in adults, but it is not indicated for use in children or young people because it is a material that does not adapt to skeletal development (6,19).

For an optimal result in cranioplasty with the use of alloplastic materials, preoperative follow-up by the neurosurgeon is extremely important to assess the need for craniolization, since the frontal sinus occupies the junction between the splenocranium and the neurocranium, located between the anterior cranial fossa and the nasolabial-ethmoidal region (20). Hence, serious complications can occur if the treatment is performed inappropriately, especially late sepsis, as well as recurrent sinusitis, osteomyelitis of the frontal bone, meningitis, encephalitis, or cavernous sinus thrombosis (21,22).

In the present study, computer-assisted techniques were used for craniofacial reconstructions, offering more precise surgical planning and technique, aiming to re-establish the anatomical characteristics of the patient (23). Currently, 3D images from CT scans are being used more frequently for the evaluation of craniofacial defects, traumas, and pathologies among maxillofacial surgeons, and through these images, individual prototyped models are obtained.

The virtual planning obtained from CT, 3D printing of prototypes, and synthetic materials, is a major advance in the field of surgery and a great benefit when employed in complex defect reconstructions.

With the technological resources that the CAD/CAM system can offer us, such as virtual planning and 3D printing, it is necessary that professionals be qualified with great knowledge to perform adequate and safe planning. However, using this technique may still be an inaccessible procedure for some patients due to the cost of making the models and guides (23).

## CONCLUSION

The use of virtual planning and the CAD/CAM system resulted in greater predictability and greater safety for the craniofacial reconstruction procedure, as well as a reduction in the perioperative time. The material used, PMMA, presented as a material of easy manipulation, low cost, and with perfect adaptation to bone contours.

The authors declare that there are no conflicts of interest.

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## CASE REPORT

# DIRECT COMPOSITE RESIN VENEER USING OPACIFYING PIGMENTS FOR ANTERIOR AESTHETIC REHABILITATION OF DISCOLORED TEETH: CASE REPORT

## FACETA DIRETA DE RESINA COMPOSTA UTILIZANDO PIGMENTOS OPACIFICADORES PARA REABILITAÇÃO ESTÉTICA ANTERIOR DE DENTE ESCURECIDO: RELATO DE CASO

Amanda Falcão<sup>1</sup>, Mariana Mota da Silveira<sup>2</sup>, Natasha Lamêgo Brandão de Souza<sup>3</sup>, Eduardo Victor Maroun<sup>3</sup>, Cristiane Soares Mota<sup>3</sup>

### ABSTRACT

The esthetic treatment of teeth with discoloration is a major challenge in restorative dentistry. In this sense, the use of composite resin veneering techniques associated with the use of opacifying stains allows restorations to be made using a direct technique, which results in less wear to the tooth structure during preparation. Thus, the present study presents a clinical case of a direct composite resin veneer using an association of three opacifying pigments. A 54-year-old male patient presented with severe color change on the central upper left incisor, a report of dental trauma, endodontic treatment, and contraindication for a new internal bleaching protocol. In order to make the direct resin veneer, a mixture of three opacifiers in a fluid consistency was used. To check the value of the applied layer of the mixture, black and white photographs were taken. Layering proceeded with translucent resin layers for the palatal base, opaque dentin resin and translucent achromatic resin for the enamel. As a result, the function and efficacy of the use of the association of opacifying pigments was verified in the resolution of the case. A reevaluation was performed 30 days and 7 months after the restorative procedure, when the color stability of the restoration was verified. This case allows to conclude that using composite resin layering technique associated with the use of opacifying pigments brings satisfactory and favorable aesthetic results through a direct technique, performed in a single clinical session and with high predictability.

**Keywords:** Composite resins; Tooth discoloration; Dental aesthetics; Case reports; Dyes; Dental veneers

### RESUMO

O tratamento estético de dentes com alteração de cor é um grande desafio na Odontologia Restauradora. Nesse sentido, a utilização de técnicas de estratificação com resina composta associada ao uso de pigmentos opacificadores permite que seja possível restaurar por meio de uma técnica direta, que resulta em um menor desgaste da estrutura dental durante o preparo. Dessa forma, o presente trabalho apresenta um caso clínico de faceta direta de resina composta utilizando associação de três pigmentos opacificadores. Paciente do sexo masculino, 54 anos, procurou atendimento apresentando alteração de cor severa do dente 21, relato de trauma dental, tratamento endodôntico e contraindicação de novo protocolo de clareamento interno, sendo sugerido, como plano de tratamento, a restauração direta com resina composta. Para a confecção da faceta direta de resina, foi utilizada uma mistura de três opacificadores na consistência fluida. Para verificar o valor da camada aplicada da mistura, foram feitas fotografias em preto e branco. A estratificação prosseguiu com camadas de resina translúcida para a base palatina, resina opaca de dentina e resina acromática translúcida para o esmalte. Como resultado, constatou-se a função e eficácia do uso da associação de pigmentos opacificadores na resolução do caso, em seguida, foi realizada uma reavaliação após 30 dias e 7 meses do procedimento restaurador, quando verificou-se a estabilidade de cor da restauração. Concluiu-se, portanto, que a utilização da técnica de estratificação de resinas compostas associada a utilização de pigmentos opacificadores traz resultados estéticos satisfatórios e favoráveis por meio de uma técnica direta, realizada em sessão clínica única e com alta previsibilidade.

**Palavras-chave:** Resinas Compostas; Descoloração de dente; Estética dentária; Relatos de casos; Corantes; Facetas dentárias

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## INTRODUCTION

The darkening of single teeth has been a huge challenge for restorative dentistry, and usually leads to the need for esthetic restorations with extensive wear of the tooth structure. In this sense, the success of restorative treatment is determined by functional and aesthetic principles, and the search for suitable materials that meet these requirements must consider the importance of an integration between the restoration, dental tissues, and optical phenomena (1).

The first treatment option for teeth with altered color is tooth bleaching, characterized as an effective, low cost, and non-invasive treatment. The choice of technique depends mainly on the type of color change of the tooth substrate and whether the tooth is vital or non-vital (2,3). In situations of severe discoloration, in which bleaching alone is not enough to provide the patient with desirable chromatic characteristics (4,5), more invasive procedures are indicated. These procedures include composite resin restorations and indirect restorations as ceramic veneers or full crowns. The broad combination of available techniques and the difficulty in obtaining the ideal color result in clinical questions about how to solve esthetic issues with safety and predictability of the colorimetric result (6,7).

Currently, composite resin procedures make it possible to restore anatomical details of the natural dentition that make the restorations almost imperceptible to the human eye. Thus, the restorative technique and the understanding of the application of layered resin, combined with the perception of the interaction of light with the dental tissues, allow results with a high aesthetic level (8). The literature shows great heterogeneity in the longevity of composite resins in anterior teeth, due to the small number of clinical studies with long follow-up periods. However, among the risk factors that can influence the survival of restorations are patient factors (e.g. caries risk, parafunctional habits, number of revisions per year, socioeconomic status), dentist factors (different operators, operator experience), and tooth/restoration factors (endodontic treatment, tooth type, number of restored surfaces) (9-13).

Among the available strategies for veneering with composite resin in masking teeth with marked color change, opacifying stains have been used as an effective and minimally invasive alternative, allowing less tooth wear to achieve masking of the darkened substrate. Thus, considering that the result of a composite resin restoration can vary according to the background color, choosing the appropriate materials capable of blocking and transmitting light becomes one of the most complex steps in restorations of darkened teeth (14-16).

Thus, this article aims to describe a clinical case of an indication for a direct composite resin veneer for aesthetic treatment of a discolored tooth, using opacifying pigments for masking the substrate.

## CASE REPORT

A 54-year-old male Caucasian patient, in good general health, came to the Dentistry Clinic of the Navy Central Dental Clinic seeking esthetic treatment due to darkening of the central upper left incisor (Figure 1). During the anamnesis, the patient reported a history of dental trauma in the mentioned tooth more than 20 years ago, with endodontic treatment and unsuccessful internal tooth whitening, and a new protocol was contraindicated.



**Figure 1** - Initial photographs

After clinical and radiographic analysis of the tooth structure, the substrate color change, satisfactory endodontic treatment, and the absence of an intraradicular retaining pin were verified. Considering there was enough structure for a direct restoration, the proposed treatment plan was to make a direct composite resin veneer. The Informed Consent Form was signed by the patient and the present case report was approved by the Research Ethics Committee of Hospital Naval Marcílio Dias under Protocol no. 131151/2022.

For the restorative procedure, infiltrative anesthesia was performed, modified absolute

isolation adapted to the case and insertion of retractor wire (Ultrapack® #000, Ultradent, Utah, USA) in the gingival sulcus to promote separation and protection of the gingival tissue during the preparation. Then, the element preparation was performed with the help of a rounded end and spherical truncated cone diamond tip (Reference 4138 and 1014, KG Sorensen, São Paulo, Brazil). Diamond tip diameter no. 4138 (1.8 mm) was used to guide the wear for the veneer preparation (approximately 0.9-1.0 mm) and incisal reduction was performed, considering the severe color change of the substrate.

Restorative procedures were performed after prophylaxis with pumice stone powder and water, followed by total acid etching using 37% phosphoric acid (Ultra-Etch®, Ultradent, Utah, USA) for 15 seconds, surface washing with water and subsequent drying. The Adper Scotch Bond Multipurpose Adhesive System (3M ESPE, Minnesota, USA) was used for adhesive layer, according to the manufacturer's instructions. Initially, a layer of primer was actively applied for approximately 10 seconds, followed by a blast of air to evaporate the solvent. Then, the adhesive layer was applied and an air jet was blown to disperse the adhesive and polymerized for 20 seconds with the VALO® photoactivator (Ultradent, Utah, USA) (Figure 2).



