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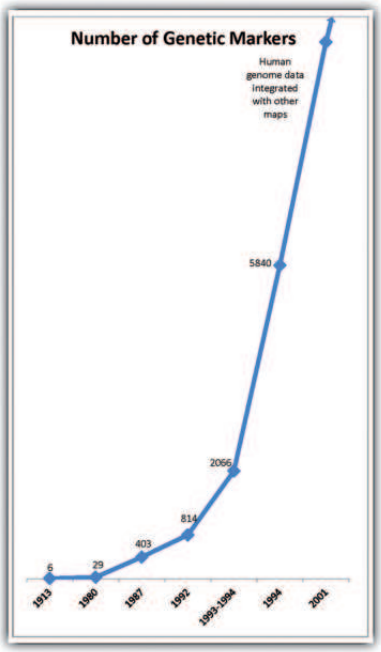
HUMAN MOLECULAR GENETICS AND ITS IMPACT ON DENTISTRY



The genetics field came a long way in regards to utilizing genetic variation to identify linkage between specific loci and phenotypes. From the first suggestion that linkage could be used to physically locate genes in chromosomes in 1911 to genome wide genotyping scans utilizing array-base devices with more than one million single nucleotide polymorphisms (Figure 1),[1-5] fulfilling the promise to utilize genomic approaches to clinically manage patients is upon us.

The first concrete step in dentistry has been the ability of predicting treatment responses for head and neck squamous cell carcinomas. Cetuximab, a monoclonal antibody against the epidermal growth factor receptor (EGFR), was approved in the United States in 2006 as the first molecular targeted therapy for head and neck squamous cell carcinoma. Cetuximab in conjunction with radiotherapy significantly improved survival in 5 years by 9% (from 36.4% to 45.6%).[6,7] EGFR is bound by mainly EGR or transforming growth factor alpha (TGFA), which promotes dimerization with other molecules, which will activate an intracellular signaling pathway that leads to apoptosis, activation of cell proliferation and angiogenesis, and increased metastatic spread potential.[8]

There have been signs that genomic information may be helpful for other areas of dentistry as well. Of the interest of the orthodontist, the genetic variant rs10850110 in the myosin 1H gene is a potential marker for the genetic susceptibility to class III malocclusion with mandibular prognathism.[9,10]

For the general dentist, the genetic variant rs1784418 in *MMP20* (metalloproteinase 20) appears to be a protecting factor against dental caries.[11] Another promising genetic variant regarding individual risk for higher caries experience is the *ESRRB* (estrogen related receptor beta) rs1676303. Interestingly, *ESRRB* recessive mutations cause a form of hearing imparment.[12] Another interesting finding for the general dentist and potentially the endodontist is that the assessment of the *MMP2* rs9923304 genetic variant may be useful to predict the more likely need for endodontic treatment and formation of periapical lesions when individuals have untreated deep lesions in dentin or the more likely loss of an extensive dental composite resin restoration.[13,14]

Finally, insurance claims data regarding individual preventive visits and their tooth losses (the ultimate consequence of dental caries and/or periodontal diseases) showed that individuals classified as low risk based on smoking, diabetes, and interleukin 1 genotype statuses did not benefit from additional preventive dental visits when tooth loss was measured.[15] We performed a similar experiment adding high blood pressure as an additional risk factor for tooth loss, and showed that a portion of the population that "tests" positive for a higher risk for tooth loss based on smoking and diabetes statuses, blood pressure levels, and interleukin 1 genotypes should visit the dentist more often, potentially as much as four to six times per year.[16]

These developments call for a better preparation of the dental professional to a dentistry that incorporates molecular approaches to diagnose and treat oral and dental disease. It is coming the time when gene therapy for radiation-induced hyposalivation will be a reality. Patients that survived head and neck cancer radiation therapy and lost their salivary gland functionality showed signs of salivation after adenoviral-mediated transfer of the aquaporin 1 gene.[17] Remarkable is that this effect appears to last for a few years.[18] Similarly, after more than a decade of animal studies, patients born with the X-linked form of hypohidrotic ectodermal dysplasia may benefit from a single course of an ectodysplasin protein replacement to rescue and permanently correct the ectodermal defects (tooth agenesis, abnormally conical teeth, dysplastic nails, sparse hair, lack of sweat glands) present in this syndrome.[19]

There has been the suggestion that dentists and dental hygienists need to learn human molecular genetics and clinical research in general.[20] How the professionals in the future can quickly translate the growing knowledge of genomics and translational research into their practices? Although the answer for this question may not be obvious, if the dentist does not proactively embrace the era in which decisions are based on genomic information and therapies include gene and protein replacement, some other professional (likely a physician) will be performing these procedures.

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THE UNFORTUNATE FASHION OF "ORTHO OSTENTATION"



In the middle of 2010, a new musical style was born in Brazil called "FUNK OSTENTATION", a style that spread rapidly through the peripheries of the big cities, imposing a new way of thinking, acting and dressing the young people. The central themes addressed in the songs of "FUNK OSTENTATION " refer to the consumption and the proper ostentation, where most of the representatives try to sing about cars, motorcycles, drinks and other values, as well as making frequent quotations to women and how they achieved a greater power of material goods, exalting the ambition to leave the favela and achieve the objectives. You who read this text may be wondering what is the "FUNK OSTENTATION " with Dentistry, since this magazine is dedicated to dental matters? The way it is, sadly, Dentistry more specifically Orthodontics has been suffering a hard blow in the present time to be associated with the said "FUNK OSTENTATION". Practitioners of this fashion in addition to as displaying gaudy clothes, gold chains and tattoos also show "personalized" orthodontic appliances according to them. So far so good, since a significant portion of the population has orthodontic needs. However the way that Orthodontics is being practiced is what frightens them. Orthodontic brackets are being glued to the teeth by the youngsters themselves using cyanoacrylate glue (Superbonder, São Paulo, Brasil) and the styling of the device is performed with colored broom bristles associated with chain elastics directly to the brackets without any orthodontic arch (Figure 1). Not to mention that all this process is being done without professional guidance. The risks to the patient are enormous and can range from a simple allergic reaction to those materials that were not developed for such a function, besides tooth movement to undesired positions with consequent bone loss that could progress to tooth loss. But who could take the blame? It is worth noting that in Brazil there is no specific legislation for the purchase of dental materials and equipment, which can be acquired by any individual and anywhere. Nowadays it is not new for anyone to walk through the center of big cities and come across street vendors selling brackets and colorful orthodontic elastics. In developed countries legislation makes it difficult to sell material even to foreign orthodontists. It is necessary that measures are taken as soon as possible so that this fashion ends and our Dentistry is respected. The Federal Council of Dentistry (CFO) has worked hard to supervise clandestine practice of the profession, but situations such as this one of "ORTO OSTENTATION " is out of place because it is not carried out by professionals, but rather by clandestine ones. Our role as an orthodontist is fundamental for clarifying the population about the risks involved in this practice.

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ORAL HEALTH AND SELF-CARE IN ADOLESCENTS FROM DIFFERENT BRAZILIAN REGIONS

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Palavras-chave: Adolescentes. Autocuidado. Saúde Bucal. Cárie Dentária. Prevalência.

RESUMO

Introdução: Adolescentes apresentam potencial risco para o desenvolvimento das doenças cárie e periodontal. **Objetivo**: O objetivo do presente estudo foi revisar, na literatura, dados acerca da saúde oral de adolescentes brasileiros através da prevalência ou presença de cárie e sangramento gengival, como indicadores indiretos (consequências), e frequências de escovação dentária, uso de fio dental e visita odontológica como indicadores diretos de autocuidado oral. **Fontes dos dados**: Utilizou-se a estratégia de busca ((adolescent AND oral health) AND Brazil*) nas bases de dados PubMed e LILACS. Os artigos publicados entre setembro 2012-2017 que apresentaram dados de ao menos um dos indicadores de saúde oral e autocuidado em adolescentes brasileiros, foram incluídos nesta revisão. As características dos estudos e os dados obtidos foram apresentados de forma descritiva. **Síntese dos dados**: Foram recuperados nas bases de dados PubMed e LILACS 837 e 1375 artigos, respectivamente. Após a aplicação dos critérios de inclusão e exclusão, 10 artigos foram incluídos. A maioria dos estudos incluiu adolescentes entre 15 e 19 anos, com relato de atendimento odontológico realizado em menos de 1 ano antes da entrevista, sendo a cárie a alteração bucal mais prevalente. **Conclusão**: Dentro das limitações do presente estudo, de acordo com os dados obtidos através dos indicadores de autocuidado pesquisados, os adolescentes brasileiros mostraram cárie como o agravo observado mais prevalente; as frequências de escovação e uso de fio dental variaram na região Sul; e relataram atendimento odontológico no período inferior a um ano da entrevista.

Keywords: Adolescents. Self-care. Oral Health. Dental Caries. Prevalence.

ABSTRACT

Introduction: Adolescents present a potential risk for the development of caries and periodontal diseases. **Objective**: The objective of the study was to conduct a literature review on the oral health of Brazilian adolescents through the prevalence or presence of caries and gingival bleeding, as indirect indicators (consequences), and frequency of toothbrushing, flossing, and dental visits as direct indicators of oral self-care. **Sources of data**: A search strategy (adolescent AND oral health) AND Brazil* was used in the PubMed and LILACS databases. Articles published between September 2012 and September 2017 that presented at least one of the indicators on oral health and self-care of Brazilian adolescents were included in this review. **Synthesis of data**: A total of 837 and 1,375 articles were retrieved from the PubMed and LILACS databases, respectively. After applying the inclusion and exclusion criteria, 10 papers were included. The characteristics of the studies and the data regarding self-care and oral health of the adolescents were presented descriptively. Most of the studies included adolescents between the ages of 15 and 19 years, and caries was the most prevalent oral alteration, with reporting of dental care performed less than one year before the interview. **Conclusion**: Within the limitation of the present study, according to data obtained by the indicators of self-care, Brazilian adolescents showed caries as the most prevalent alteration observed and the frequency of toothbrushing and flossing varied within the southern region; reports showed that dental care had been received less than one year before the interview.

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INTRODUCTION

Changes. Impulses. Personal maturation. Adolescence encompasses a series of transformations that make the individuals living in this period unique. According to the World Health Organization (WHO),[1] the period of adolescence ranges from 10 to 24 years, with three 5-year subdivisions. However, there are other age group definitions, such as those from the United Nations (UN),[2] as individuals 15 to 24 years, and from Brazil; according to the ECA (Estatuto da Criança e do Adolescente),[3] adolescents include individuals between 12 and 18 years of age.

Due to their unique behavior, adolescents present a potential risk for the development of caries and periodontal diseases.[4] Considering the oral health of adolescents in Brazil, the last national epidemiological survey (SB Brasil 2010, Ministério da Saúde, Brasil, 2012)[5] revealed a worsening in dental conditions in the period of adolescence, compared to childhood. At 5 years of age, 46.6% of children were caries free; at 12 years, 43.5%; while with those 15–19 only 23.9% were free from the disease.

In attempting to reduce caries prevalence, oral health promotion encourages the establishment of healthy habits, such as brushing with fluoride toothpaste twice daily.[6] Self-care is considered as the performance of activities or tasks usually performed by health professionals, including the care of oneself or one's family or friends. Based on this concept, we considered indexes of caries prevalence and periodontal alterations as indirect indicators of oral self-care, while the frequency of toothbrushing, dental flossing, and dental visits were considered as direct indicators of self-care. We hypothesized that Brazilian adolescents had low frequencies of toothbrushing, flossing, and dental visits.

Therefore, the objective of the study was to review data on the oral health of Brazilian adolescents through the prevalence or presence of caries and gingival bleeding, as indirect indicators (consequences), and the frequency of toothbrushing, flossing, and dental visits as direct indicators of oral self-care.

Study design

Electronic searches up to September 2017 were conducted using the PubMed and LILACS electronic bibliography databases. The searched terms were "adolescent," "oral health," and "Brazil," limited to the title and abstract fields. The search strategy used was ((adolescent AND oral health) AND Brazil*). A 5-year publication filter was applied. Titles and abstracts and, when needed, results and full text of the retrieved papers were read and evaluated independently by the two review authors (DCN, LF) for the identification of eligible studies. According to the inclusion criteria, the selected papers were published between September 2012 and September 2017 and presented data concerning at least one of the direct or indirect indicators of oral health and self-care in adolescents with ages ranging from 10 to 19 years in Brazil. The indicators were: frequency of toothbrushing, use of dental floss, and dental visits; gingival bleeding, prevalence of dental caries (DMFT), or presence of caries. The exclusion criteria were: theses, dissertations, and studies that did not separate age groups and included individuals younger than 10 or older than 19 years, a well as those that considered pregnant adolescents, patients with special need care, and systemic diseases or syndromes.

The characteristics of the selected studies and the reported data are presented descriptively.

Synthesis of data

Initially, 837 and 1,375 references were retrieved from PubMed and LILACS, respectively. After the application of a 5-year post-publication limit, 380 and 193 papers remained, and based on the inclusion and exclusion criteria, eight studies from PubMed and six studies from LILACS were selected. Following a full reading of the papers, 10 were included in this study. Four papers were excluded: a study that evaluated children from 2 years of age together with adolescents, a study that used the same sample as that of another selected paper, and two studies that showed data from the National Survey in different periods of time.

The majority of the studies included individuals between 15 and 19 years of age.[7-11]

Geographically, considering the distribution of the selected studies among the different regions of the country, half of the studies were conducted in the southern region (n = 5), while in the southeast all three studies were carried out in the state of São Paulo, and in the northeast region only two studies were conducted. There were no studies performed in the north and central west regions with the desired characteristics.

The majority of the participants reported that they had gone to a dental appointment less than a year before the interview.[12-15]

When interviewed regarding the frequency of brushing, most participants reported brushing their teeth at least three times a day in a city in the state of Rio Grande do Sul, in the southern region.[8] On the other hand, in another city in the same region, a lower toothbrushing frequency of less than two times a day was reported.[9] Similarly, positive answers for regular flossing were obtained for the majority of the participants who reported brushing three times daily,[6] and negative answers were obtained for those with lower brushing frequency.[9]

The presence or prevalence of caries was reported in

***Table 1**: Characteristics of the selected studies*

Reference	Geographic Location	Sample size	Oral health evaluation tools	Gender M: male F: female	Age (years)	Dental care frequency	Toothbrushing frequence	Gingival bleeding Y: yes N: no	Tooth loss (%)	DMFT / Presence of caries lesions	Flossing
Cunha et al., 2017	São Paulo (SP)	5,402	DMFT CPI	M: 43.7% F: 56.3%	15-19	-	-	Y: 1,668 (30.8%) N: 3,734 (69.2%)	None: 4,694 More than 1: 708	None: 3.149 At least 1: 2,253 (41.7%)	-
Colussi et al., 2017*	Passo Fundo (RS)	736	Questionnaire (OHIP-14) + Exams/number of teeth	M: 43.9% F: 56.1%	15-19	-	3x a day: 59.2% <3x a day:15.6% >3x a day: 25.2%	-	1 tooth lost: 21.1%	-	Y: 53% N: 47%
Ely et al. 2016	Rio Grande do Sul (RS)	3,531	Questionnaire + Intrabuccal exam	M: 46.1% F: 53.9%	12-19	Never: 4.9% <1 year: 67.4% 1-2 years: 14.7% >3 years: 5.2%	-	Y: 46.5% N: 53.5%	-	DMF = ±2.80	-
Marín et al., 2016	Maringá (PR)	144	Questionnaire	M: 45% F: 55%	Mean 14.6	<1 year: 82%	-	-	-	12.15% Pain/Caries	-
Lyra et al. 2015	Recife (PE)	100	Questionnaire	-	11-15	-	-	-	-	-	2.23 ±1.90
Leão et al., 2015	Pontal do Paranapanema (SP)	180	DMFT CPI + Quetionnaire (WHOQOL-Bref) (OIDP) (GSHS-WHO)	-	10-19	<1 year: 59% 1-2 Years: 32% ≥3 years: 9%	-	Y: 37.2%	-	None: 6.7% DMFT = 5.49 ±3.33	-
Morosini et al., 2014	Curitiba (PR)	102	Intraoral exams	-	15-19	-	-	-	-	Decayed teeth: 282 Missed Teeth by caries: 50 Filled teeth with recurret caries: 18	-
Davoglio et al., 2013*	Gravataí (RS)	1,170	Questionnaire (GSHS-WHO)	M: 47.5% F: 52.5%	15-19	47.9%	>2x a day:30.16% <2x a day: 54.35%	-	-	-	Y: 31.9% N: 68.1%
Batista et al., 2012	São Paulo (SP)	1,824	Interview	M: 40.8% F: 59.2%	15-19	-	-	-	-	No caries: 9.5% DMFT: 6.5	-
Corrêa et al., 2012	Guaiúba (CE)	743	ICSB	M: 41.7% F: 58.3%	10-19	51.8% at the last year	93.4% reported brushing but not the frequency	N = 74 (10%)	-	Presence of caries: (1-2) 301;40% (≥3) 223; 30%	-

CPI – Community Periodontal Index *(evaluation of periodontal conditions: bleeding, dental calculus, and depth of gingival sulcus); DMFT – Index Decayed, Missing, and Filled Teeth (evaluation of caries and tooth loss); GSHS-WHO* Global School-based Health Survey *(evaluation of health access);* ICSB Indicador Comunitário de Saúde Bucal *(oral exam executed by a community oral health agent); OHIP-14* Oral Health Impact Profile – *resumed version (self-perception of health, self-reported oral morbidity, use of dental services, socioeconomics, and demographic issues); OIDP* Oral Impact Daily Performance – *(evaluation of quality of life); WHOQOL-Bref* World Health Organization Quality of Life *shorter version – (evaluation of quality of life); (-) data not reported. * value calculated from reported data*

eight studies.[7,10-16] It was observed that 70% of the sample participants in a city in the northeast region showed one or more lesions of caries[15], while in the southeast, 41.7% presented one caries lesion[7] and the mean DMFT in Pontal do Paranapanema (SP) was 5.49 ± 3.33.[14]

Regarding the presence of gingival bleeding, this periodontal alteration was observed in few of the participants.[7,12,14,15]

The characteristics of the included studies and pertinent data reported are described in Table I.

DISCUSSION

Adolescents require different oral health instructions and dental care, compared to the child and adult population. These developing individuals show increased susceptibility to caries, increased risk for orofacial trauma and periodontal disease, a tendency toward inadequate nutritional habits, greater potential for developing eating disorders, a potential for tobacco/alcohol and drug use, and psychosocial needs specific to age.[4]

Regarding the frequency of dental visits, many adolescents reported that they had dental care less than one year before the interview.[12-15] Based on this result, the hypothesis that Brazilian adolescents would report a low frequency of dental visits was rejected. However, the authors understand that this review included few studies, and none of them provided information on all of the parameters. The authors selected a 5-year post-publication limit for papers to be included in the review, aiming to review the most recent literature about the issue since the results of the National Survey (SB Brasil 2010).[5]

In observing the data for oral health self-care indicators, the authors recommend a standardized data collection methodology for future studies in order to contribute to comparisons of study results. Additionally, the authors observed a lack of studies regarding the oral health of adolescents in the north and central west regions of Brazil, reinforcing the idea of a scarcity of resources and low investment in oral research in these regions. The issue is even more relevant considering the data presented in SBBrasil 2010,[5] because the mean DMFT ranged from 4.02 to 6.76 among different cities of the north and from 3.46 (Federal District) to 6.91 for the cities of the central west regions.[13]

Regarding the prevalence of caries, a decrease was observed in Brazil in recent years.[17] However, it is worth mentioning that adolescents between 15 and 19 years from a rural settlement in Pontal do Paranapanema, SP,[14] showed a higher prevalence of caries (5.49) compared to the national mean of 4.25 and to that observed for adolescents in the city of São Paulo (4.21).[5] The poorer oral conditions could be explained by the fact that adolescents from the settlement faced unequal access to dental health, with the majority reporting that the last dental consultation occurred more than 12 months prior to the interview, carried out by public services, and due to toothache.[14]

Equally, lower-income regions presented lower quality of life related to oral conditions.[6] Oral disorders may negatively affect the quality of life of individuals, or in another words cause concern or modifications for individuals' attitudes. Some of the included studies evaluated the impact of the oral alterations on the quality of life of Brazilian adolescents.[7,8,11,14] Caries,[7,14] periodontal alterations,[7] increased overjet,[7] and halitosis[8] were the oral health factors that caused the most embarrassment among the adolescents and compromised their quality of life. Furthermore, adolescents perceived their quality of oral health mainly through pain and aesthetic conditions of teeth and gingiva.[11]

Although caries has been considered as the most important and prevalent oral health problem, this condition could be preventable by lower consumption of sugar and effective oral hygiene.[6] When asked about the receipt of oral hygiene instructions, 90% of the participants from one study reported that they received such instructions through dentists.[13] However, it is worth to mention that lower reported frequency of toothbrushing and flossing was significantly associated with a higher prevalence of self-reported halitosis among Brazilian adolescents.[8]

There is a consensus in the literature that strategies to promote oral health among adolescents should include instructions on oral self-care through guidance regarding satisfactory dietary habits, toothbrushing with fluoridated toothpaste,[6] and individualized oral hygiene frequency, according to a risk assessment for caries and periodontal diseases.[4,7] Likewise, adolescents should be instructed to use protective equipment in activities of potential risk for trauma. Such guidelines should further strengthen adolescents' autonomy and responsibility for their own oral health.[4,7]

CONCLUSION

Within the limitation of the present study, according to the indirect indicators of self-care in the searched publication databases, it was concluded that Brazilian adolescents showed caries as the most prevalent alteration observed, compared to gingival bleeding. Considering the directed indicators, frequency of toothbrushing and flossing varied within the southern region, while most adolescents reported having received dental care less than one year before the interview.

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LUTING AGENTS DIFFERENTIALLY MODULATE INFLAMMATION AND MATRIX METALLOPROTEINASES IN CONNECTIVE TISSUE

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Palavras-chave: Agentes Cimentantes. Cimentos Resinosos. Cimentos Ionoméricos. Resposta do Tecido Conjuntivo. Metaloproteinases da Matriz.

RESUMO

Objetivo: Avaliar a resposta tecidual e a expressão de metaloproteinases da matriz (MMP) -2 e -9 frente a um cimento resinoso e um cimento ionomérico, após implantação no tecido conjuntivo subcutâneo de camundongos. **Métodos**: O cimento resinoso RelyX™ Unicem (CR; n=30), o cimento ionomérico Ketac™ Cem Easymix (CI; n=30) e tubo de polietileno vazio (controle; n=30) foram implantados no tecido subcutâneo dorsal de camundongos isogênicos BALB/c e os tecidos removidos para análise histológica após 7, 21 e 63 dias. Foram analisadas a resposta celular local, por meio da contagem de células inflamatórias e a espessura da cápsula fibrosa. A expressão de MMP-2 e -9 foi investigada por meio de imunohistoquímica. Os dados foram submetidos à análise estatística (α=5%). **Resultados**: Foi observado que CR induziu uma inflamação leve aos 7 e 21 dias com aumento do número de células inflamatórias aos 63 dias ($p<0,05$). CI induziu uma resposta inflamatória mononuclear mais intensa aos 7 e 21 dias ($p<0,05$), com redução do infiltrado aos 63 dias, semelhante ao observado no controle ($p>0,05$). Em todos os grupos a espessura da cápsula foi considerada fina ($p>0,05$). MMP-2 foi detectada em períodos precoces para CR e CI, com diminuição com o passar do tempo. MMP-9 apresentou um padrão semelhante ao controle para o CI, enquanto para o CR houve aumento com o passar do tempo. **Conclusão**: O cimento resinoso RelyX™ Unicem induziu uma resposta inflamatória e a expressão de MMP-9 mais tardia no tecido conjuntivo subcutâneo que foi diferente da resposta induzida pelo cimento ionomérico Ketac™ Cem Easymix.

Keywords: Luting Agents. Resin Cements. Glass Ionomer Cement. Connective Tissue Response. Matrix Metalloproteinases.

ABSTRACT

Objective: The objective of this study was to evaluate the tissue response and expression of matrix metalloproteinases (MMP)-2 and -9 to resinous and glass ionomer cements in direct contact with the subcutaneous connective tissue. **Methods**: RelyX™ Unicem resinous cement (RC; n=30), Ketac™ Cem Easymix glass ionomer cement (GI; n=30), and polyethylene empty tubes (control; n=30) were implanted in the dorsal subcutaneous tissue of isogenic BALB/c mice, and the tissues were biopsied after 7, 21, and 63 days for histological analysis. The inflammatory cells and fibroblasts were counted, and the fibrous capsule thickness was measured. MMP-2 and MMP-9 expression levels were investigated by immunohistochemistry. Data were analyzed statistically (significance level=5%). **Results**: We found that RC induced a low inflammation at day 7 and 21, which was increased at day 63 ($p<0.05$). GI induced a more intense mononuclear inflammatory response at day 7 and 21 ($p<0.05$), which was reduced at day 63 to levels similar to the control ($p>0.05$). The fibrous capsule thickness was thin for RC, GI, and control ($p>0.05$). MMP-2 was detected early for GI and RC and decreased afterwards. MMP-9 presented a similar pattern for GI, whereas the MMP-9 expression was late for RC. **Conclusion**: Resinous cement RelyX™ Unicem induced an inflammatory response and late MMP-9 expression in the subcutaneous connective tissue that was different from that induced by Ketac™ Cem Easymix glass ionomer cement.