**Figure 2** - Clinical aspect after tooth preparation and adhesive procedure

Layering was started with a layer of high translucency resin for freehand fabrication of the palatal base (Forma® color Transparent, Ultradent, Utah, USA). Next, a mixture of three opacifying pigments was applied to mask the color-changed tooth substrate (Figure 3). Approximately one drop of each of the opacifiers was mixed in a plastic dappen jar so that they could be applied with the aid of a brush no. 1 curved (Cosmedent, Chicago, USA). To measure the amount of opacifier applied, black and white photographic records were taken with each application of the mixture on the dental substrate, in order to verify the value of the layer applied and the masking capacity. The opacifiers used were Creative Color Opaquer Pink® and Creative Color Opaquer® in colors A1-B1-L0 and A2-A2.5 (Cosmedent, Chicago,

USA) (17). Afterwards, the body of the restoration was made with opaque dentin resin (HerculitePrécis® color A3D, Kerr, USA) (Figure 4). In the incisal third, grooves were made for the reproduction of the dental mamelons present in the natural tooth. Between the mamelons, a translucent resin (Filtek Z350XT® color BT, 3M ESPE, Minnesota, USA) was inserted to reproduce the incisal opalescence. The layer corresponding to the enamel was made with a layer of translucent achromatic resin (EsteliteOmega® color MW, Tokuyama, Japan), to increase the passage of light in this region and allow a greater naturalness of the restoration (16) (Figure 5).



**Figure 3** - Clinical aspect after application of the opacifying pigments



**Figure 4** - Clinical appearance after application of dentin layer



**Figure 5** - Clinical aspect after application of translucent achromatic resin layer

At the end of the procedure the restoration was finished with carbide multilaminated burr (Reference 7404 and C48L, Jota, Florianópolis, Brazil) and with the abrasive disc sequence Sof-Lex Pop-On® (3M ESPE, Minnesota, USA). The occlusal fit and

excursive movements were checked with carbon paper for articulation (Accufilm®, Parkell, New York, USA). Polishing was performed with polishing rubbers (FlexiCups®, Cosmedent, USA), diamond spiral-shaped disc (A.S.A. P® pink color 3-6 micron, Cosmedent, USA) and felt disc (FlexiBuff®, Cosmedent, USA) associated with polishing pastes of different microcrystalline diamond particle sizes (Diamond Polish® 1µm and 0.5 µm, Ultradent, Utah, USA) and finished with aluminum oxide-based polishing paste (Enamelize®, Cosmedent, Chicago, USA).

The patient reported a high level of satisfaction with the immediate transformation and aesthetic rehabilitation of his smile that can be observed in the figure 6. Reevaluation visits were performed 30 days and 7 months after the restorative procedure (Figures 7 and 8), and the maintenance of the restoration integrity and polish was observed.



**Figure 6** - Immediate final clinical aspect



**Figure 7** - Clinical aspect after 30 days of the restorative procedure



**Figure 8** - Final appearance 7 months after the restorative procedure

## DISCUSSION

Chromatic changes in anterior teeth are frequent complaints from patients seeking aesthetic solutions. These changes can affect one or more teeth, and the involvement of only one element is a great challenge, due to the technical difficulty in obtaining the expected final color. Thus, the choice of the appropriate treatment plan should respect the following principles: minimal intervention, optimize tooth shape and provide aesthetics (18,19).

To achieve a good esthetic result, besides mastering the technique used, it is important to know the optical behavior of resin materials. Composite resin restorations in anterior teeth are usually capable of reestablishing the aesthetics, form, and function of the tooth, and the restorative concepts are directly related to the concepts of preserving the dental structure (8).

Although the masking of darkened teeth is influenced by several factors, making it difficult to determine the factor that most influences the result, the incorporation of resin pigments in composite resin restorations can interfere in the optical characteristics of the outcome, so that the thickness of material deposition and, consequently, dental wear decreases, making the restorative procedure less invasive than the conventional one for cases of dental discoloration (20).

Opacifiers are highly pigmented resin materials containing metal oxides that are responsible for their potent opacification capacity, characteristic shade, and saturation. The ability to mask the background effect by the complex interaction between absorption and scattering can be achieved by adding opacifiers to the composite resin, such as titanium oxide or aluminum oxide. Opacifying pigments are available in a fluid consistency (e.g. Creative Color®, Pink Opaquer®, Cosmedent, Chicago, USA), as a base-catalyst paste (e.g. Dual-Cured Opaquer® Bisco, Chicago, USA) or as a powder-liquid (e.g. Sinfony Opaquer®, 3M ESPE, Minnesota, USA) (14, 21-22).

Among opacifiers, different products offer different opacification abilities and while some can effectively mask a darkened substrate with as little as 0.1mm of material thickness, others may require two or more layers (21,22). In this sense, the use of opacifiers in fluid consistency allows a material of high opacity with reduced thickness to be used, which favors the masking of the discolored substrate without compromising the use of resin layers of dentin, effect, and enamel, important for layering and aesthetic result as close as possible to the natural tooth (16,20). Thus, the opacity level of an opacifier should be such that it only partially blocks light. In some cases, the use of the opacifier may be limited unless they are mixed with opacifiers of varying colors, which could

make the process unpredictable (22-23). While colors A1-B1-LO and A2-A2.5 have similar values and little difference in chroma, PINK has much higher value and, in some cases, can be used alone on darkened teeth (24).

Thus, the combination of composite resin layering techniques associated with the use of opacifiers to use a logical protocol of selection and application in the fabrication of direct veneers for masking darkened teeth can provide favorable esthetic results, as well as associating with a greater preservation of the dental structure when compared to full ceramic crowns, shorter clinical time for execution and greater ease of repair (1, 16).

## CONCLUSION

The correct application of the layering technique is capable of minimizing color discrepancies and the use of opacifying pigments offers a satisfactory aesthetic result in masking cases of marked discolorations, aiding in the dental surgeons' clinical routine and increasing the predictability of satisfactory results.

The authors declare that there are no conflicts of interest.

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## CASE REPORT

# GAP ARTHROPLASTY WITH TEMPORALIS FASCIA INTERPOSITION FOR THE TREATMENT OF TEMPOROMANDIBULAR JOINT ANKYLOSIS: CASE REPORT

## ARTROPLASTIA EM GAP COM INTERPOSIÇÃO DE FÁSCIA DE TEMPORAL PARA O TRATAMENTO DE ANQUILOSE DE ARTICULAÇÃO TEMPOROMANDIBULAR: RELATO DE CASO

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### ABSTRACT

Ankylosis of the temporomandibular joint (TMJ) is characterized by the intracapsular union of the condyle-disc complex to the surface of the temporal bone, which can cause restriction of the mandibular movements and a limitation of a mouth opening. Alterations are also described as a restriction of masticatory capacity, difficulty in phonation and suitable oral hygiene, as well as difficulty in social interaction. A 27-year-old female patient with a bilateral history of parasymphysis and mandibular condyle fracture after a trauma in 2014, which evolved to an ankylosis of the right TMJ, with a maximum mouth opening of 13.27 mm. For the treatment of the described case, it was used the Al-Kayat approach, ipsilateral coronoidectomy and resection of the ankylotic mass in gap with interposition of temporalis muscle fascia flap on the right side. After six months of the surgical procedure, it was made a new computed tomography of the face in which it was possible to notice the absence of lesions and signs of recurrence of the ankylosis. It was also observed the maintenance of the gap space made by the bone resection. The satisfactory result of the technique was attributed to the achievement and stabilization of an adequate mouth opening, improved chewing ability and phonation. Besides the clinical success, an advantage of the technique used was the low cost of the procedure by using only temporal muscle interposition without the use of alloplastic materials. In addition, the associated ipsilateral coronoidectomy was sufficient to help maintaining the achieved mouth opening, and the contralateral coronoidectomy was not necessary, as a result it was minimized the surgical time and morbidity of one more accessed surgical site.

**Keywords:** Arthroplasty, Ankylosis, Temporomandibular Joint, Traumatology, Condyle, Pathology.

### RESUMO

A anquilose da articulação temporomandibular (ATM) é caracterizada pela união intracapsular do complexo disco-côndilo à superfície do osso temporal, podendo gerar restrição dos movimentos mandibulares e limitação de abertura bucal. São descritas ainda alterações como restrição da capacidade mastigatória, dificuldade de fonação e de uma adequada higiene bucal, além de dificuldade de interação social. O presente caso retrata um paciente feminino, 27 anos, com histórico de fratura de parassínfise e côndilo mandibular bilateral após trauma em 2014, evoluindo com anquilose da ATM direita, com abertura máxima de 13,27 mm. Para o tratamento do caso descrito, foi utilizado o acesso de Al-Kayat, coronoidectomia ipsilateral e ressecção de massa anquilótica em gap com interposição de retalho da fáscia do músculo temporal no lado direito. Após seis meses do procedimento cirúrgico, foi realizada uma nova tomografia da face na qual se observa ausência de lesões e de sinais de recidiva da anquilose e também foi observada a manutenção do espaço de lacuna feita pela ressecção óssea. O resultado satisfatório da técnica foi atribuído pela obtenção e estabilização de uma abertura bucal adequada, melhora da capacidade mastigatória e da fonação. Além do sucesso clínico, uma vantagem da técnica utilizada foi o baixo custo do procedimento por utilizar apenas interposição do músculo temporal sem uso de materiais aloplásticos. Além disso, a coronoidectomia ipsilateral associada foi suficiente para auxiliar na manutenção da abertura alcançada, não sendo necessária a coronoidectomia contralateral, o que minimizou o tempo operatório e a morbidade de mais um sítio cirúrgico acessado.

**Palavras-chave:** Artroplastia, Anquilose, Articulação Temporomandibular, Traumatologia, Côndilo, Patologia

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## INTRODUCTION

The ankylosis of the temporomandibular joint (TMJ) refers to the intracapsular union of the condyle-disc complex to the surface of the temporal bone, with restriction of mandibular movements, which causes limitation of mouth opening, restriction of the masticatory capacity, poor oral hygiene and difficulty in phonation, as well as difficulty in social interaction, among other psychological disorders (1,2).

Basically, there are three relevant factors in the etiology of ankylosis, which are orofacial infection, trauma, and systemic/genetic conditions. In adults, condyle fractures are more frequent causes of ankylosis, followed by previous TMJ interventions, such as tumor excision, discopexy, and eminectomy. Other etiologies would be systemic diseases, such as ankylosing spondylitis, psoriasis, osteoarthritis and juvenile rheumatoid arthritis (2-6).

Intra-articular hematoma alongside scar tissue and excessive bone formation are responsible for the restriction of the mandibular movement, in cases in which trauma is the etiological cause (3). TMJ ankylosis treatment seeks essentially to reestablish the mouth opening preventing future recurrence. Its handling is surgical, under general anesthesia. Besides, during the preoperative period, it should be discussed with the anesthesiologist how the patient's intubation will be performed, with the options of nasofibroscope or elective tracheotomy. The preferred one is the intubation with bronchofibroscope assistance (7-9).

Surgical treatment can be performed according to techniques based on a complete excision of the ankylotic mass, or in the creation of a gap between the condyle and the temporal ankylosed bone, which imitates a new joint. Among these, the most recommended techniques today are: TMJ reconstruction with alloplastic materials, the use of autogenous grafts, such as those of costochondral origin, and interpositional arthroplasty, in which a gap is formed and a material is placed in it, such as the fascia of the temporal muscle, and auricular cartilage (8-10).

When ankylosis is already established for a long period, coronoid hyperplasia and muscle fibrosis often occur. Thus, in the perioperative period, in cases of mouth opening smaller than 35 mm, afterwards ankylosis treatment with ipsilateral coronoidectomy, it is recommended to perform a contralateral coronoidectomy by the intraoral approach. In the postoperative period, intermaxillary blockade is indicated for approximately 10 days, to avoid cicatricial fibrosis in the joint. After patient's

release, a strict physiotherapy protocol alongside speech therapy should be followed (4,10,11).

The present study aims to report the treatment of TMJ ankylosis through the surgical technique of ipsilateral coronoidectomy and resection of ankylotic mass in patients with gap, alongside flap interposition of the temporal muscle fascia.

## CASE REPORT

A 27-year-old female patient was treated at Hospital Adão Pereira Nunes (HMAPN) in Duque de Caxias - Rio de Janeiro - RJ, Brazil. She reported a severe mandibular hypomobility after a trauma in 2014. In her previous medical history, there was a bilateral parasymphiseal and mandibular condyle fracture, which evolved to a right TMJ ankylosis and a maximum mouth opening of 13.27 mm (Figure 1). The patient did not know when symptoms started exactly, however she reported worsening in the last two years. In face computed tomography (CT), it is seen, in the coronal, sagittal sections, and in the 3D reconstruction (Figure 2A, 2B, 3), a hyperdense image, which shows the union of the fractured condyle to the glenoid fossa.



Figure 1 - Maximum preoperative mouth opening at 13.27 mm.



Figure 2 - Coronal (A) and sagittal (B) sections of the face CT scan.



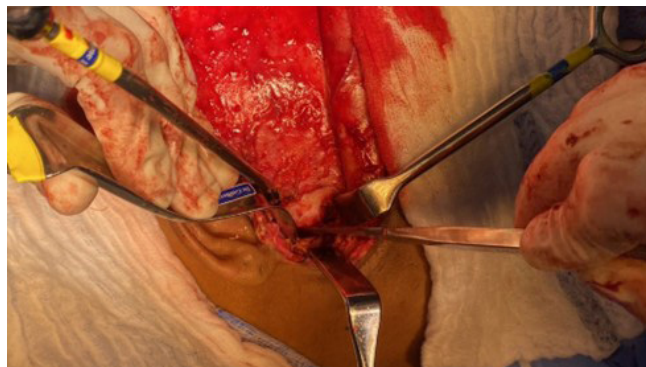
**Figure 3** - Three-dimensional reconstruction of face CT scan displaying osteosynthesis in the left mandibular parasymphysis region.

The treatment selected for this case was the ipsilateral coronoidectomy and the resection of the ankylotic mass in a gap, alongside flap interposition of the temporal muscle fascia on the right side. The patient was informed about the risks and benefits of the treatment and signed an informed consent form. The Research Ethics Committee of Carlos Chagas Institute approved the present case under protocol number: 68933223.8.0000.0251.

In the surgery, Al-Kayat and intraoral access in the base of the mandibular vestibule were used to perform coronoidectomy. The procedure was performed with the patient under general anesthesia with nasotracheal intubation. After the establishment of anterior and posterior limits of the ankylosed mandibular condyle, resection of the bone segment, and the preparation of the gap started. In this process were used: burs 701 and 702 (Razek, São Carlos, SP, Brazil), oscillating saw, alongside the tools and Stryker TPS motor (40,000 rotations per minute), hammer, and chisel (Figure 4). Segments irregular edges were smoothed by the bur, and the branch was completely separated from the upper bone block. For this technique, the minimum of 10 mm interval is created between the mandibular branch and the base of the skull, also known as temporal bone (glenoid fossa) (1).

After the ankylosed block removal, it is expected the passive mouth opening to be around

35 mm. As a result of the opening limitation, after the creation of the gap, ipsilateral coronoidectomy was performed. If the problem continues, it is recommended to perform a contralateral coronoidectomy (Figure 5). Based on the creation of this interval, that completely separated the bone blocks, the temporal fascia graft was done, and this regional flap bypassed the zygomatic arch to fill in the gap. After establishing and anchoring with a 1.9 mm orthopedic anchor, it was done a flat suture and the installation of a drain to prevent the formation of a "dead space" and an edema (1,2,4).



**Figure 4**- Perioperative photography showing the moment of making the gap with the use of burs, hammer and chisel.



**Figure 5** - Mouth opening of 32 mm, during perioperative.

The beginning of speech therapy monitoring and physiotherapy exercises started at the hospital bed fourteen days after surgery. Speech therapy, peri-



and intraoral massages, myofunctional exercises and bandage application were maintained. Twenty sessions were performed, three per week in the first month and two per week in the subsequent month (4,12).

During the clinical control in the postoperative period, eleven days after the surgical procedure, the patient presented a good mouth opening, with maintenance of more than 30 mm, which allows the recovery of masticatory and speech functions normally (Figure 6). Figure 7 presents the tomographic control after 6 months. It was possible to observe local healing without any bone formation and ossification that could indicate relapse of treatment. The mouth opening approach and the recovered functions are the parameters that can be analyzed so far.



**Figure 6** - Mouth opening maintained in the period of 11 days after the surgical procedure.



**Figure 7** - Face CT scan. 6 months postoperative period.

## DISCUSSION

TMJ ankylosis should be treated as soon as the condition is diagnosed. The treatment aims to remove the ankylotic block and return the function

of the TMJ, preventing ankylosis of coming back. Thereby, surgical procedures have been described for this purpose (12,13).

Arthroplasty in gap without interposition needs a greater amount of bone resection, when compared with the material interposition. For this technique, a wide material variety has been discussed, such as auricular cartilage, costochondral graft, silicone, various metals, muscle, and temporal fascia (2,9).

Total arthroplasty, with the interposition of material, has the option of self-curing the methacrylate, with the surgical proposal of two convex articular surfaces (14). If alloplastic materials are chosen as the interpositional material type, the chance of site rejection and morbidity increases (12,15). In more severe cases, extensive bone erosion was found in the glenoid fossa area. Another complication reported was alloplastic fragmentation material and progressive wear, which can cause loosening and fracture of the prosthesis (16). Despite of the fact that the use of interposition with alloplastic and autogenous material presents similar mouth opening values, ankylosis recurrence was higher in patients treated with alloplastic material, highlighting which one showed the worst performance in interposition (11).

Autogenous materials can be used as another option to form this interposition, resulting in benefits that converge when they achieve an early mobilization after the surgical procedure. As a consequence of the physical barrier created with the use of interpositional material, the presence of pluripotent cells was minimized and fibrosis and heterotopic ossification (HO) prevented. Costochondral grafting is a technique used due to its growth potential and its biocompatibility and functional adaptation. However, its growth can be unpredictable and cause unsatisfactory results (4,17).

The comparison of the arthroplasty in gap and the use of the interpositional graft showed significantly lower recurrence events of temporomandibular ankylosis with interposition, when studies with less than two years of follow-up are evaluated. Nonetheless, over a longer period of time, including studies that evaluated follow-up over then two years, similar rates of relapse were observed between them. Relapses over long follow-up periods, longer than two years, were observed less frequently in patients treated with interposition of material (11,18).