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INTRODUCTION

Glass ionomer and resin cements are widely used for cementation of indirect restorations. Studies have shown that glass ionomer cement causes low irritation when applied near the pulp,[1-3] allowing it to be used as a restorative material without requiring the use of a cavity base.[4] *In vitro* studies revealed that Ketac™ Cem presents low cytotoxicity and it is not genotoxic,[5] although moderate inflammatory responses in the pulp have been reported *in vivo*.[6] Resin-modified glass ionomer, on the other hand, induces severe inflammation and large areas of tissue necrosis when directly applied as a pulp capping agent.[7]

The resinous cement RelyX™ Unicem induces a slight reduction in cell viability *in vitro.*[8] *In vivo,* when applied to the dentin after indirect pulp capping, RelyX™ Unicem caused minimal inflammation,[9,10] resulting in a small amount of tissue disorganization. In contrast, there was a severe inflammatory response when it was accidentally exposed to the pulp,[9] demonstrating that the material is unsatisfactory for direct contact with connective tissue. Usually, teeth prepared to receive total crowns present extensive decay and luting agents are applied nearly to the dental pulp. Because dentin and pulp are closely related tissues,[11] materials applied to the dentin might diffuse through pulpal tissue and induce inflammatory response. For that reason, the mechanisms involved in the tissue disorganization and inflammatory response induced by glass ionomer and resin cements should be further investigated.

Proteases responsible for extracellular matrix degradation, such as matrix metalloproteinases (MMPs), are involved in the connective tissue breakdown.[12] Previous studies have demonstrated that MMP-9 can be detected in teeth with pulp inflammation[13,14] and that the collagenolytic activity was increased in the dentin-pulp complex after an application of self-curing dental adhesives.[15,16] Additionally, dental pulp cells that were stimulated with tumor necrosis factor-α (TNF-α) expressed MMP-1, -2, and -13, demonstrating their importance during pro-inflammatory events.[17] However, the effect of direct contact between glass ionomer- or resin-based cements and the connective tissue on the *in vivo* MMP expression has not been investigated.

Therefore, the aim of this research was to study the histopathological tissue response and the matrix metalloproteinase-2 and -9 expression patterns resulting from two cements, one glass ionomer-based and the other resin-based, applied to the subcutaneous connective tissue in mice.

MATERIALS AND METHODS

All animal procedures were performed according to the protocols reviewed and approved by the Animal Care Committee of the University of Sao Paulo in compliance with the applicable ethical guidelines and regulations of the international guiding principles for biomedical research involving animals (#11.1.540.53.9).

Subcutaneous Connective Tissue Implantation in Isogenic Mice

Ninety isogenic male BALB/c mice, which were 6-8 weeks old and weighed 18-20 g, were obtained from the central vivarium of the University of São Paulo. Polyethylene tubes, measuring 1 cm in length and 2 mm in diameter, were sterilized using ethylene oxide and then filled with the materials to be tested. One end of the tube was closed with heated clinical tweezers. Dental materials were prepared according to the manufacturers' instructions under aseptic conditions and immediately prior to their implantation in the dorsal region. For the RelyX™ Unicem cement group, the material was added to the polyethylene tube and then photopolymerized for 20 seconds at 450 mW/cm^2, as measured with a curing radiometer (Ultralux; Dabi Atlante, Ribeirão Preto, Brazil).

The animals were anesthetized by an intramuscular injection of 10% ketamine chlorhydrate (100 mg/kg; Agener União Química Farmacêutica Nacional S/A, Embu-Guaçu, Brazil) and xylazine (10 mg/kg; Dopaser, Laboratórios Calier S/A, Barcelona, Spain) into their hind flank. Next, trichotomy was performed on the animal's dorsal region with a razor, and 1% chlorhexidine digluconate was used for antisepsis. The surgical procedure consisted of a 1-cm incision on the dorsal region, which was followed by divulsion using Kelly forceps.

Each animal was implanted with a polyethylene tube in its dorsal region containing the following compounds: Group 1 (experimental; 30 animals) - the glass ionomer cement Ketac™ Cem Easymix (3M ESPE, Seefeld, Germany); Group 2 (experimental; 30 animals) - the resin cement RelyX™ Unicem (3M ESPE, Seefeld, Germany); and Group 3 (control; 30 animals) - an empty polyethylene tube. The animals were randomly allocated to the groups, the operator was blind to experimental procedure and sample size was determined in a pilot study as recommended by ISO 10993-6: 2007.[18]

After positioning the tube in the connective tissue, the skin was sutured with silk thread (Ethicon, Johnson & Johnson, USA). The surgery was performed under aseptic conditions while aiming to minimize the trauma to the implant area. The animals were maintained and fed *ad libitum* in the vivarium during the experimental periods and periodically observed for local, systemic, and behavioral abnormalities.

Euthanasia, biopsy, and histological evaluation

At the end of each experimental period (7, 21, and 63 days), 10 animals from each group were randomly selected and anesthetized for careful removal of the implant together with the surrounding tissues (skin and connective tissue). Next, the animals were euthanized by means of an anesthesia overdose. The excised tissue was fixed in a 10% formaldehyde solution for 36 hours and submitted to routine histological processing. After embedding the specimens in paraffin, serial 5-micrometer thick sections were made parallel to the tube axis and were stained with hematoxylin and eosin or with Brown and Brenn for bacterial detection.

A blinded histological evaluation was performed using a

Zeiss Axio Imager M1 binocular light microscope (Upright microscope; Carl Zeiss AG, Göttingen, Germany) with 5, 10, 20, 40, 63, and 100x magnification. The intra-examiner calibration showed a kappa index of 0.83 in the pilot study. The number of inflammatory cells [both mononuclear and polymorphonuclear (PMN) cells] and fibroblasts were counted using the 63x magnification for 3 fields near the open end of the tube as follows: the center of the tube, 250 µm to the right of the tube center, and 250 µm to the left of the tube center. The global inflammatory cell counts were accomplished by video microscopy using the ImageJ 1.42q cell counter tool (National Institutes of Health, Bethesda, MD, USA) and an AxioCam MRc5 video camera (Carl Zeiss AG). The thickness of the fibrous capsule was measured (in micrometers) in images of 3 regions of each section at 5x magnification. Three sections were used per specimen.

Dichotomic data were analyzed by means of a Fisher's exact test. Continuous data were analyzed with a 2-way analysis of variance, which was followed by a Bonferroni multiple comparison post-hoc test (significance level= 5%).

Immunohistochemistry

The Goat ImmunoCruz™ assay (Santa Cruz Biotechnology Inc., La Jolla, CA, USA) was used for the immunohistochemical analyses. Briefly, tissue sections were quenched in peroxidase buffer for 5 min, and antigen retrieval performed by boiling sections in 10 mM sodium citrate (pH 6.0) at 93ºC for 10 min. Nonspecific binding was blocked by treating the sections with donkey serum blocker for 30 min. Next, the sections were incubated for 1 hr with primary antibodies for MMP-2 (5.0 µg/ml; Santa Cruz Biotechnology Inc., sc-8835) or MMP-9 (5.0 µg/ml; Santa Cruz Biotechnology Inc., sc-6840). Then, the sections were incubated with an anti-goat secondary antibody for 30 min, which was followed by streptavidin-conjugated horseradish peroxidase for 20 min with 3,3'-Diaminobenzidine as the enzyme substrate for 5 min. The tissues were counterstained with Harris's hematoxylin and mounted using standard protocols. Negative controls consisted of replacing the primary antibody with goat IgG. Microscopic analysis was performed to evaluate the presence or absence of positively labeled cells and the location of the staining, using the Zeiss Axio Imager M1 binocular light microscope with the 20, 40, 63, and 100x magnification.

RESULTS

Histological analysis

Two specimens from the 21-day samples and 2 from the 63-day samples of the resinous cement were lost during the histological processing. Two specimens were lost from the empty tube (control) group from each experimental time point. No specimens from the glass ionomer cement group were lost.

A comparison of the glass ionomer cement group with the control (empty tube) group showed that the cellular response induced by glass ionomer cement was more intense than by the control tubes at days 7 and 21, as a higher percentage of mononuclear and PMN cells were observed at day 7 ($p<0.05$), and more mononuclear cells were observed at day 21 ($p<0.05$). A higher percentage of fibroblasts was observed in the control group at day 21 ($p<0.05$). At the end of the experiment (day 63), no difference among fibroblasts, mononuclear and PMN was observed when glass ionomer cement was compared to empty tube ($p>0.05$) (Figures 1 and 2).

A comparison of the resinous cement group and the control group showed that fibroblasts were more common in the resinous cement group than in the control group ($p<0.05$) at days 7 and 21, and mononuclear cells were more common in the control group ($p<0.05$). At the end of the experiment (day 63), a higher percentage of mononuclear and PMN cells and a lower number of fibroblasts were observed in the resinous cement group, compared to empty tube ($p<0.05$) (Figures 1 and 2).

A comparison of the resinous cement and glass ionomer cement-induced inflammatory responses in mice at day 7 showed that the two materials had similar percentages of fibroblasts, mononuclear cells, and PMN cells ($p>0.05$). At day 21, the percentage of fibroblasts was higher in the resinous cement ($p<0.05$) group, and mononuclear cells were most prevalent in the glass ionomer cement ($p<0.05$) groups. There was no difference in the number of PMN cells ($p>0.05$). At day 63, the percentage of mononuclear and PMN cells was higher in the resinous cement ($p<0.05$) group, and the fibroblasts were higher in the glass ionomer cement group ($p<0.05$) (Figures 1 and 2).

At day 7, the resinous cement group showed a larger fibrous capsule thickness than the glass ionomer cement group and the empty tube group ($p<0.05$). At day 21, the thickness of the fibrous capsule in the resinous cement group was similar to the thickness of the empty tube ($p>0.05$). The glass ionomer cement group showed a thicker fibrous capsule than the empty tube ($p<0.05$) at this time point. At day 63, the thickness of the fibrous capsule in the resinous cement and glass ionomer cement groups was similar to that in the empty tube group ($p>0.05$) (Figures 1 and 2).

Overall, glass ionomer cement showed a tissue response similar to the control group, while resinous cement induced a late inflammatory response. Bacteria were not found in any group at any time point.

Matrix metalloproteinase-2 expression

Glass ionomer cement (Figure 3)

Positive staining was detected in the subcutaneous

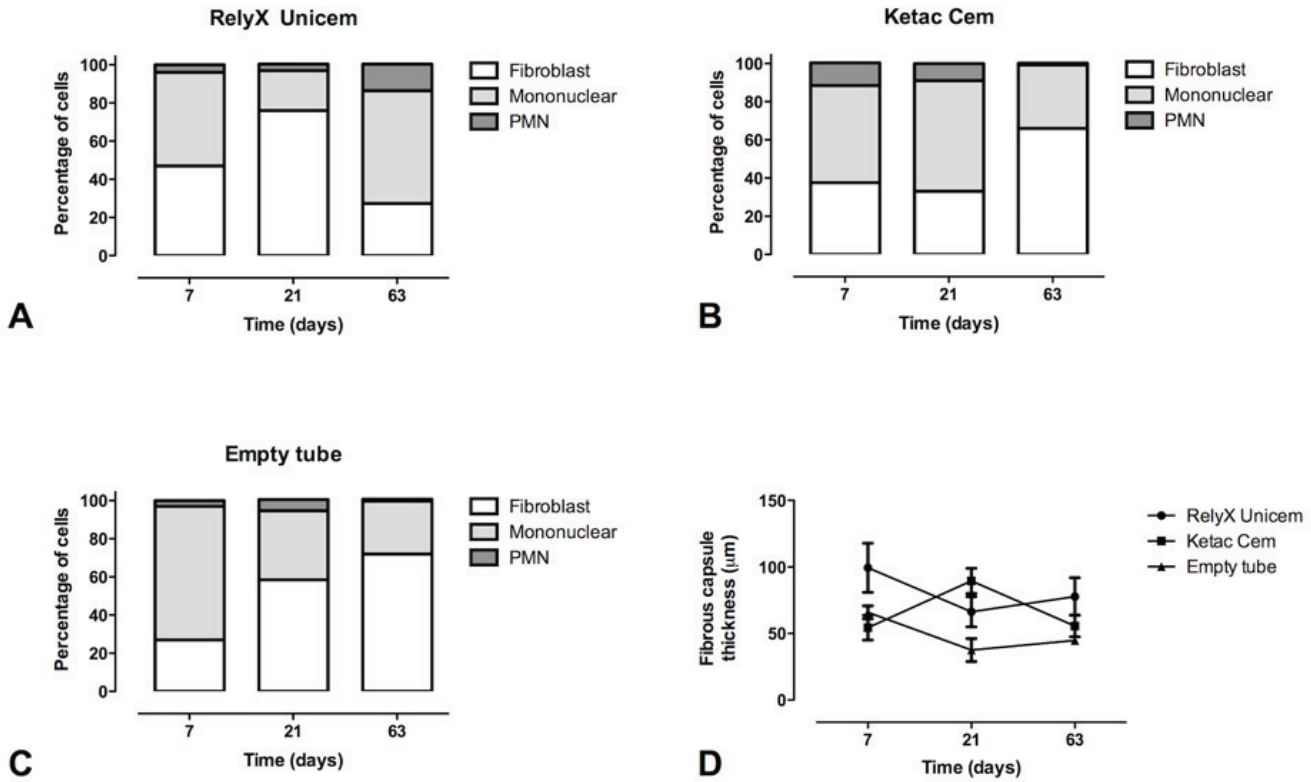

***Figure 1**: Graphs showing the percentages of cells [fibroblasts, mononuclear, and polymorphonuclear (PMN) cells] within the fields of vision at 63x for each of the groups (A- Ketac™ Cem, B- RelyX™ Unicem, and C- empty tube) at different time points (7, 21, and 63 days). D- The thickness of the fibrous capsule in µm for each group (Ketac™ Cem, RelyX™ Unicem, and empty tube) at day 7, 21, and 63.*

connective tissue in contact with the material at the open end of the polyethylene tube and along its sidewalls at day 7. Staining was weak in the extracellular matrix and in the fibroblast and mononuclear cell cytoplasms, but the PMN cells were strongly stained.