The use of regional flap, with the muscle and temporal fascia, maintains the advantages of being an autogenous material, having resilience and proximity to the joint. The muscle included in the flap results in a greater thickness above the zygomatic arch. Most because the material is shaped when placed in the gap created, which is its biggest disadvantage (3).

Mittal *et al.* found that temporomandibular fascia is the most common material for arthroplasty (11). Regardless the aspects of providing vascularization, an autogenous tissue with adequate blood supply, and resistance, the temporal fascia is superior. In our case, we chose only the temporal fascia and there were no complications in the largest projection on the face (3,19). Rodrigues *et al.* (2021) also chose the use of the of temporal muscle fascia with the interposition of the material in the gap, which was created by removing the ankylotic block. In this case, the choroid was removed from both sides. Mouth opening was in 27 mm on the first postoperative day, but there was an increase to 30 mm on the 20<sup>th</sup> day, and 32 mm about two months after the surgical procedure (20).

The temporal muscle can form the induction of a scar, which causes recurrence of ankylosis at the surgical site. However, the knowledge of the current literature is insufficient to prove that the type of autogenous material can favor recurrence (7). Dimitroulis (2004) published a relapse after a follow-up of 15 months in a case initially treated with adipose graft. In this case, it was necessary to reapproach the patient for a costochondral graft (7). For an efficient treatment, the risk factors are the patient's age, duration of the process, previous surgery in the TMJ area, and the associated systemic impairment. Thus, the types of graft or flap properties have influence in the process, but are not able to determine absolutely the treatment's longevity (1).

The technique of choice for the treatment of this case performance was due to its conservative style, since condylar prostheses have an expectation of 20 years, requiring replacement after this period (21). Therefore, since the patient was young, ipsilateral coronoidectomy and resection of the ankylotic mass in gap were chosen alongside the interposition of the flap of the temporal muscle fascia. In case of symptoms recurrence, the placement of grafts or prostheses in the area will be indicated.

The results of previous studies have highlighted the importance of immediate exercise and physiotherapy for relapse prevention (20). Surgery to release TMJ ankylosis, besides increasing mouth opening, results in decreased action potentials during maximal isometric voluntary contraction for the masseter muscle on both sides, resulting in less pain to the patient and release of the joint for functional activities (22). According to Karamesi *et al.* (2013), the early application of exercises, under the supervision of physiotherapists and speech therapists, supported interincisal opening, which went from 20mm to 29.5mm (4).

## CONCLUSION

The satisfactory result of the arthroplasty technique in gap with temporalis fascia interposition

for the treatment of TMJ ankylosis was attributed to the achievement and stabilization of mouth opening in 32 mm. This consequently resulted in an improvement of the masticatory capacity and phonation. Early mobilization, physiotherapy and a close follow-up were also decisive for the occurrence of a successful outcome so far. In outpatient follow-up, six months after the surgical procedure, a new CT of the face was performed, in which it was observed absence of lesions and maintenance of the gap space made by bone resection. Another advantage of the technique used was the low cost of the procedure, since only the temporal muscle interposition was used, without the use of alloplastic materials. In addition, the associated ipsilateral coronoidectomy was sufficient to help maintaining the achieved opening, and the contralateral coronoidectomy was not necessary. As a result, the surgical time and morbidity of one more accessed surgical site were minimized.

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# DEMYSTIFYING THE USE OF LITHIUM DISILICATE AND CUBIC PHASE STABILIZED ZIRCONIA IN MONOLITHIC RESTORATIONS: A LITERATURE REVIEW

## DESMISTIFICANDO O USO DO DISSILICATO DE LÍTIO E DE ZIRCÔNIAS ESTABILIZADAS NA FASE CÚBICA EM RESTAURAÇÕES MONOLÍTICAS: UMA REVISÃO DE LITERATURA

Allan Oliveira da Silva<sup>1</sup>, Ilana Santos Ramalho<sup>2</sup>

### ABSTRACT

The development and popularization of operative techniques associated with dental materials have enabled the transformation of oral health conditions into aesthetic rehabilitations. The aim of this study was to review the literature on the use of lithium disilicate and cubic phase stabilized zirconia in monolithic restorations. The databases used were Lilacs, Pubmed/Medline, Scielo, and ScienceDirect, crossing the following English descriptors: "Zirconium", "Yttrium", "CAD-CAM", "Ceramics", "Dental Porcelain" and "Material Resistance". Monolithic indirect restorative techniques with dental ceramics coupled with the use of CAD/CAM technology have several short and long-term advantages. Lithium disilicate and high translucency zirconias stabilized in the cubic phase are current materials and of constant evolution in dental research due to their mechanical behavior, biological, optical, and aesthetic aspects, ensuring their use as materials of excellence in aesthetic-functional rehabilitations.

**Keywords:** Dental aesthetics; Ceramics; Zirconium; CAD-CAM.

### RESUMO

O desenvolvimento e a popularização de técnicas operatórias associadas aos materiais odontológicos propiciaram a transformação das condições de saúde bucal em reabilitações estéticas. O objetivo deste estudo foi revisar a literatura acerca da utilização do dissilicato de lítio e de zircônias estabilizadas na fase cúbica em restaurações monolíticas. As bases de dados utilizadas foram Lilacs, Pubmed/Medline, Scielo e ScienceDirect, cruzando os seguintes descritores em língua inglesa: "Zirconium", "Yttrium", "CAD-CAM", "Ceramics", "Dental Porcelain" e "Material Resistance". As técnicas restauradoras indiretas monolíticas com as cerâmicas odontológicas atreladas ao uso da tecnologia CAD/CAM possuem diversas vantagens a curto e a longo prazo. O dissilicato de lítio e as zircônias de alta translucidez estabilizadas na fase cúbica são materiais atuais e de constante evolução na pesquisa odontológica devido ao seu comportamento mecânico, biológico, aspectos ópticos e estéticos, garantindo seu uso como materiais de excelência nas reabilitações estético-funcionais.

**Palavras-chave:** Estética dentária; Cerâmica; Zircônio; CAD-CAM.

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## INTRODUCTION

Monolithic restorations have been considered the gold standard in esthetic-functional dental rehabilitations because of their optical characteristics, their excellent biocompatibility and mechanical properties, and the ease of their fabrication method by computer-aided design/computer-aided manufacturing (CAD/CAM) (1, 2). Lithium disilicate ceramics were introduced to the dental community by Ivoclar Vivadent (3). It is a glass matrix ceramic containing lithium disilicate crystals, which results in higher mechanical strength compared to feldspathic ceramics and in better esthetics than highly crystalline ceramics, resulting in the evolution of dental glass-ceramics for its mechanical and esthetic behavior and manufacturing technology (4).

Currently, lithium disilicate has the CAD/CAM-favored manufacturing method, which has adequate clinical performance as a restorative material in monolithic restorations (5). Moreover, its optical properties and translucency are superior to restorations made of different types of zirconia (6).

First-generation yttria-stabilized zirconia (Y-TZP) has been increasingly used in oral rehabilitation as a component of the framework, anterior and posterior, single and multiple restorations, presenting superior mechanical properties and biocompatibility when compared to other dental ceramics, besides high strength, fracture toughness and excellent mechanical properties as its main characteristics (7,8,9,10,11). The high opacity of Y-TZP is a negative factor especially when used in esthetic restorations though (12,13).

The second generation of Y-TZP presents higher translucency, due to more refined processing, which occurs by reducing the concentration of alumina oxide grains ( $Al_2O_3$ ) and by increasing the sintering temperature, which aims to eliminate material porosity (11,14). This same second-generation zirconia presents medium translucency, with a better indication for the production of monolithic crowns in the posterior region (14). Despite the improvement in the optical properties of second-generation zirconia, they are not yet comparable to glass ceramics in terms of esthetics, which encourages the introduction of third-generation zirconia in the search for translucency and tooth mimicry (11,15).

The third generation had the important change of increasing the percentage of yttrium oxide stabilizer (> 3 mol%). This change resulted in a partially or fully stabilized material, in which up to 53% of the cubic phase could be observed in the ceramic crystalline microstructure, in addition to the tetragonal phase, present in previous generations such as Y-TZP (11).

In order to promote improvements in the optical properties of third-generation zirconia, partially stabilized cubic phase zirconia (Y-PSZ) and fully stabilized cubic phase zirconia (Y-FSZ) were developed, which have in their composition a higher amount of yttrium oxide when compared to Y-TZP (4 to 6 mol% for Y-PSZ and 8 mol% for Y-FSZ) (13,16). The addition of yttrium oxide to zirconia promotes an increase in the crystalline content of the cubic phase and allows for increased translucency because, unlike the tetragonal phase, the cubic phase has an isotropic refractive index (13,14,17).

The aim of this study is to present the characteristics of lithium disilicate, Y-PSZ, and Y-FSZ, such as structural aspects, phase transformation, mechanical and optical properties, abrasion and wear, and clinical performance, in order to demystify their use and support their correct indication in monolithic dental restorations.

## LITERATURE REVIEW

### *Data Collection*

A non-systematic electronic search was performed in the Lilacs, Pubmed/Medline, Scielo, and ScienceDirect databases using the following English descriptors: "Zirconium", "Yttrium", "CAD-CAM", "Ceramics", "Dental Porcelain", and "Material Resistance". Research articles, literature reviews, randomized clinical trials, and case reports pertinent to the subject, published from 2007 to 2020, were included. Exclusion criteria included articles with disparities in the proposed theme, abstracts, and letters to the editor. A total of 1613 articles were found, forty of which met the selection criteria for inclusion in this study.