At day 21, weak staining at the material border and surrounding the polyethylene tube was observed. There was low staining in the extracellular matrix and in the cytoplasm of fibroblasts and mononuclear cells. When present, the PMN cells were inconsistently stained.

Staining at the material border or around the polyethylene tube was not observed at day 63. Weak staining was observed extracellularly and intracellularly in the mononuclear cells, fibroblasts, and PMN cells.

Resinous cement (Figure 4)

Positive staining was observed in the subcutaneous connective tissue in contact with the material at the open end of the polyethylene tube and along its sides at day 7. Staining was moderate in the extracellular matrix and more evident in the fibroblast and mononuclear cell cytoplasms, while the PMN cells were clearly marked.

Positive staining in the subcutaneous connective tissue in contact with the open end of the polyethylene tube and along its sides was evident at day 21. Staining was moderate in the extracellular matrix and weak in the fibroblast, mononuclear cell, and PMN cell cytoplasms.

Weak staining was observed at the material border and surrounding the polyethylene tube at day 63. There was weak to no staining in the extracellular matrix and in the fibroblast, mononuclear cell, and PMN cell cytoplasms.

Empty tube (control)

Positive staining was observed in the subcutaneous connective tissue at the edge of the material at the open end of the polyethylene tube and along its sidewalls at day 7. The staining was weak in the extracellular matrix and in the fibroblast, mononuclear cell, and PMN cell cytoplasms and was restricted to the tube/tissue interface. The staining pattern in the control group was different from the staining pattern in the experimental groups.

Weak staining was observed at the material border and near the polyethylene tube at day 21. When present, the staining in the extracellular matrix and in the fibroblast, mononuclear cell, and PMN cell cytoplasms was weak. The line marking the division between the underlying connective tissue was less evident.

No staining was observed at the material border or around the polyethylene tube at day 63. Slight extracellular or intracellular staining was observed in the mononuclear cells, fibroblasts, and PMN cells. The line between the tube and the connective tissue, which was observed at day 7 and 21, was absent by the end of the experiment.

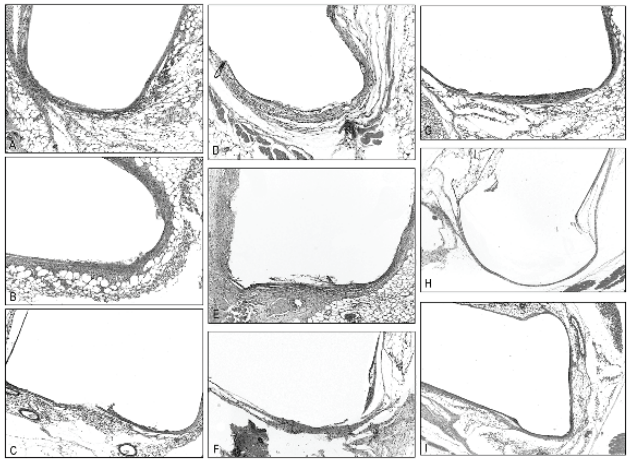

***Figure** 2: Representative photomicrographs of the tissue response in the mouse subcutaneous connective tissue at 7, 21, and 63 days after the implantation of a polyethylene tube filled with Ketac™ Cem (A, B, C), RelyX™ Unicem (D, E, F) or an empty tube (G, H, I). Original magnification: 5× (A, B, D, H, I), 10× (C, E, F, G). The thickness of the fibrous capsule decreased over time for resinous cement and the empty tube. However, glass ionomer cement caused an increase in the capsule thickness until day 21, which subsequently decreased until it was similar to the empty tube at day 63.*

Matrix metalloproteinase-9 expression

Glass ionomer cement (Figure 5)

Positive staining was detected in the subcutaneous connective tissue in contact with the material at the open end of the polyethylene tube and along its sidewalls at day 7. The staining was moderate in the extracellular matrix and in the fibroblast, mononuclear cell, and PMN cell cytoplasms. Some specimens had a bright line at the polyethylene tube wall, and PMN cells, fibroblasts, and mononuclear cells were stained in this region.

At day 21, the extracellular staining was weak and homogenous with few stained cells (PMN cells, fibroblasts, and mononuclear cells). A clearly defined line marked the edge of the polyethylene tube.

Diffuse staining was observed in the extracellular matrix at day 63. The staining was more visible near the polyethylene tube. PMN cells, fibroblasts, and mononuclear cells were sporadically stained.

Resinous cement (Figure 6)

Strong staining was observed around the tube, both at the opening and along the sidewalls, at day 7. The extracellular matrix was weakly stained with positive staining in both the mononuclear cells and fibroblasts.

The extracellular matrix staining around the tube was weak at day 21. Fibroblasts and mononuclear cells were lightly stained.

Intense, well-defined staining was observed around the tube at day 63 with positive staining in the extracellular matrix and the cytoplasms of fibroblasts and mononuclear cells. The PMN cells were not stained.

Empty tube (control)

Weak positive staining of the extracellular matrix and a stronger level of staining at the polyethylene tube interface were observed at day 7. Few cells (mononuclear cells and fibroblasts) were stained.

Weak positive staining of the extracellular matrix and at the polyethylene tube interface was observed at day 21 and 63. Few cells (mononuclear and fibroblast cells) were stained.

DISCUSSION

The group of mice implanted with polyethylene tubes filled with glass ionomer cement in the subcutaneous connective tissue showed a high percentage of fibroblasts, a low percentage of mononuclear and PMN cells, and a thin fibrous capsule, which is a state compatible with tissue repair. In contrast, the group of mice implanted with polyethylene tubes filled with resinous cement in the connective tissue showed an increased inflammatory response at the end of the experiment that was characterized by increased percentages of mononuclear and PMN cells with decreased numbers of fibroblasts, indicating a late inflammatory response.

The PMN and mononuclear cell numbers peaked at day

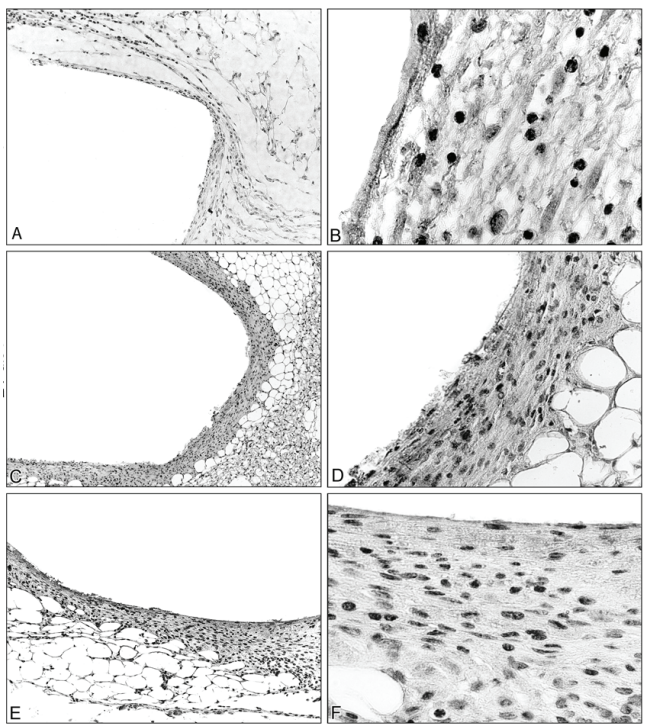

***Figure 3**: Immunohistochemical staining of MMP-2 in the subcutaneous tissue of mice at 7, 21, and 63 days after the implantation of a polyethylene tube filled with Ketac™ Cem ionomer cement. Original magnification: 10× (A, C), 20× (E), 63× (D), and 100× (B, F). Positive staining in the extracellular matrix and in fibroblast, mononuclear cell and PMN cytoplasm were detected at day 7, decreased at day 21, and had disappeared by day 63.*

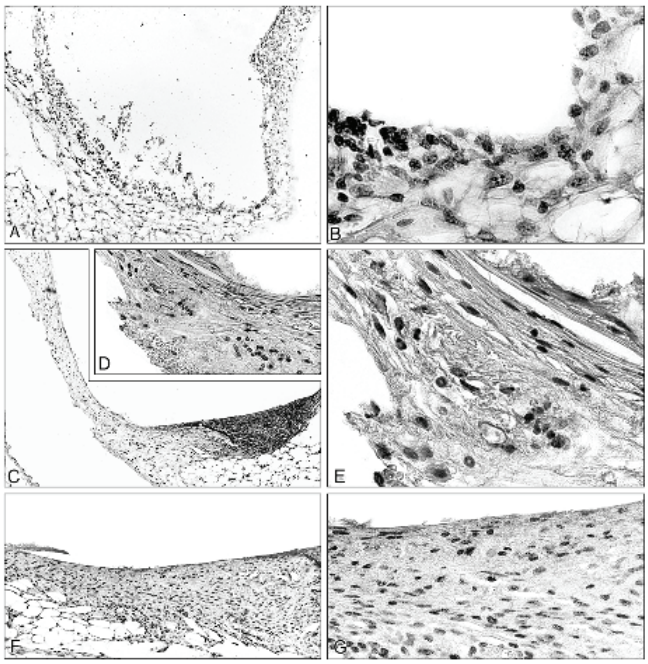

***Figure 4**: Immunohistochemical staining of MMP-2 in mouse subcutaneous tissue 7, 21, and 63 days after implantation of a polyethylene tube filled with RelyX™ Unicem resin cement. Original magnification: 5× (C), 10× (A, F), 20× (D), 40× (G), and 100× (B, E). Positive staining in the extracellular matrix and in the fibroblast, mononuclear cell, and PMN cell cytoplasm was detected at day 7, decreased at day 21, and was weak at day 63.*

21 for glass ionomer cement (mononuclear cells) and at day 63 for resinous cement (mononuclear and PMN cells). One possible explanation for this cell behavior is that glass ionomer cement is more easily dissolved than resinous cement,[19] which results in an early tissue response. The low solubility of RelyX™ Unicem has been attributed to its high concentration of silanized glass powder and treated silica, which prevent its immediate degradation in a humid environment.[20]

The fibrous capsule in this study was thin for both resinous cement and glass ionomer cement across all time points based on previously published parameters, which state that a capsule is thin if it is less than 150 µm thick.[21,22] However, the capsule thickness in the glass ionomer cement group increased between day 7 and 21 and later decreased until it was the same thickness as the control group at the end of the experiment. The increased capsule thickness at day 21 occurred when the mononuclear cell percentages near the tube were also increasing. The thickness of the reactive tissue is a parameter for measuring the tissue's response, as the majority of the reactive tissue is mostly occupied by macrophages in addition to young fibroblasts. Thus, measuring the thickness of the reactive tissue qualitatively measures the prevalence of macrophages in the inflammatory response.[23]

A higher expression of MMP-2 was observed shortly after the polyethylene tube implantation with or without cement, which then decreased over time. At the end of the experiment (day 63), there was low intra- or extracellular MMP-2 expression for both resinous and glass ionomer cements, similar to what was observed in the control group (empty tube). The higher MMP-2 expression observed in both the cement and empty tube groups early in the experiment may be due to tissue remodeling after the polyethylene tube implantation.

The MMP-9 expression was high early in the experiment and decreased over time for the glass ionomer cement and empty tube groups. In contrast, a weak MMP-9 expression was observed early in the resinous cement group that increased at the end of the study (day 63). These results are consistent with the histological analyses, which showed that direct contact of the resinous cement with the connective tissue resulted in a delayed inflammatory response characterized by mononuclear and PMN cells. Previous *in vitro* studies have shown that adhesives can cause MMP-2 expression in fibroblasts isolated from dental pulp, which is possibly due to the acidic nature of the material and the presence of non-polymerized monomers.[24] However, a direct comparison is difficult, as we could not find any *in vivo* studies on the effect of cements on the MMP expression.

According to ISO 10993-6,[18] it is recommended that implants be initially performed in the subcutaneous connective tissue based on a preliminary source of information on the compatibility of the material with the biological activity of the tissues in the area at a macro- and microscopic level.[25-27] Further confirmatory tests are also recommended for applications of the material to the dental

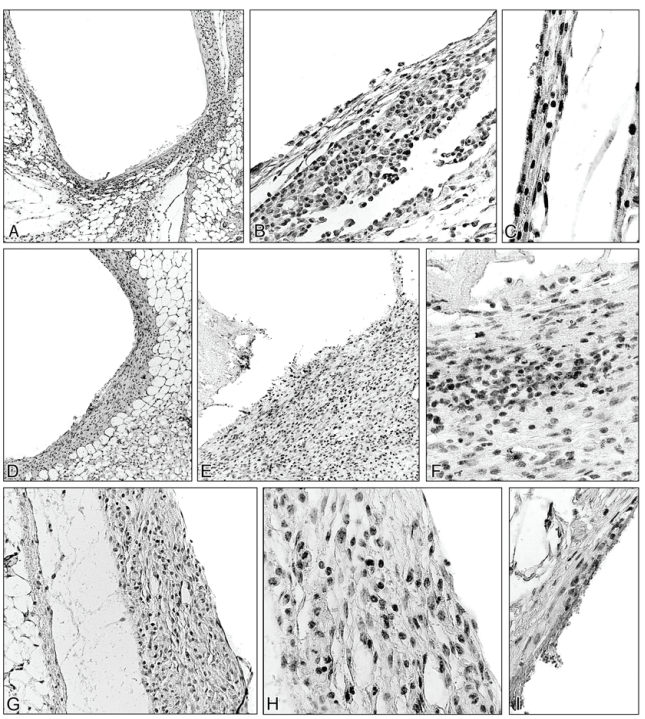

***Figure 5**: Immunohistochemical staining of MMP-9 in the mouse subcutaneous tissue at 7, 21, and 63 days after the implantation of a polyethylene tube filled with Ketac™ Cem ionomer cement. Original magnification: 10× (A, D, E), 20× (G), 40× (B, F), and 63× (C, H, I). Positive staining in the extracellular matrix and in the fibroblast, mononuclear cell, and PMN cell cytoplasm was observed at day 7, which later became weak and homogeneous by day 21. At day 63, diffuse staining of the extracellular matrix was detected, and PMN cells, fibroblasts, and mononuclear cells were sporadically stained.*

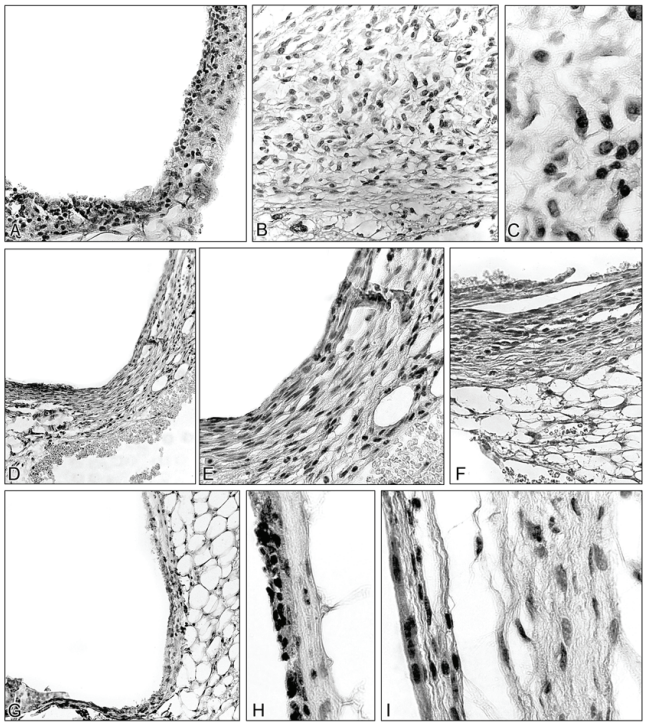

***Figure 6**: Immunohistochemical staining of MMP-9 in the mouse subcutaneous tissue at 7, 21, and 63 days after the implantation of a polyethylene tube filled with RelyX™ Unicem resin cement (A-E, G-I). Negative control = Immunoglobulin G (F). Original magnification: 20× (D, G), 40× (A, F), 63× (B, E, H), and 100× (C, I). The extracellular matrix, fibroblasts, and mononuclear cells were weakly stained at day 7, with staining in the fibroblasts and mononuclear cells decreasing at day 21. At day 63, intense, well-defined staining was observed in the extracellular matrix and in the fibroblast and mononuclear cell cytoplasm.*

tissue to evaluate the response of the pulp, apical, and periapical tissues.[28] Due to the unsatisfactory results obtained for resinous cement, including the inflammatory response and late MMP-9 expression in the mouse subcutaneous connective tissue, studies investigating its clinical application for direct pulp protection are not recommended.

CONCLUSION

The glass ionomer cement Ketac™ Cem showed a good compatibility with mouse connective tissue, unlike the resin cement RelyX™ Unicem. In both the groups, the MMP-2 expression was highest immediately after implantation and decreased over time. However, the RelyX™ Unicem cement caused a late increase of MMP-9 expression, which was not observed in the Ketac™ Cem group, indicating delayed wound healing.

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THE APPLICABILITY OF THE CARREA'S METHOD FOR HUMAN HEIGHT ESTIMATION THROUGH LOWER AND UPPER TEETH IN DENTAL MODELS

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Palavras-chave: Antropologia Forense. Odontologia Legal. Estatura. Arco Dental. Identificação Humana.

RESUMO

Objetivo: Avaliou-se a aplicabilidade do método de Carrea, original e modificado na estimativa da estatura humana. **Métodos**: Trata-se de estudo seccional, realizado com 31 pares de modelos de gesso de 33 graduandos de odontologia. Cada modelo inferior foi analisado com o emprego do Método de Carrea (1939), original, e o método modificado (LIMA et al., 2017) foi utilizado na análise dos modelos superiores. Os dados foram analisados por estatística descritiva e inferencial (α=5 %). **Resultados**: Pelo método de Carrea original, a altura estimada incluiu a altura real em 51,6% (n=16) dos casos, com concordância de 38,7% (n=12) para o quadrante 3 e de 32,3% (n=10) para o 4. A mesma concordância global foi observada para o método modificado (51,6%; n=16), com percentual de 35,5% (n=11) e 32,3% (n=10) para os quadrantes 1 e 2, respectivamente. Não houve diferença estatisticamente significante entre os sexos. A altura foi subestimada em 58,1% (n=18) dos casos quando analisados pelo método de Carrea original, independente do quadrante analisado, e superestimada em 3,2% (n=1) no quadrante 3, e 9,7% (n=3) no quadrante 4. Pelo método modificado, subestimou-se a altura em 45,2% (n=14) para o quadrante 1, e em 38,7% (n=12) para o quadrante 2. A superestimação ocorreu em 19,4% (n=6) no quadrante 1 e em 29,0% (n=9) no quadrante 2. Obtiveram-se baixos coeficientes de correlação entre os valores estimados e reais. **Conclusão**: Os métodos de Carrea, original e modificado, apresentaram aplicabilidade questionável, devendo ser utilizados de maneira complementar a outras técnicas de estimativa de estatura.

Keywords: Forensic Anthropology. Forensic Dentistry. Body height. Dental arch. Human identification.

ABSTRACT

Objective: To evaluate the applicability of the Carrea's method in its original and modified versions for human height estimation. **Methods**: This was a cross-sectional study using 31 pairs of plaster dental models from undergraduate dental students. The lower and upper models were analyzed based on the Carrea's original method (1939) and its modified version (LIMA et al., 2017), respectively. The data were analyzed by descriptive and inferential statistics (α=5%). **Results**: The original method estimated the actual height in 51.6% of the sample (n = 16), with an agreement of 38.7% (n = 12) for quadrant 3 and 32.3% (n = 10) for quadrant 4. Similar overall agreement was observed for the modified method (51.6%; n = 16), with a 35.5% (n = 11) and 32.3% (n = 10) agreement for quadrants 1 and 2, respectively. There was no significant difference between sexes. The original method underestimated human height in 58.1% of the sample (n = 18), regardless of the quadrant analyzed, while it overestimated height in 3.2% (n = 1) of the models in quadrant 3 and in 9.7% (n = 3) in quadrant 4. The modified method underestimated height by 45.2% (n = 14) in quadrant 1 and by 38.7% (n = 12) in quadrant 2. The modified method overestimated height in 19.4% (n = 6) of the models in quadrant 1 and in 29.0% (n = 9) in quadrant 2. Low correlation coefficients were obtained between actual and estimated measurements. **Conclusion**: Both the original and modified Carrea's methods presented questionable applicability and should therefore be used with caution.

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INTRODUCTION

Human identification comprises a meticulous and extremely important process in several situations which require sex, ancestry, age and height determination through specific methods developed from anthropological studies.

Human stature is considered to be a substantial element in forensic anthropology because it represents an objective feature in the search for human identification. The estimation of stature is indispensable in anthropological examinations as it can exclude or certify the identity of an individual.[1,2]

Human stature is usually estimated from long bones which, however, might be not frequently available. Under such conditions, other parameters could be analyzed in order to predict human stature, as in example of human teeth. In many cases, as only dental elements are available for investigation, the use of methods for estimating human height from specific dental measurements becomes significant.[3-5]

It is worth noting the considerable importance of the studies carried out by the Argentine mathematician Juan Ubaldo Carrea, who was responsible for the creation of methods which have significantly contributed to Forensic Dentistry, mainly in the identification processes of damaged bodies. He developed a formula to estimate height using the dimensions of the lower incisives and canines.[6]

The modification of the Carrea's formula (1939) developed by Lima et al.[2] is notable for expanding the use of the method. It makes it possible to use the method in the upper dental arch, particularly in cases when the skull is found without the mandible, therefore accomplishing height estimation when necessary.

Based on that, this study aimed to evaluate the applicability of the original and modified Carrea's methods for human height estimation. In order to achieve this objective, plaster dental models of the upper and lower dental arches were analyzed, and the results obtained were compared to the actual height previously measured in individuals composing the study sample.

MATERIALS AND METHODS

This was a cross-sectional, documentary and descriptive study using secondary data. Plaster dental models of the upper and lower teeth, made during the Forensic Dentistry discipline in a public university, were used for analysis.

This study followed the guidelines that regulate research involving human beings and was approved by the Research Ethics Committee of our institution (CAAE: 45851815.0.0000.5188; Protocol number 0307/2015).

The study population was comprised of plaster dental models from 58 undergraduate dental students regularly enrolled in two semesters of the Forensic Dentistry discipline. The convenience sample included 31 pairs of plaster dental models, which were separated by the professor responsible for the discipline and delivered, coded, to the study examiner.

We only included plaster dental models of individuals from both sexes, who presented the anterior dental elements without any morphological alterations, erupted and that did not present any fillings in their proximal faces that could make it difficult to perform tooth measurements.

The exclusion criteria considered the following: plaster dental models in which any upper or lower anterior tooth were absent; models from individuals who had used orthodontic appliances; those who had restorations on the proximal faces of their teeth or any morphological anomalies of the tooth crowns.

As part of the practical activities of the Forensic Dentistry discipline in each semester, the height of the undergraduate students is measured and registered in a standard identification form of the discipline. Measurement is performed with the individual standing erect, with arms extended close to the body, and feet standing firmly on the ground. According to the Frankfurt plan, the head is positioned parallel to the ground, with the individual in inspiratory apnea. The distance from the heel to the horizontal plane running through the head is then measured with a slider at an angle of 90° to the metric scale.

Within the same practical class, plaster dental models are obtained by dental impressions of upper and lower teeth using irreversible hydrocolloid (alginate type II for dental impression) and subsequent casted with type IV stone. Not all students perform this activity. Those who have sensitivity to irreversible hydrocolloid, vomiting sensation, or the presence of fixed orthodontic appliances, are dismissed from participation.

Plaster dental models from each semester are stored by the discipline as part of a collection, along with the human identification cards. The professor responsible for the discipline separated the students' models and records from their collection, and handed over all the material to a trained examiner, whom performed an analysis of the eligibility criteria for sample selection.

The main investigator received the coded plaster dental models and measured the mesio-distal diameter of the central incisor, lateral incisor and canine using a digital caliper in order to obtain the arch and chord measurements (Figure 1 and 2). The caliper was zet at zero after each measurement so that to prevent variability and keep high accuracy levels.