### *Structural Properties and phase transformation*

Injection-molded lithium disilicate ceramics have one glassy phase and two crystalline phases in their matrix. The glassy matrix involves both crystalline phases for structural shaping (3). These properties are present in the material after its complete sintering cycle (18). Its microstructure is characterized by a lithium disilicate crystalline phase (70%) surrounded by a silica glass phase and a second lithium orthophosphate crystalline phase. The crystals are elongated (5  $\mu m$  in length and 0.8  $\mu m$  in diameter) and interconnected, which prevents the propagation of cracks (18,19).

The commercialized lithium disilicate blocks for CAD/CAM undergo a two-stage sintering process. In the pre-sintered phase, the crystals of metasilicate, lithium disilicate, and orthophosphate have a size of 0.2 to 1.0  $\mu m$  and a flexural strength of about 130 to 150 MPa, which allows milling and, when tested, facilitates occlusal adjustment. Additionally, in the final

sintering, the prosthetic piece must be baked at 850°C (4,18,20).

The third-generation zirconia characterized by Y-PSZ and Y-FSZ are considered more translucent than other zirconias and are indicated for the fabrication of monolithic crowns in the anterior region, providing better aesthetic results (17). This translucency is mainly related to the isotropic refractive index and the absence of light scattering by birefringence at the cubic grain boundaries, unlike what occurs in Y-TZP (15). In this generation, the optical and aesthetic properties, characterized by translucency and light transmittance, have been improved, although the mechanical properties are expected to be somewhat compromised by the elimination of the mechanism of transformation from tetragonal phase to monoclinic phase (11,21). In addition, it is worth noting that improved resistance to low-temperature degradation of Y-PSZ and Y-FSZ is suggested (14).

The increase in the cubic phase of Y-FSZ reduces its mechanical properties. In addition, the total stabilization in the cubic phase does not allow the transformation from the tetragonal to the monoclinic phase (22). These modifications aim to reduce light scattering and thus improve the translucency of the material (14).

In terms of adhesion, the absence of any glass matrix in zirconia is a silica free and therefore detrimental as it cannot be etched with conventional acid etching techniques, unlike glass ceramics such as lithium disilicate (1,13,23).

### *Mechanical Properties*

The crystalline structure of lithium disilicate influences its mechanical properties and the material undergoes 2% shrinkage after complete sintering. It can undergo mechanical changes in different sintering cycles contrary to what is indicated by the manufacturer (4). After sintering, it has a biaxial flexural strength of  $407 \pm 45$  Mpa (20), a modulus of elasticity of  $\pm 95$  GPa, which is similar to that of dental enamel 91 GPa, and a fracture toughness of  $\pm 3$  MPa  $m^{1/2}$ . These values are 10% higher than those of injected lithium disilicate, ensuring better mechanical performance (24).

Lithium disilicate, when fabricated for monolithic restorations, is also able to withstand fracture loads better ( $2665.4 \pm 759.2$  N) when compared as a cover material ( $1431.1 \pm 404.3$  N) (5). The technique of fabricating monolithic lithium disilicate restorations with CAD/CAM reduces the possibility of porosities in the restoration that can negatively affect its fracture toughness and flexural strength (24).

Due to the greater occlusal overload in the posterior region, lithium disilicate milled crowns have a higher fracture rate in the molar region when

compared to the premolar region. These risks are greater in patients with bruxism, for example (20). The same material, when used for the fabrication of posterior indirect restorations, requires minimum thicknesses of 1.5 to 2 mm in the occlusal thickness for good mechanical performance (6). This material is not indicated for the fabrication of three-unit fixed partial dentures because it does not support the minimum loads (500 MPa) of fatigue strength and 3.5 MPa of fracture toughness (25).

Moreover, minimum thicknesses of the material on the enamel surface provide a lower risk of micro fractures when compared to larger thicknesses on the dentin tissue substrate due to the different values in the modulus of elasticity, demonstrating its good performance in minimally invasive indirect restorations (23).

Obermeier *et al.* demonstrated that the use of screw-retained lithium disilicate monolithic crowns on dental implants leads to a lower risk of implant-related damage compared to monolithic crowns made of Y-TZP and Y-TZP with lithium disilicate coating (26).

Y-FSZ has a partial reduction or absence of tetragonal grains that may limit its application in situations of high mechanical stress, suggesting that further investigations are necessary for a better characterization of the clinical performance of this type of zirconia since the high translucency makes this material promising to act in esthetic areas (27). The higher translucency of Y-FSZ, when compared to Y-TZP and Y-PSZ, is a result of the increased yttria oxide concentration, which stabilizes higher content in the cubic phase. These cubic grains have an isotropic orientation, having less interference with light transmission. In addition, they are larger than tetragonal grains, which reduces the grain boundary, which are sources of light deviation (22).

Currently, lithium disilicate ceramics are the most used material for monolithic crowns in the anterior region (28). However, this material is friable and susceptible to fatigue failure after mechanical loading (17). Y-PSZ, when compared to lithium disilicate ceramics, despite being less translucent, presents higher values of flexural strength and fracture toughness (29).

There is also a consensus that Y-FSZ has lower flexural strength than Y-PSZ due to the higher concentration of yttrium oxide and, consequently, a higher amount of crystalline content in the cubic phase (16,17,30).

### *Optical properties*

The presence of the crystalline structure of lithium disilicate influences the microstructural properties of the material and is directly related to its

optical properties (24). The colors of the material are determined by dye ions, usually, vanadium being the major composition of the dyes that are incorporated into the matrix. Moreover, lithium disilicate presents colors and translucency that differ by the size of the crystals and the amount of staining ions, bringing great advantage in the use in aesthetic regions, such as in anterior teeth, where the material can provide mimicry, besides its better translucency when compared to Y-TZP (4,31).

Milled lithium disilicate also allows the application of liquids for extrinsic staining and glazing after sintering, with great aesthetic gains as the optical properties of the material, are improved (4,5). Adhesive cementation and the color availability of the adhesive cements available in the dental market provide less interference in the color and translucency of the material (2).

Third-generation zirconia is considered more translucent than other zirconias and is indicated for the fabrication of monolithic crowns in the anterior region, providing better aesthetic results (17). This translucency is mainly related to the isotropic refractive index and the absence of light scattering by birefringence at the cubic grain boundaries, unlike what occurs in Y-TZP (14). The optical and aesthetic properties characterized by translucency and light transmittance have been improved, although the mechanical properties are expected to be somewhat compromised by the elimination of the transformation mechanism from the tetragonal to the monoclinic phase (11).

Y-PSZ and Y-FSZ are good alternatives to overcome the opacity of first and second-generation monolithic zirconia crowns, given the greater translucency and coloring possibilities of the material that can be associated, improving the optical and esthetic properties (32). This partial and total stabilization of Y-PSZ and Y-FSZ with cubic grains, which are isotropic, can improve the light transmission through the restoration, bringing great esthetic advantages (33). This factor also contributes to the cementation of Y-FSZ restorations due to the amount of light able to pass through the material, increasing the degree of conversion of resin cements during photoactivation (27).

### *Abrasion and wear*

Lithium disilicate has a better performance against enamel abrasion, bringing less wear on the antagonist when compared to Y-ZTP and feldspathic ceramics (34). However, the material promotes higher values of abrasiveness to the enamel surface compared to composite infiltrated ceramics and nanoceramic resin also available for making and milling in CAD/CAM, due to the higher hardness of

lithium disilicate (35,36). Lithium disilicate has a similar abrasiveness to dental enamel, so the glazing of the material has a greater indication of esthetic surfaces and smooth slopes that will not be influenced by masticatory wear over the clinical time (5).

It is important to be accurate throughout the fabrication of indirect restorations with this material, since intraoral adjustments with diamond-tipped instruments can lead to the formation of surface irregularities responsible for the initiation of micro cracks and fractures, making it necessary to polish the material after occlusal adjustments to minimize damage to the structure of the restorations (5,33).

Some authors have reported that polishing and glazing reduce the flexural strength of Y-PSZ, while the staining procedure increases the flexural strength of Y-FSZ, directly influencing the abrasive process against its antagonist (17,20,30,37).

Hatanaka *et al.* established that different protocols for adjusting monolithic Y-FSZ restorations such as the application of glaze and polishing rubbers do not increase the flexural strength of the material; even when subjected to the aging process in an autoclave at 134°C and 200KPa for twenty hours (33).

### *Clinical Performance*

Lithium disilicate restorations show good clinical performance in oral rehabilitations followed up to eleven years, as well as a 25-year longevity as veneers and ceramic laminates (20,38).

Brand *et al.* evaluated the longevity of restorations with single crowns made of IPS e.MAX lithium disilicate over a period of four years and demonstrated great success. They concluded that there is a higher survival rate in endodontically treated teeth and that adhesive cementation, as a sensitive technique, may negatively influence this rate (2).

Yang *et al.* demonstrated a 96.6% survival rate of 6855 different indirect lithium disilicate restorations in a five-year clinical follow-up. They also observed a lower survival rate in veneer restorations (90.6%) and concluded that the most frequent failures are related to delamination, cracks, and fractures and that the failures occur mainly one year after cementation (24).

Beier and Dumfahrt observed a survival rate of lithium disilicate restorations of 93.5% in ten years and 78.5% in twenty years of follow-up. The failures were mainly attributed to bruxism and caries infiltration (39).