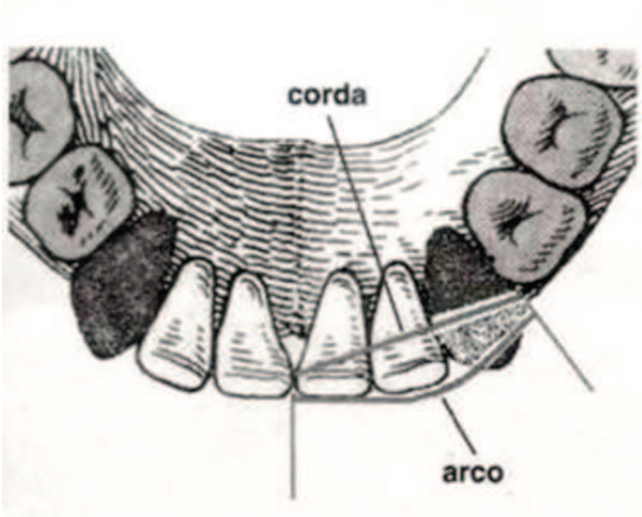

***Figure 1**: Schematic drawing of the "arch" and "chord" trace between the mesial face of the first lower incisor and the distal face of the lower canine on same quadrant. These measurements were necessary to calculate the height according to the Carrea's formula. Source: Vanrell, 2009.*



***Figure 2**: Ilustration of a plaster dental model showing the measure of the mesio-distal diameter of a canine using a digital caliper.*

With regards to the lower teeth, the arch was measured as being the tangent line through the vestibular face from the mesial limit of the central incisor until the distal limit of the canine. It means the sum of the mesio-distal diameters of the central incisor, the lateral incisor and the lower canine, measured on the vestibular face. The chord consisted of a straight lingual line between the mesial edge of the central incisor and the distal face of the canine. Maximum and minimum height was calculated using the original Carrea's formulas presented in Chart 1.

As for the upper teeth, the arch was composed by the sum of the mesio-distal diameters of the maxillary central incisor, lateral incisor and canine, measured on the vestibular face. The chord consisted of a lingual straight line from the mesial edge of the central incisor to the distal edge of the canine on the same quadrant. The maximum and minimum height was calculated using the Carrea's index modified by Lima et al.[2] as described in Chart 1.

	Carrea index	Carrea Index modified by Lima et al. (2017)
Maximum height (in milimiter)	$\frac{\text{LowerArch} \times 6 \times \pi \times 100}{2}$	$\frac{\text{UpperArch} \times 6 \times \pi \times 100}{2.55}$
Minimum height (in milimiter)	$\frac{\text{LowerChord} \times 6 \times \pi \times 100}{2}$	$\frac{\text{UpperChord} \times 6 \times \pi \times 100}{2.55}$

***Chart 1**: Maximum and minimum height calculations using the original Carrea's index and the modified Carrea's index (Lima et al, 2017).*

The data were tabulated and analyzed using the SPSS software (Statistical Package for Social Sciences), version 20.0. The data were treated and analyzed descriptively and inferentially by Pearson chi-square test and Pearson correlation coefficients, with a 5% significance level. Human height estimated by the Carrea's index (1939) and by its modified index[2] were compared to investigate the applicability of the methods.

RESULTS

From a total of 58 students regularly enrolled in the Legal Dentistry discipline, 33 pairs of plaster dental models were assigned to the discipline file and 31 of which met the eligibility criteria. Two pairs of models were excluded because of the absence of canines in the upper and/or lower arch. The participants' ages ranged from 21 to 33 years, with an average of 23.74 (±2.42) years. With regards to sex, 51.6% (n = 16) of the models belonged to females and 48.4% (n = 15) to males.

The original Carrea's method estimated the actual height in 51.6% (n = 16) of the cases, showing an agreement of 38.7% (n = 12) for quadrant 3 and 32.3% (n = 10) for quadrant 4. The same overall agreement was observed for the modified Carrea's method (51.6%; n = 16), with an agreement percentage of 35.5% (n = 11) and 32.3% (n = 10) for quadrants 1 and 2, respectively (Table 1). No statistically significant difference was observed between the sexes (p-value < 0.05, Pearson Chi-square test) (Table 2).

We also evaluated the cases in which the height was underestimated (the actual height was above the range of estimated values) or overestimated (the actual height was lower than the estimated range). Table 3 shows that the height was underestimated in 58.1% (n = 18) of the cases when analyzed by the original Carrea's method, with an average error of 10.6 cm in quadrant 3 and 5.7 cm in quadrant 4. The original method overestimated height in 3.2% (n = 1) of the cases in quadrant 3, with an average error of 4.1 cm, and in 9.7% (n = 3) of the models in quadrant 4, with an average error of 5.7 cm.

Table 1: *Minimum and Maximum values, Mean, Median, Standard Deviation (SD) and percentage of agreement (%Concordance) between the actual height and the height estimated through the original and modified Carrea's indices, per dental quadrant.*

Original Carrea method									
	Total			Quadrant 3			Quadrant 4		
	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance
Minimum	1.36	1.49		1.37	1.49		1.36	1.50	
Maximum	1.70	1.82		1.70	1.81		1.69	1.82	
Mean	1.54	1.66	51.6	1.55	1.66	38.7	1.53	1.66	32.3
Median	1.52	1.66		1.53	1.66		1.53	1.66	
SD	0.08	0.10		0.09	0.10		0.08	0.10	
Modified Carrea method									
	Total			Quadrant 1			Quadrant 2		
	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance
Minimum	1.41	1.51		1.45	1.51		1.41	1.52	
Maximum	1.86	1.94		1.86	1.90		1.80	1.94	
Mean	1.61	1.70	51.6	1.61	1.70	35.5	1.62	1.70	32.3
Median	1.60	1.71		1.61	1.70		1.60	1.72	
SD	0.08	0.08		0.08	0.08		0.09	0.08	

Table 2: *Minimum and Maximum values, Mean, Median, Standard Deviation (SD) and percentage of agreement (%Concordance) between the actual height and the height estimated through the original and modified Carrea's indices, according to sex.*

Original Carrea method									
	Total			Male			Female		
	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance
Minimun	1,36	1,49		1,39	1,50		1,36	1,49	
Maximun	1,70	1,82		1,70	1,82		1,64	1,82	
Mean	1,54	1,66	51,6	1,57	1,70	60,0[a]	1,51	1,61	43,8[a]
Median	1,52	1,66		1,56	1,71		1,51	1,60	
SD	0,08	0,10		0,09	0,08		0,07	0,09	
Modified Carrea method									
	Total			Male			Female		
	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance
Minimum	1.41	1.51		1.45	1.58		1.41	1.51	
Maximum	1.86	1.94		1.86	1.94		1.75	1.81	
Mean	1.61	1.70	51.6	1.64	1.74	46.7[b]	1.58	1.66	56.3[b]
Median	1.60	1.71		1.64	1.73		1.58	1.66	
SD	0.08	0.08		0.10	0.07		0.06	0.07	

[a]*No statistically significant difference (p=0.366; Pearson Qui-Square test).*
[b]*No statistically significant difference (p=0.594; Pearson Qui-Square test).*
SD: Standard Deviation

Height underestimation was also observed for the modified method in 45.2% (n = 14) of the models for quadrant 1, with an average error of 3.9 cm, and in 38.7% (n = 12) for quadrant 2, with an average error of 4.9 cm. Height was overestimated by the modified method by an average of 4.3 cm in 19.4% (n = 6) of the models (quadrant 1), and by 7.5 cm in 29.0% (n = 9) of the models (quadrant 2). Statistically significant differences between quadrants were observed for both lower teeth (original Carrea's method) and upper teeth (modified Carrea's method) (p-value <0.05, Pearson Chi-square test).

The results presented in Table 4 indicate significant correlations between the actual height and the minimum height estimated by the modified Carrea's method, based on quadrant 1. It is also shown a significant correlation between the actual height and the maximum height estimated by the modified Carrea's method, based on quadrant 2.

When analyzing the models, some special conditions were observed, such as the presence of crowding and/or diastema. We chose not to exclude these models in an attempt to assure a minimum sample number and also to allow analysis of the interference of such conditions in the application of the methods under study. As shown in the literature, this evaluation allowed the separation of the sample into 4 groups. Table 5 presents the estimated values and the respective agreement when the division into the groups was considered, and no statistically significant difference was observed (p-value>0.05, Pearson Chi-Square Test).

Table 3: *Absolute frequency and percentage of agreement with the actual height, and underestimation or overestimation rates obtained through the original and modified Carrea's methods, per quadrant.*

Original Carrea method	Quadrant 3[a]					Quadrant 4[a]				
			Deviation in meters					Deviation in meters		
	n	%	Min.	Max.	Mean	n	%	Min.	Max.	Mean
Concordance	12	38.7	-	-	-	10	32.3	-	-	-
Underestimation	18	58.1	0.072	0.140	0.106	18	58.1	0.003	0.111	0.057
Overestimation	1	3.2	0.052	0.030	0.041	3	9.7	0.112	0.003	0.057
Total	31	100	-	-	-	31	100			
Modified Carrea method	**Quadrant 1[b]**					**Quadrant 2[b]**				
			Deviation in meters					Deviation in meters		
	n	%	Min.	Max.	Mean	n	%	Min.	Max.	Mean
Concordance	11	35.5	-	-	-	10	32.3	-	-	-
Underestimation	14	45.2	0.025	0.054	0.039	12	38.7	0.044	0.054	0.049
Overestimation	6	19.4	0.046	0.040	0.043	9	29.0	0.096	0.055	0.075
Total	31	100	-	-	-	31	100	-	-	-

[a]*Statistically significant difference (p=0.003; Pearson Qui-Square test).*
[b]*Statistically significant difference (p=0.001; Pearson Qui-Square test).*

Table 4: *Spearman correlation coefficients and hypothesis test (nullity for absence of association between estimated height values and the actual height, in meters) for the original and modified Carrea's methods.*

Original Carrea method	Quadrant 3		Quadrant 4	
Statistics	Minimun Height (m)	Maximum Height (m)	Minimun Height (m)	Maximum Height (m)
Correlation coefficient	0.108	0.334	0.175	0.178
p-value	0.562	0.067	0.345	0.338
Number of observations	31	31	31	31
Modified Carrea method	**Quadrant 1**		**Quadrant 2**	
Statistics	Minimun Height (m)	Maximum Height (m)	Minimun Height (m)	Maximum Height (m)
Correlation coefficient	0.411	0.229	0.206	0.407
p-value	0.022[a]	0.216	0.267	0.023[a]
Number of observations	31	31	31	31

[a]*Statistically significant difference (p<0,05).*

DISCUSSION

The present study shows that the original Carrea's method resulted in 51.6% of agreement between the estimated and actual height. These findings differ from those reported by Furlan et al.[7], in which a 91.6% of agreement was observed. We highlight that in the latter study, the authors did not include crowded and/or diastema arches to their sample, and all measurements were made directly in the oral cavity of the participants. In that case, the measurements were taken through the use of dental floss and the distances between the marks were then measured with a digital caliper. Lima et al.[8] also identified higher percentages of agreement in aligned dental arches as compared to those in the present study, with 82.6% and 72.2% of agreement for the lower right and left teeth, respectively.

The percentages of agreement presented herein were similar to those identified by Silva[9], whom used digitized dental models and obtained 41.7% of agreement between the actual height and the height interval estimated by the original Carrea's method. The sample in Silva's[9] study consisted in a group of individuals who had teeth aligned and no history of orthodontic treatment, which corresponds in the present study to the data presented for group I in Table 5. The same author found a percentage of correctness of 72.3% for the group with crowded teeth and no orthodontic treatment, which is close to what we found for group II (Table 5). As in our study, the study by Sanchéz[10] included normal, crowded and diastematic lower dental teeth in the sample. However, the latter observed 45.6% of agreement between

Table 5: *Minimum and Maximum values, Mean, Median, Standard Deviation (SD) and percentage of agreement (%Concordance) between the actual height and the height estimated through the original and modified Carrea's indices, according to the special conditions.*

Original Carrea method												
	Absence of Crowding and Diastema (n=19)			Presence of Crowding (n=9)			Presence of Diastema (n=2)			Presence of Crowding and Diastema (n=1)		
	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance
Minimum	1.41	1.49		1.39	1.65		1.36	1.49		1.60	1.60	
Maximum	1.67	1.79		1.64	1.82		1.68	1.72		1.66	1.65	
Mean	1.54	1.63	42.1[a]	1.52	1.74	77.8[a]	1.52	1.60	50.0[a]	1.63	1.63	0[a]
Median	1.53	1.61		1.51	1.73		1.52	1.53		1.63	1.63	
SD	0.07	0.09		0.07	0.06		2.21	1.54		-	-	
Modified Carrea method												
	Absence of Crowding and Diastema (n=19)			Presence of Crowding (n=9)			Presence of Diastema (n=2)			Presence of Crowding and Diastema (n=1)		
	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance	Min. Height	Max. Height	% Concordance
Minimum	1.49	1.56		1.49	1.67		1.41	1.51		1.45	1.66	
Maximum	1.80	1.94		1.75	1.81		1.79	1.75		1.48	1.70	
Mean	1.61	1.70	47.4[b]	1.63	1.74	55.6[b]	1.60	1.62	50.0[b]	1.46	1.68	100.0[b]
Median	1.60	1.67		1.63	1.73		1.60	1.62		1.46	1.68	
SD	0.08	0.08		0.07	0.04		1.92	1.54		-	-	

[a]*No statistically significant difference (p=0.238; Pearson Qui-Square test).*
[b]*No statistically significant difference (p=0.769; Pearson Qui-Square test).*
SD: Standard Deviation

the actual and estimated height, which correspondes to lower rates than those observed in our study.

By using the modified Carrea's method, we found 51.6% of agreement between the estimated and actual height. This percentage is lower than that found by Lima et al.[2] when analyzing different denominators to propose the modification of the mathematical formula. Lima et al.[2] observed 63.6% of agreement, which led them to select the denominator of 2.55 for application of the formula in the upper teeth. However, in a second stage of their research in which they proposed to test the new formula, concordance percentages varied according to dental position and sex, somehow closer to what we found in our study: aligned hemiarches - 34.7% for males and 42.3% for females; and hemiarches with crowding - 65.0% for males and 51.7% for females.

Although there was a better fit for the right hemiarch when only the quadrants with normal positioning were considered, Lima et al.[8] did not find a statistically significant difference between them, which also occurred in the present study.

Silva[9] stated that Carrea did not make any reports as to which hemiarch, right or left, should be used to obtain the measurements. It means that Carrea's work was based on a study of the proportionality relation between measures of the human body, through which the two hemiarches should be equal. This confirms that there should not be an ideal hemiarch to obtain the necessary measures.

The analysis of Spearman's correlation coefficients confirmed the median results obtained in the descriptive statistics (percentage of agreement between actual and estimated height) by both methods. Despite the significant correlations between the actual values and the minimum height estimated by the modified Carrea's method based on quadrant 1, and between the actual values and the maximum height estimated by the same method from the analysis of quadrant 2, the values obtained are below the values considered to be adequate by the literature. In this correlation, values above 0.8 are considered as excellent internal consistency. According to Prieto and Muniz[11], for samples with a number below 200, values above 0.6 are already considered adequate, so that the Spearman classification can be as follows: 0.70-0.79 (adequate); 0.80-0.84 (good) and >0.85 (excellent). We did not find in the literature studies that used this statistical method to evaluate the Carrea's method, either original or modified, making it difficult to discuss these findings.

It is well known that cases with severe changes in the dental arch (tooth loss, wear, or abnormalities) should not be analyzed for estimation of body measurements. However, it is important to consider dental arches with light crowds and/or diastema, mainly in studies evaluating estimation methods such as the original and modified Carrea's indices. Under those conditions, significant percentage of agreements can be achieved and, consequently, the validity of the methods can be strengthened and extended.

It is valid to emphasize that the median values of agreement found can be attributed to the methods used in our study. As stated by Lima et al.[2], despite the high accuracy of the measurements, the use of the digital caliper can result in difficulties to measure dental dimensions due to their blunt stems, which are commonly unable to adapt adequately to dental spaces.

Cavalcanti et al.[12] used the original Carrea's height estimation technique, however using a dry-point compass and a millimeter ruler to replace the digital caliper to obtain the measurements. This resulted in 36.0% of agreement for the right lower quadrant and 48.0% for the left lower quadrant. This slight modification of the Carrea's technique may not have improved the percentage of agreement between the actual and estimated height.

Thus, it is believed as suggested by the above-mentioned authors that the dry-point compass has finer points, which would provide a more accurate measurement of the mesiodistal diameters of the dental elements. In this perspective, it is important to consider the good applicability of the technique used by Furlan et al.[7], who used dental floss to measure the dimensions and then transferred them to the digital caliper for quantification of the distances obtained, thereby achieving a great percentage of accuracy between the actual and estimated height.

Besides the possibility that the instrument used to perform the measurements interfered with the results, it is necessary to consider that this study has limitations. The main one refers to the sample size, which can be considered small, but it was what could be obtained at the study site from a non-probabilistic sampling. The difference between the study population and the sample size was mainly due to the large number of students using fixed orthodontic appliances, which may be a relatively expected and understandable feature among dental students.

The original Carrea's method and the method modified by Lima et al.[2] need further investigation with larger samples comprising heterogeneous populations in order to demonstrate their real efficacy in the estimation of human height. Thus far, both methods can be considered as complementary to other techniques recommended for height estimation during an identification process, but their sole use should be avoided.

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KNOWLEDGE OF PAEDIATRIC PATIENTS AND THEIR GUARDIANS ABOUT MOUTH GUARDS

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Palavras-chave: Protetores Bucais. Adolescentes. Prevenção.

RESUMO

Introdução: Os protetores bucais são usados para prevenir lesões durante atividades esportivas. **Objetivo**: O objetivo deste estudo é avaliar o conhecimento sobre os protetores bucais dos pacientes pediátricos e seus responsáveis. **Métodos**: Pacientes pediátricos de 9 a 15 anos, que procuraram atendimento na Clínica Pediátrica da Faculdade de Odontologia e seus responsáveis foram convidados a participar. Seu conhecimento sobre protetores bucais foi coletado através de um questionário em duas partes com perguntas abertas e fechadas. A primeira parte do questionário continha algumas questões sociodemográficas e uma questão principal sobre o que é um protetores bucais. A segunda parte era apenas sobre protetores bucais e foi aplicada imediatamente após uma explicação sobre os protetores bucais no final da primeira parte. Todos os dados coletados foram tabulados e analisados de forma descritiva. **Resultado**: Um total de 122 guardiões foram entrevistados, 39.3% tiveram crianças que praticavam algum tipo de atividade esportiva e 32% relataram um episódio de trauma. A maioria (54.9%) não sabia o que é um protetor bucal, mas após a explicação, 57.4% tinham visto alguém usando um. Um total de 33 pacientes pediátricos foram entrevistados, 60.6% praticaram algum esporte e 27.3% deles já sofreram algum tipo de trauma dental durante a atividade. Nenhum dos entrevistados usa um protetor bucal durante a atividade esportiva, embora 97% acreditem que usar um protetor bucal é importante e 78.8% acreditam que o protetor não interfere com a atividade. **Conclusão**: Em conclusão, os guardiões e pacientes pediátricos têm pouco conhecimento sobre os protetores bucais.

Keywords: Mouthguards. Adolescents. Prevention.

ABSTRACT

Introduction: Mouth guards are devices used to prevent injuries during sports activities. **Objective**: The aim of this study is to evaluate the knowledge of paediatric patients and their guardians about mouth guards. **Methods**: Paediatric patients from 9 to 15 years old and their guardians who sought care in the Paediatric Clinic of the Dentistry School were invited to participate. Their knowledge about mouth guards was collected through a two-part questionnaire with open and closed ended questions. The first part of the questionnaire contained sociodemographic questions and a main question about what a mouth guard is. The second part was solely about mouth guards and was applied immediately after an explanation about mouth guards at the end of the first part. All data collected were tabulated and analysed descriptively. **Results**: A total of 122 guardians were interviewed; 39.3% had children who practised some type of sports activity and 32% reported a trauma episode. Most (54.9%) did not know what a mouth guard was but, after explanation, 57.4% had seen someone using one. A total of 33 paediatric patients were interviewed, 60.6% of whom practised some sport; 27.3% of these had already suffered some type of dental trauma during the activity. None of the interviewees used a mouth guard during their sports activity, although 97% believed that using a mouth guard was important and 78.8% believed that the protector did not interfere with the activity. **Conclusion**: Guardians and paediatric patients have little knowledge about mouth guards.

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INTRODUCTION

Orofacial trauma is characterized as being a serious injury that occurs with great frequency in children and adolescents.[1–3] Factors considered to be predisposing to the occurrence of trauma include sex, age, overjet, Angle's class II occlusion, mouth breathing, anterior open bite, short or hypotonic upper lip, obesity and the presence of neurological disorders.[1,4–7] The most common causes are falls, collisions with other people and objects, sports activities, automobile accidents and physical aggression.[1,4–7]

Due to social, aesthetic and functional damage, injuries have a negative impact on patients' quality of life and on their guardians'.[8,9] Thus, initiatives aimed at preventing orofacial trauma should be encouraged. Mouth guards are considered devices for individual protection against traumatic injuries, being fundamental for the protection of individuals' dental, soft and bone tissue during sports practice.[10]

Sports-related oral injury in school children is mainly seen between the ages of 7 and 11 years.[11] Participants in sporting and recreational activities are often susceptible to dental injury, so use of a mouth guard is recommended in any athletic or recreational activity.[12] The mouth guards do not totally prevent the occurrence of dental trauma; however, the sequelae of the trauma can be minimized.[13]

Dental trauma is considered a public health problem; however, little is invested in its prevention. Although cheap, easy and of recognized importance by dentists, mouth guards are still not used worldwide.[14,15] Since the family has a fundamental role in teaching and establishing habits in young people,[16] the objective of this study was to evaluate whether paediatric patients and their guardians knew about mouth guards.

MATERIALS AND METHODS

This descriptive cross-sectional study was approved by the Research Ethics Committee (no.1,153,278) and all subjects were treated according to the Declaration of Helsinki. Each participant signed a consent form with detailed information, according to their comprehension capacity.

Paediatric patients of both genders aged 9 to 15 years, who sought care in the Paediatric Clinic of the Dentistry School of the Federal University of Rio de Janeiro from October to December 2016, and their guardians were invited to take part in the present study. Illiterate participants, those with neurological deficiency or who had difficulty understanding, and those who refused to participate in the study were excluded.

The participants' knowledge about mouth guards was collected through a two-part questionnaire with open and closed questions elaborated by the authors of this study. The questionnaires were elaborated in three stages. In the first stage, the questionnaires were evaluated by Master's and PhD students. In the second stage, the questionnaires were re-evaluated by the same postgraduate students and by high school students. In the third stage, the questionnaires were applied to five patients aged 9 to 15 years and their guardians. At each stage, the questions and answers were evaluated in order to improve the understanding of the text and to obtain more information for data collection.

The final questionnaire for guardians had 14 items; that for paediatric patients had 13 items. All interviews were conducted by a single researcher. The first part of the questionnaire contained some sociodemographic questions and a main question: 'Do you know what a mouth guard is?' Subsequently, the researcher explained to each individual what a mouth guard is. The second part was solely about mouth guards. Ultimately, participants were instructed about the importance of using mouth guards during physical/sports activity. All questions are described in Tables 1 and 2.

All data collected were tabulated in the statistical program SPSS (version 21.0; SPSS Inc., Chicago, IL, USA) and analysed descriptively.

RESULTS

A total of 122 guardians were interviewed (mean age 34.8 years; dp±9.4). Table 1 shows the results obtained from guardians: 39.3% had children who practised some type of sports activity and 32% reported a trauma episode. In the interview, 54.9% answered that they did not know what a mouth guard is, but after the explanation was given, 57.4% said they had seen someone using one. Although 90.2% of those responsible indicated that their children used some kind of protector during sports activity, 95% stated that their children did not use any kind of protector.

A total of 33 paediatric patients aged between 9 and 15 years (mean age 10.3 years; dp±1.4) were interviewed. Table 2 shows the results obtained from the paediatric patients, of whom 60.6% practised some sport and 27.3% had already suffered some type of dental trauma during the activity. None of the interviewees used a mouth guard during sports activity, although 97% believed that using a mouth guard was important and 78.8% believed that the protector did not interfere with the activity.

None of the girls knew what a mouth guard was, and most of the boys (70.6%) did not know. Considering the boys, 58.8% did not know what a mouth guard was irrespective of whether they practised a sport activity. With regard to the guardians, despite practising physical activity, the children use a protector and the caregiver knew what it was in only 1.6% of cases.