Lithium disilicate should be avoided in three-unit fixed partial dentures in the posterior region since there is a higher fracture rate due to the compression forces developed by chewing, which are accentuated in patients with bruxism (20,25). Stabilizing plates associated with indirect lithium disilicate restorations

in patients with bruxism is an indication that ensures treatment predictability and longevity (39).

## DISCUSSION

Monolithic restorations have satisfactory optical properties, biocompatibility, and mechanical properties for clinical use (1). Their manufacture enables the use of the same ceramic material throughout the structure, reducing the likelihood of problems related to delamination, cracks, and fracture of the restoration (2,5,24). Lithium disilicate is a promising ceramic for clinical use in monolithic restorations such as veneers and ceramic laminates, anterior and posterior single crowns, and implant or denture-supported fixed partial dentures (2,26,38).

Lithium disilicate blocks for monolithic restorations have the advantage of processing facilitated by CAD/CAM, providing a reduction in the time to fabricate the restoration (18,20). Moreover, some crystals that are elongated and interconnected prevent the propagation of cracks and micro-cracks, contributing to success and ensuring longevity (18,19).

The respect for mechanical principles in the fabrication of monolithic restorations and the correct indication of use ensure the clinical success of the material. The sintering cycle, respecting the manufacturer's recommendation, contributes to its adequate mechanical performance (4); furthermore, the elasticity modulus of lithium disilicate after sintering corresponds to  $\pm 95$  GPa which is similar to dental enamel (91 GPa) contributing to the good clinical performance against the adjacent dental tissues (24). The greatest meticulousness in the preparation and indication of the material falls on posterior indirect restorations with the need for minimal occlusal thicknesses, as well as the use with caution on posterior fixed partial dentures, given the greater occlusal overload on these teeth (6,25).

However, Y-PSZ has higher flexural strength and fracture toughness values compared to lithium disilicate ceramics and has good indications for making posterior monolithic crowns (29). Whereas Y-FSZ is better indicated for the anterior region because of its lower mechanical performance when compared to Y-PSZ and Y-TZP (40).

Currently, the great use of lithium disilicate in indirect restorations is mainly due to its optical properties and greater dental mimicry compared to other ceramic systems and its possibility of staining (4,24). It has the great advantage of use in esthetic regions, such as in anterior teeth, besides its better translucency when compared to Y-TZP, which has

an indication for infrastructure due to its high opacity (31). The finishing of the material with glaze and liquids for extrinsic staining becomes essential steps for improving the optical properties of the material (4,5). Furthermore, Y-PSZ and Y-FSZ are also good alternatives to overcome the opacity of Y-TZP, due to their optical and aesthetic properties such as higher translucency and coloring possibilities of the material (32). Y-PSZ and Y-FSZ also allow a light transmittance through the restoration, bringing great esthetic advantages and ensuring indications for use in anterior monolithic restorations (6,31).

Lithium disilicate has similar abrasiveness to dental enamel compared to other ceramic systems (5,34). The Y-PSZ has low abrasiveness and the ability to wear antagonist teeth, with indications, especially for patients who present bruxism or other parafunctional habits (31). Protocols for material finishing and polishing processes are essential for the success of monolithic restorations, directly influencing the process of wear, crack formation, micro-cracks, and fractures of the material (5,6).

Lithium disilicate has better adhesion due to the presence of a glassy matrix and being acid-sensitive, showing high adhesion strength to the substrate, because of micromechanical and chemical bonding mechanisms, unlike zirconia that its adhesion is still controversial in the literature (13,23).

*In vitro*, studies are highly recommended to clarify the performance and longevity of restorations fabricated with Y-PSZ and Y-FSZ (40). As Y-PSZ and Y-FSZ are recent materials in the dental market, the scientific literature is scarce in clinical studies of these materials. Among the limitations of the present work, we can highlight the diversity of research methodologies of the articles, as well as the limitation of studies with zirconia stabilized in the cubic phase.

## CONCLUSION

Lithium disilicate has proven clinical success and longevity and becomes a viable ceramic alternative for the fabrication of indirect restorations, while meticulously respecting the mechanical and biological principles and properties of the material. Cubic phase stabilized zirconia, despite its mechanical, optical, and biological properties proven by *in vitro* studies, are recent materials in the dental market and present themselves as viable alternatives in monolithic restorations when correctly indicated.

The authors declare that there is no conflict of interest.



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### ORAL AND MAXILLOFACIAL MANIFESTATIONS OF COVID-19 – INTEGRATIVE LITERATURE REVIEW

#### MANIFESTAÇÕES ORAIS E MAXILOFACIAIS DA COVID-19 – REVISÃO INTEGRATIVA DA LITERATURA

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#### ABSTRACT

Scientific evidence suggests that SARS-CoV-2 is present in the oral tissues in the initial phase of contamination as the main viral reservoir. Besides the oral cavity being the main means of spread, it also becomes a common location of clinical manifestations during the onset and evolution of the disease. The objective was to evaluate the literature about the oral and maxillofacial clinical manifestations arising from Covid-19 contamination. This is an integrative literature review of the databases Latin American and Caribbean Literature on Health Sciences (Lilacs), Scientific Electronic Library Online (SciELO) and BBO Dentistry, of articles published between 2019 and 2022 that portrayed the theme of the study. Initially, the search for the descriptors was conducted individually, then, the crossings were performed using the Boolean operator “AND” and, subsequently, the three descriptors were crossed together. The inclusion criteria were articles published in Portuguese, English and Spanish, published and indexed in the databases, starting in 2019 - year of the emergence of Covid-19 and that portrayed the theme of the study. The exclusion criteria were articles published before 2019, articles outside the chosen databases, and articles that ran away from the theme of the study. During the study, 28 articles were selected from all the cited criteria. It was concluded that patients contaminated with Covid-19 had oral and maxillofacial clinical manifestations that may include ulcerations, inflammation in the oropharynx, retromandibular edema, fungal infections, xerostomia, anosmia, and ageusia.

**Keywords:** Oral manifestations; Covid-19; Signs and symptoms.

#### RESUMO

Evidências científicas sugerem que o SARS-CoV-2 está nos tecidos orais na fase inicial da contaminação como principal reservatório viral. Além da cavidade oral ser o principal meio de propagação, também se torna uma localização comum das manifestações clínicas durante o início e a evolução da doença. O objetivo foi avaliar na literatura as manifestações clínicas orais e maxilofaciais decorrentes da contaminação pela Covid-19. Trata-se de uma revisão integrativa da literatura das bases de dados Literatura Latino-Americana e do Caribe em Ciências da Saúde (Lilacs), Scientific Electronic Library Online (SciELO) e BBO Odontologia, de artigos publicados entre os anos de 2019 e 2022 que retratassem a temática do estudo. Inicialmente, realizou-se a busca pelos descritores individualmente, em seguida, foram realizados os cruzamentos utilizando o operador booleano “AND” e, posteriormente, os três descritores foram cruzados em conjunto. Os critérios de inclusão foram: artigos publicados em português, inglês e espanhol, publicados e indexados nas referidas bases de dados, a partir de 2019 – ano do surgimento da Covid-19 e que retratassem a temática em estudo. Os critérios de exclusão foram: artigos publicados antes de 2019, artigos fora das bases de dados escolhidas e que fugissem da temática do estudo. Durante o estudo, 28 artigos foram selecionados a partir de todos os critérios citados. Conclui-se que pacientes contaminados com a Covid-19 tiveram manifestações clínicas orais e maxilofaciais que podem incluir ulcerações, inflamações na orofaringe, edemas retromandibulares, infecções fúngicas, xerostomia, anosmia e ageusia.

**Palavras-chave:** Manifestações bucais; Covid-19; Sinais e sintomas.

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## INTRODUCTION

On December 31st, 2019, in Wuhan - China, the Chinese government issued the first alert of global significance about the spread of the SARS-CoV-2, a virus that causes Covid-19 disease. For Capocasale et al, its high level of spread is due to the contact of droplets of body fluids of the contaminated person (mainly saliva), with the oral, nasal, and ocular mucous membranes of other individuals (1-3).

Studies have shown that this fluid pathway constitutes the major means of viral transmission due to the compatibility of the virus with the structures that are part of its production, in addition to the structures that secrete it serving as a means of viral storage and proliferation (4-5). It was emphasized that the angiotensin-converting enzyme 2 (ACE-2), present mainly in oral and maxillofacial tissues, facilitates the entry and installation of the virus in the cells. Because it stores such a large viral load, the oral cavity is the first structure to express some disorders, such as ageusia, anosmia, and inflammation of the oropharynx in the early stages of the disease (2,6). Initially, the patient may have mild, moderate, or severe symptoms depending on his/her immune response and the presence of comorbidities. The patient may be asymptomatic or have symptoms that can last for about 10 days. The most prevalent symptoms include cough, dyspnea, chills, oropharyngeal inflammation, glossitis, candidiasis, ageusia, anosmia, xerostomia, sialoadenitis, ulcerations and petechiae, which can evolve rapidly and with an unfavorable prognosis. Metallic taste and halitosis were also identified, but in an individualized way (7,8).

The consensus on the clinical manifestations has not yet been achieved due to the widely mutating nature of the virus, which produces diverse symptoms in each person. However, the accurate and complete clinical record of the various forms of manifestations caused by Covid-19 in the scientific community is essential to achieve a consensus that is efficient for the definition of strategies to combat the disease worldwide (9, 10).

Thus, this integrative review aims to evaluate in the literature the oral and maxillofacial clinical manifestations resulting from contamination by Covid-19, highlighting and unifying the current scientific information, since the virus is still circulating worldwide and the oral cavity is considered one of the main routes of infection.

## LITERATURE REVIEW

This is an integrative literature review of the databases Latin American and Caribbean Literature on Health Sciences (Lilacs), Scientific Electronic Library Online (SciELO), BBO Dentistry and PUBMED,

of articles published between the years 2019 and 2022 that portrayed the theme of the study. For the survey of articles, the following descriptors were used: “Oral manifestations”, “Covid-19” and “Signs and Symptoms”.

Initially, the search for the descriptors was conducted individually. Next, two of these descriptors were crossed using the Boolean “AND” operator, and then the three descriptors were crossed together. The samples were selected at each step of the individual search and crossover process. The guiding question of this study was: What are the oral and maxillofacial clinical manifestations reported in patients affected by Covid-19?

The inclusion criteria for the selection of the sample were articles published in Portuguese, English and Spanish, published and indexed in the aforementioned databases, from 2019 - year of the appearance of Covid-19 – to 2022, that portrayed the studied theme. The exclusion criteria for the selection of the sample were articles published before 2019, articles outside the chosen databases and that ran away from the theme of the study. The research was conducted between September 2021 and April 2022. Figure 1 shows the flowchart evidencing the inclusion and exclusion steps by title, abstract, and full article.

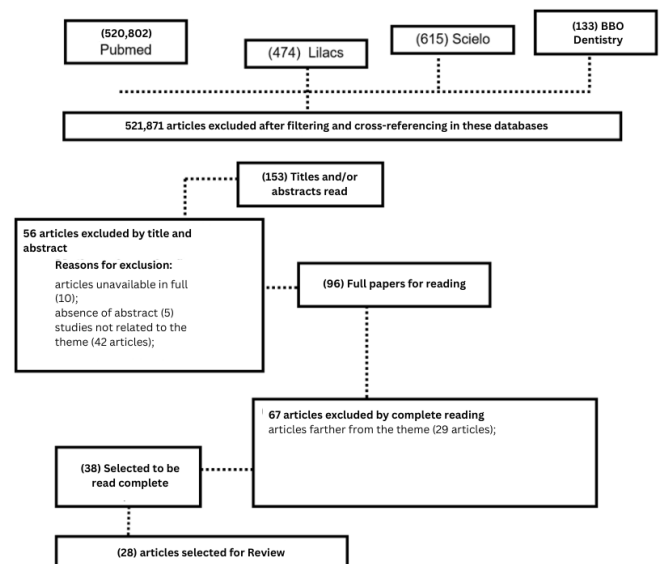


Figure 1 - Flowchart showing the inclusion and exclusion steps by title, abstract and full article

During the study, 28 articles were selected from all the cited inclusion and exclusion criteria (Table 1). Ageusia, anosmia, oropharyngeal inflammation, oral candidiasis (due to the lowered immunity of the affected individual), oral ulcerations, retromandibular edema and xerostomia were the most frequently reported manifestations in the

presented studies. In contrast, halitosis and metallic taste sensation were reported in a more individualized way. The manifestations found were limited to the oral cavity, oropharynx and retromandibular region. Ageusia is an unequivocal symptom in the papers. The most discussed hypothesis is about the loss of taste and smell.

**TABLE 1 - WORKS INCLUDED IN THE INTEGRATIVE REVIEW**

Title	Author	Year/Country	Study Design	Outcomes
Oral Manifestations Associated With Covid-19 disease: an observational cross sectional study.	CHAWLA, Jitendra. et al.	2022/India	Cross-sectional observational	Xerostomia and ageusia can be used as indicators to identify suspected Covid-19 disease while intraoral signs such as ulcers need further evaluation.
Orofacial mycoses in coronavirus disease-2019 (Covid-19): A systematic review	SAMARANAYAKE LP, et al.	2022/China	Systematic review	Patients with SARS-CoV-2 are more susceptible to fungal infections.
The impact of Covid-19 on the oral health of patients with special needs	ETTINGER R., et al.	2022/USA	Systematic review	The burden of oral health problems during the Covid-19 crisis was most intense for people with special needs or residents of long-stay institutions.
An integrative review of oral manifestations in patients with Covid-19: signs directly related to SARS-CoV-2 infection or secondary findings?	REIS VP., et al.	2022/Brazil	Integrative review	Healthcare professionals should be aware of care related to oral symptoms and, whenever possible, patients with Covid-19 should undergo an intraoral examination
Oral manifestations of Covid-19: a brief review of the literature	SANTOS, Serenna Viana dos et al.	2021/Brazil	Literature review	Traumatic ulcers, taste changes, periodontitis, reduced salivary flow, are common in patients with Covid-19.
Oral and cutaneous manifestations of Covid-19 in pediatric patients.	MORAIS, Mayara Faria de et al.	2021/Brazil	Literature review	Taste dysfunction is what stands out the most.
Role of oral tissues during SARS-CoV-2 infection.	LÓPEZ, Luis Ángel Ortiz et al.	2021/Mexico	Literature review	Ageusia is the most present symptom.
Prevalence of oral lesions in Covid-19 Egyptian patients	ELAMROUSY W, et al.	2021/Egypt	Observational Cross-Sectional	Systemic health and disease severity were not related to the spread of oral lesions
A german awmf's s2e/realist synthesis and meta-narrative snapshot of craniomaxillofacial manifestations in Covid-19 patients: rapid living update on 1 january 2021	PITAK-ARNNOP, Poramate et al.	2021/Germany	Metanarrative	Some complications, such as extensive infections during corticosteroid therapy, have a prolonged relieve due to long-term ventilator dependence.
Tongue ulcer in a patient with Covid-19: a case presentation.	NEJABI, Bashir M et al.	2021/China	Literature review	To avoid positive Covid-19 results, awareness programs for diagnosis and management of clinical symptoms should be implemented among patients.
Is SARS-CoV-2 an etiologic agent or predisposing factor for oral lesions in Covid-19 patients? A concise review of reported cases in the literature.	ETEMAD-MOGHADAM S, et al.	2021/Iran	Literature review	Observing oral lesions similar to those reported in Covid-19 patients can neither confirm nor rule out the disease without additional testing.

Characteristics of oral manifestations in symptomatic non-hospitalized Covid-19 patients: a cross-sectional study on a sample of the Saudi population.	NATTO, Zuhair S et al.	2021/Saudi Arabia	Cross-sectional Study	Taste loss was the most prevalent specific oral manifestation. It was suggested that oral examinations of patients with Covid-19 should be performed as part of routine examinations to discover any correlation between the disease and the oral cavity.
Oral and maxillofacial implications of Covid-19: an integrative review.	AMANCIO, A DE M et al.	2021/Brazil	Integrative Review	Clinical orofacial signs and symptoms may be the first to appear in patients contaminated with Covid-19 and may be important in diagnosing the infection. In addition to oral and maxillofacial clinical manifestations, however, the disease also presents systemic manifestations
Oral health conditions in people with Covid-19.	BRAGA, Débora R Alves et al.	2021/Brazil	Cross-Sectional Study	Usually, people who have a severe degree of the disease are more likely to trigger oral changes.
An s2e/realistic synthesis from the German awmf and a metanarrative snapshot of a skull-maxillofacial manifestations in patients with Covid-19: rapid life update on 1 January 2021.	PITAK-ARNNOP P. et al.	2021/Germany	Metanarrative	In addition to taste and smell dysfunctions, some nonspecific lesions such as aphthae, erythema/petechiae, fungal superinfections, conjunctivitis, necrosis, can be seen, but often treated conservatively.
Halitosis in Covid-19 patients.	RIAD A, et al.	2021/Czech Republic	Cross-Sectional Observational	The prevalence of halitosis among patients with Covid-19 and possible etiologies that can be linked directly or indirectly to SARS-CoV-2 indirectly, to SARS-CoV-2 infection.
Oral manifestations in patients with Covid-19: a 6-month update.	SANTOS, J. Amorim et al.	2021/Brazil	Systematic Review	Xerostomia is the most frequent oral symptom, with a prevalence of 43%, followed by taste disturbances (38%).
Oral ulceration and blistering in patients with Covid-19.	SINADINOS A, et al.	2021/England	Case Report	The authors suggest a link between Covid-19 and oral ulceration and blisters, but acknowledge that these signs can often go unnoticed due to lack of intraoral examination during hospital admission.
Signs and symptoms of oral and cutaneous manifestations in children with Covid-19: a narrative review.	TAVARES, Nathália Cristina dos Santos Araujo, et al.	2021/Brazil	Narrative Review	The signs and symptoms in children with Covid-19 have some peculiarities when compared to adults.
Oral and maxillofacial manifestations associated with Covid-19. Literature review.	PARRA-SANABRIA, Erika Alexandra et al.	2020/Argentina	Literature Review	The most frequent oral and maxillofacial manifestations in Covid-19 patients are retromandibular edema and ulcers.
Apthous-like stomatitis of Covid-19 patients: case report and review of evidence.	AL-KHANATI, Nuraldeen Maher et al.	2020/Brazil	Case Report And Systematic Review	Apthous stomatitis is a predictable and clinically relevant oral complication in patients with Covid-19.
General information, management, care and clinical manifestations of SARS-CoV-2.	ORELLANA-CENTENO, José Eduardo et al.	2020/Mexico	Literature Review	Clinical manifestations General: fever, dry cough, feeling short of breath and breathlessness, fatigue, muscle pain, headache, sore throat, confusion, diarrhea, vomiting. Oral: ageusia, shortness of breath, and dry mouth.
Pandemic: oral repercussions and its possible impact on oral health.	MACIEL, Panmella Pereira et al.	2020/Brazil	Literature Review	Oral manifestations including dental anomalies, can occur as a direct result of SARS-CoV- infection. 2.
Orofacial manifestations of Covid-19: a brief review of the published literature.	HALBOUB, Esam et al.	2020/Brazil	Literature Review	Oral and maxillofacial surgeons are one of the groups of healthcare professionals with a high risk of nosocomial infection.

Management of patients in oral and maxillofacial surgery during the crisis and post-pandemic control period of the Covid-19 pandemic.	GIL, Monje Florencio et al.	2020/Spain	Literature Review	Oral and maxillofacial surgeons are one of the groups of healthcare professionals with a high risk of nosocomial infection.
Oral manifestations in patients with Covid-19: a living systematic review.	SANTOS, J. Amorim et al.	2020/Brazil	Literature Review	Taste disorders are associated with Covid-19 positivity, mild/moderate severity, and female gender.
Oral manifestations of Covid-19 patients: an online survey of the egyptian population.	KADY, Dina M. El et al.	2020/Egypt	Literature Review	Covid-19 has significant consequences for the oral cavity and salivary glands, such as gland-related salivary symptoms and taste disturbances.
How to deal with coronavirus disease 2019: a comprehensive narrative review about oral involvement of the disease.	CAPOCASALE, Giorgia et al.	2020/Italy	Literature Review	Recognizing and detecting some oral signs and symptoms of Covid-19 can make it easier to perform better screening and follow up with early treatment to the manifestations of the disease.

## DISCUSSION

The results show that SARS-CoV-2 is stored mainly in oral tissues in the initial phase of contamination. Some structures, such as the tongue, salivary glands and gingival epithelium, become means of propagation of high viral load by the distribution of salivary flow. Thus, besides the oral cavity being the main means of propagation, it also becomes one of the foci of clinical manifestations during the evolution of the disease. Studies confirm the presence of SARS-CoV-2 in saliva, in the ducts of the glands that produce it, in the fluid of the gingival crevices, and in secretions of the upper and lower respiratory tract. The oral and oropharyngeal microbiota are similar to those of the respiratory tract, which facilitates virus adhesion in these regions specifically (6, 11).

The high viral load in saliva is detected early in the infection, this may account for the presence of anosmia and ageusia reported as early symptoms in most studies. The rate decreases along with the disease over time, suggesting that salivary clearance of the virus correlates with disease manifestation. SARS-CoV-2 is predominantly lodged in the nasal, buccal, and pharyngeal mucosa during the first 10 days of infection, evolving later to the lungs. The peripheral nervous system is affected by the virus, and since taste buds are innervated by cranial nerves, related functions can be impaired, resulting in taste disturbances that can last for about 10 days (2, 12).

The scientific evidence shows that the manifestations frequently found among symptomatic patients are cough, dyspnea, vomiting, pharyngeal pain, chills, glossitis, candidiasis, ageusia, anosmia, xerostomia, salivary gland infections, changes in the oral mucosa with presentation of erythematous

lesions, ulcers and enanthema buccalis which are small eruptions on the oral mucosa, mainly on the palate - numerous petechiae (13, 14). Moreover, the literature shows cases of gingivitis, halitosis, hairy tongue, lingual ulceration, dry lips, and dental anomalies (4, 15,16), aphtous lesions, papillar areas of the tongue with abnormal papillary growth - accompanied by pain and a burning sensation - and absence of smell and taste (1,17). Most oral lesions were on the palate, followed by gingival, labial, jugal and specialized mucosa and facial region. Due to salivary gland infections, the appearance of retromandibular edema usually caused by acute periodontal lesions has also been reported (1,17).

The symptoms sporadically found are maxillofacial manifestations such as: facial weakness, retroauricular pain and sialoadenitis. Increase in retromandibular volume, pain when eating and erythema (15,18). Among the relevant oral symptoms related to Covid-19, ageusia is an unequivocal symptom in the papers, resulting from the mentioned pathology. The most discussed hypothesis in the literature about taste loss is about the ACE2 receptors, which are in great quantity on the lingual surface. It was evidenced by Santos *et al.* that the virus interacts directly with these receptors and taste components by interfering with the sialic acid that is responsible for protecting the glycoproteins that carry the taste molecules to the taste bud, causing the disorder (19-20).

It had been quoted that a 42-year-old man reported feeling metallic taste. Recovery of taste after illness may be associated with regeneration of the cells or reversal of the effects on them (2, 17). Other reactions, such as gingivitis, halitosis, hairy tongue, lingual ulceration, and dry lips, have also been cited, but may be associated with the side effects of the Covid-19 treatment itself and the

difficulty of oral hygiene in more advanced cases, which highlights the need for expanded application of hospital dentistry during treatment. Braga *et al.* stated in a cross-sectional study that there are some exceptions, since some patients contaminated with Covid-19 considered severe did not trigger any oral signs and symptoms though (4, 15, 21).

Oral candidiasis was one of the most frequently detected oral manifestations in several reported cases. This can be attributed to the drop in immunity, opportunistic fungal and bacterial infections, antibiotic therapy, and long-term deterioration of oral hygiene. This can be explained by the misused antibiotics during Covid-19 contamination significantly affecting the microbial balance and also be related to candida infection (22, 23).

Among the maxillofacial manifestations, facial weakness, retroauricular pain, and sialoadenitis can be cited. Sialoadenitis is an inflammation in the salivary glands of infectious or non-infectious origin and may be caused by SARS-CoV-2 due to the superficial composition of the glandular cells (they have ECA2: transmembrane protein that may suffer inflammation and, later, repair by fibrosis) with direct impact on the salivary flow. Increased retromandibular volume, pain when eating, erythema, fever and dry mouth are some of the signs and symptoms of this pathology. In case of hyposalivation, there may be an increased risk of salt deposition on the ductal wall that induces sialolithiasis and contributes to duct stenosis and dilatation (17, 19).

Acute periodontal lesions were also found in abnormally high numbers in patients diagnosed with SARS-CoV-2, the main cause of retromandibular edema. This is mainly due to the biological storage potential of the periodontal pocket and the side effects of the medications used to treat the disease. The periodontal pocket is a reservoir for viruses because it provides a suitable environment for their multiplication, since the cells have receptors compatible with these viruses in their membrane, so it may also be related to the deposition of SARS-CoV-2. Many lesions started as simple gingivitis and evolved into necrotizing ulcerative gingivitis (24,25).

There is the possibility of worsening the symptoms of the disease by the presence of previously installed periodontitis, which can exacerbate the inflammatory reaction in the bloodstream, and may exert negative effects on other parts of the body. In constant metagenomic analyses of infected patients, there is detection of a high number of anaerobic bacteria such as *Prevotella intermedia*, *Streptococci*, *Fusobacterium*, *Treponema*, and *Veillonella*, which precipitate the appearance of necrotizing periodontitis. Another

important factor is the ability of periodontal bacteria to increase the virulence of the virus by cleavage of S-glycoproteins, since the pocket is a viral reservoir and shows greater potential for contamination during subgingival scaling. In addition, periodontitis is a risk factor for patients affected by Covid-19 by increasing the risk of mortality (26).

The oral microbiota plays a key role in the development of co-infections following infection with this virus, as well as in the immune response that is triggered by viral contamination. In this sense, the oral and maxillofacial clinical signs in patients with Covid-19, as discussed here, provide a significant picture of the impact that SARS-CoV-2 can have on an individual's oral and systemic health. It is possible to verify the essential role of the diagnosis of the oral cavity in all stages of the virus adhesion to the human body, evidencing that both primary care and attention to the central gateway of contamination is essential in the evolution of the control and eradication of the disease (3, 27, 28). Furthermore, it was observed that the intensity of oral health problems during the Covid-19 crisis was greater in people with special needs or residents of long-stay institutions (29).

It is recommended that health professionals perform a detailed oral examination and pay attention to oral manifestations to ensure better patient support and control of manifested symptoms. In oral and maxillofacial surgeries, for example, there is a great exposure and release of oral and body fluids and aerosols. There must be a selection and prioritization of indispensable procedures to be performed and with operative techniques to avoid contagiousness in advanced levels (12, 30).

This integrative literature review integrates four databases (Lilacs, Scielo, BBO Dentistry and PUBMED), with articles published from 2019 - year of the emergence of Covid-19 - until April 2022. The consensus on clinical manifestations has not yet been done due to the widely mutating nature of the virus and, because of its uniqueness, this study presented limitations in the number of samples available during the search. The perspective is that with the detailed, unified, and complete evidence of all the oral and maxillofacial clinical manifestations resulting from contamination by Covid-19, the scientific community will be able to reach a consensus that will be efficient in defining strategies to fight the disease worldwide.

## CONCLUSION

Patients contaminated with Covid-19 reported cough, oropharyngeal pain, ageusia, anosmia, xerostomia, salivary gland infections, erythematous lesions, ulcers, blisters, metallic taste, halitosis, glossitis, facial weakness, and oral candidiasis. Ageusia and anosmia were the oral



and maxillofacial clinical manifestations most often cited in this integrative literature review and may be important symptoms for screening and early diagnosis of patients with Covid-19.

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