Table 1: *Caregiver evaluation of the mouth guard (n = 122)*

Questions	Answer	N (%)
Sex	Male	13 (10.7%)
	Female	109 (89.3%)
Education	Elementary school	37 (30.3%)
	High school	65 (53.3%)
	Higher education	20 (16.4%)
Family income	≤ 3 Minimum wages	107 (87.7%)
	> 3 Minimum wages	15 (12.3%)
Does your child play any sport?	Yes	48 (39.3%)
	No	74 (60.7%)
If so, which one?	School physical education	7 (15.2%)
	Boxing	15 (32.4%)
	Soccer	9 (19.6%)
	Others (Swimming, Volleyball, Gymnastics)	17 (32.8%)
Has your child ever had any dental trauma?		
	Yes	39 (32.0%)
	No	83 (68.0%)
Do you know what a mouth guard is?*	Yes	55 (45.1%)
	No	67 (54.9%)
Do you know anyone who uses one or have you ever seen anyone using one?		
	Yes	70 (57.4%)
	No	52 (42.6%)
If yes, who?	Friends	8 (12.3%)
	Family	11 (16.9%)
	Boxer	44 (67.7%)
	Already use	2 (3.1%)
Do you believe that the mouth guard is important?		
	Yes	112 (91.8%)
	No	1 (0.8%)
	Do not know	9 (7.4%)
When should a mouth guard be used?		
	Never	1 (0.8%)
	All the time	3 (2.5%)
	When you go to sleep	5 (4.1%)
	When you play some sport	110 (90.1%)
	Do not know	3 (2.5%)
Does your child wear a mouth guard during sports activity?		
	Yes	6 (5.0%)
	No	116 (95.0%)
How long does a mouth guard last?		
	All the time	4 (3.3%)
	Two months	4 (3.3%)
	Six months	10 (8.2%)
	One year	2 (1.6%)
	Do not know	102 (83.6%)
Where or from whom would you source a mouth guard?		
	Sports store	24 (19.7%)
	Doctor	2 (1.6%)
	Dentist	52 (42.6%)
	Sports teacher	5 (4.1%)
	Do not know	39 (32%)

** After the answer, the researcher explained what a mouthguard is.*

***Table 2**: Evaluation of the paediatric patients' (aged 9 to 15 years) knowledge about mouth guard (n= 33)*

Questions	Answer	N (%)
Sex	Male	17 (51.5%)
	Female	16 (48.5%)
Type of school	Public	14 (42.4%)
	Private	19 (57.6%)
Do you play any sport?	Yes	20 (60.6%)
	No	13 (39.4%)
If so, which one?	School physical education	3 (15.0%)
	Boxing	7 (35.0%)
	Soccer	5 (25.0%)
	Others (Swimming, Volleyball, Gymnastics)	5 (25.0%)
Have you suffered any dental trauma?	Yes	9 (27.3%)
	No	24 (72.7%)
Do you know what a mouth guard is?*	Yes	5 (15.2%)
	No	28 (84.8%)
Do you know anyone who uses one or have you ever seen anyone using one?		
	Yes	23 (69.7%)
	No	10 (30.3%)
If yes, who?	Friends	9 (40.9%)
	Family	4 (18.2%)
	Boxer	9 (40.9%)
Do you believe that the mouth guard is important?	Yes	32 (97.0%)
	Do not know	1 (3.0%)
When should a mouth guard be used?		
	All the time	2 (6.1%)
	When you play some sport	27 (81.8%)
	Do not know	4 (12.1%)
Do you use the mouth guard during sports activities?		
	Yes	0 (-)
	No	33 (100.0%)
Do any friends of yours, from the sport, wear a mouth guard?		
	Yes	12 (36.4%)
	No	21 (63.6%)
Do you believe that the mouth guard interferes with sports activities?		
	Yes	5 (15.2)
	No	26 (78.8%)
	Do not know	2 (6.0%)

** After the answer, the researcher explained what a mouthguard is.*

DISCUSSION

Dental trauma can occur in different routine situations, making it difficult to carry out preventive measures. One of the few situations in which injuries can be effectively prevented is during sports activities. According to Spinas and Savasta,[17] the prevention of dentoalveolar trauma in sport practitioners should be carried out by analysis and awareness of the problem; control of predisposing factors; and study and awareness of methods and devices aimed at reducing trauma outcomes. Interviewees did not know what a mouth guard was, even though they had experienced dental trauma during sports practice. This result is similar with that found in other study[17] and corroborates the high prevalence of a lack of information on the prevention of dental injuries.

A mouth guard can be defined as a resilient device placed in the mouth to reduce oral injuries such as dental trauma. After an explanation of what a mouth guard is and what a mouth guard does, guardians said that they considered the mouth guard to be important and that going to the dentist would be the correct way to get it, but that their children did not use one. These results corroborate with literature,[18,19] which shows that despite individuals knowing about mouth guards, only a few report using them.

The literature proves the preventive value of mouth guards, especially in contact sports.[17,20,21] In our results, despite practising contact sports and having had a dental trauma experience, most of the paediatric patients did not use mouth guards. These results were the same as those found for athletes, who also demonstrated little use of mouth guards despite information about usage during sports practices and general knowledge of their use.[22] In addition, girls have been shown to have less knowledge about mouth guards than boys. This result can be explained by the fact that, in general, boys practise more contact sports than girls.[23] The most common reasons for not using a mouth guard were discomfort and difficulty in breathing or talking.[24] These reasons could be minimized through the use of individualized mouth guards made by dentists; however' the lack of mandatory use of this apparatus during most contact sports does not encourage the search for prevention.

Guardians still have questions about when the mouth guard should be used and its durability. There is no specific period of durability of the mouth guard evaluated in the literature. When used by children, however, it is important to evaluate the development of the face and changes in the dental positioning. In this sense, the protector should be changed every year or reassessed if it is maladaptive.[10] Magunacelaya and Glendor's study[25] shows that there is a high amount of information about mouth guards on the internet but that the quality of this information varies.

According to Biagi et al.,[16] most young people obtain information about mouth guards from family members; however, our results showed that guardians also have little information on the subject, which could impair the use of such devices, thus negatively influencing the protection against trauma in the studied population. Some factors can influence the guardian's knowledge: for example, of the working mothers, 72% knew that mouth guards are useful in the prevention of dental trauma while only 37% of the non-working mothers had this knowledge.[26]

In the bibliographic search, the authors of the present study did not find a specific questionnaire that evaluated knowledge about mouth guards. The use of a questionnaire not previously used in other studies may be considered a limitation of the work, since comparison with other results becomes limited. Furthermore, a small sample could be questionable. Despite a limitation in the sample size, however, the present study could guide further studies, preferably multi-centre studies, to assess the knowledge of different sample groups such as children, guardians, teachers, athletes and coaches.

The results found in the present study corroborate the findings in the literature and contribute to reinforce the need for effective dental trauma prevention programmes. Studies such as these are effective in monitoring the potential of a failure to disclose the importance of using mouth guards to prevent dental injury. A change in this prospect should begin with the education of schoolchildren, guardians and teachers about the importance of mouth guards and the strengthening of strategies that make it compulsory to use them during sports activities.

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THE FLUORIDE CONCENTRATION OF THE PUBLIC WATER SUPPLY IN THE URBAN ZONE AND INDIGENOUS VILLAGES OF BAÍA DA TRAIÇÃO, PARAÍBA, BRAZIL

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Palavras-chave: População Indígena. Fluoretos. Vigilância em Saúde Pública. Controle da Qualidade da Água.

RESUMO

Introdução: É sabido que o município de Baía da Traição possuía sistema de fluoretação de águas de abastecimento. **Objetivo**: Avaliar a concentração de fluoreto (F^-) na água de abastecimento público do município de Baía da Traição-PB. **Métodos**: Amostras de água de abastecimento público foram coletadas em 13 locais, sendo um na zona urbana (Centro) e 12 distribuídas na zona rural (aldeias indígenas). Para cada local, três pontos de coleta distintos foram selecionados por conveniência entre novembro de 2015 e janeiro de 2016. A análise foi realizada em duplicata, utilizando-se um eletrodo íon-específico para fluoreto acoplado a um potenciômetro, previamente calibrados. As amostras (750 µL) foram adicionadas a 750 µL de solução TISAB II, consideradas a uma curva de calibração com concentrações de 0,2 a 1 mg/L. **Resultados**: Em novembro, dezembro e janeiro, respectivamente, as concentrações de F^- no Centro foram 0,32, 0,11 e 0,09 mg/L, e a média das aldeias indígenas, 0,08 (±0,02), 0,08 (±0,03) e 0,07 (±0,02) mg/L. Todas as amostras apresentaram concentrações abaixo do recomendado (<0,60 mg/L) pelo Ministério da Saúde para o benefício anticárie. **Conclusão**: Portanto, as águas de abastecimento público de Baía da Traição apresentaram concentrações de F^- insuficientes para prevenir a cárie dentária em nível populacional.

Keywords: Indigenous Population. Fluorides. Public Health Surveillance. Water Quality Control.

ABSTRACT

Introduction: It is known that the municipality of Baía da Traição, Brazil, has a system for fluoridation of the water supply. **Objective**: To evaluate the fluoride concentration (F^-) of the public water supply in the city of Baía da Traição-PB. **Methods**: Public water samples were collected in 13 sites, being one in the urban zone (downtown) and 12 in the rural zone (indigenous villages). In each site, three distinct collection points were selected for convenience between November 2015 and January 2016. The analysis was performed in duplicate using a fluoride ion-specific electrode coupled to a potentiometer, previously calibrated. The samples (750 µL) were added to 750 µL of TISAB II solution, considered on a calibration curve with concentrations of 0.2 to 1 mg/L. **Results**: In November, December and January, respectively, concentrations of F^- in the downtown area were 0.32, 0.11 and 0.09 mg/L, while the average concentrations in the indigenous villages were 0.08 (± 0.02), 0.08 (± 0.03) and 0.07 (± 0.02) mg/L. All samples had concentrations below the recommended levels (<0.60 mg/L) by the Ministry of Health for the anticaries benefit. **Conclusion**: The public water supply of Baía da Traição presented concentrations of F^- insufficient to prevent dental caries at the population level.

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INTRODUCTION

The indigenous population is subject to a process of transculturation that leads to a higher incidence of dental caries due to increased cariogenic feeding.[1,2] In addition, the history of social exclusion, coupled with neglect of oral health services, contributes to a framework of epidemiological invisibility that hampers the elaboration of strategies for prevention and health promotion in these populations.[2,3]

As compared to the Brazilian population in general,[4] the indigenous population living in the Potiguara Indigenous Reservation of Paraíba (Rio Tinto, Baía da Traição and Marcação) presented a higher mean of decayed,

missing and filled teeth of deciduous (dmft) and permanent dentition (DMFT) at the ages of 5 (dmft = 5.8), 12 (DMFT=3.6), and 15 to 19 (DMFT=7.1).[5] Thus, comprehensive health measures, such as fluoridation of the public water supply, could contribute to the reduction of dental caries rates among the indigenous population that are considered to be vulnerable.[6,7] A cohort study of Brazilian adults[6] demonstrated that access to fluoridated water for over 75% of the lifetime was associated with a lower prevalence of caries. In addition, a systematic review[7] demonstrated that discontinuation of the fluoridation process contributed to increased prevalence of dental caries.

Fluoridation of the public water supply is a cost-effective public health measure as it has a low per capita cost[8] to prevent caries regardless of age and socioeconomic or cultural level, thereby reducing the disease prevalence with a population-wide coverage.[6-8] If recommended fluoride levels are provided, this process becomes an efficient, simple and safe measure to promote the anticaries benefit.[6,7,9]

The World Health Organization[10] and the National Oral Health Policy[11] encourage the implementation of actions that favor the fluoridation of the public water supply. Federal Law nº 6.050 as of May 24, 1974, regulated by the Decree nº 76,872 as of December 22, 1975, establishes the mandatory fluoridation in the treatment of the public water supply in Brazil, in the Water Treatment Stations (WTS).[12] The Ordinance nº 2914, dated from December 12, 2011, provides for the procedures for controlling and monitoring the quality of water for human consumption and its drinking water standard. In the case of fluoride addition, the recommended values must comply with the Ordinance nº 635, dated from January 30, 1976, with maximum permitted values of up to 1.5 mg/L of the fluoride ion.[13,14]

Baía da Traição presents two entities responsible for supply management and distribution of the public water supply, namely: the Autonomous Water and Sewage Service (SAAE) under the city management, responsible for the central area of the municipality, and the Department of Sanitation of the Special Secretariat of Indigenous Health (SESAI), responsible for controlling the water supplied to the indigenous villages. In addition, the National Program for Surveillance of Water Quality for Human Consumption plays an important role in Health Surveillance. However, there is no surveillance of the water quality in the municipality under the terms recommended by current legislation.[13,14]

Fluoridation monitoring is the part of the health surveillance that assesses the fluoride concentration in the public water supply in a given region through public and private institutions unrelated to the corresponding WTS.[15] In order to promote the maintenance of fluoride at optimal concentrations for human consumption, monitoring of fluoride levels is offered as a regular measure to verify the quality of the public water supply.[15-17] Baía da Traição does not have an entity unrelated to the municipality that inspects the levels of fluoride in the public water supply, with the purpose of notifying those responsible for managing the irregularities identified.

Considering the history of fluoridation of the public water supply in Baía da Traição, it is necessary to monitor the levels of fluoride in the water supply, so that to guide the sanitary organs in regard to the adequate enrichment of the waters. Verification of the fluoride concentration is relevant to determining the natural concentration of fluoride in drinking water and the amount needed to achieve the optimal concentration for the anticaries benefit of fluoridation. In addition, the possible inequality of access to fluoridated water for a population under vulnerable situations motivates the development of our study. In order to contribute to this matter, the present study aimed to evaluate the concentration of fluoride (F^-) in the public water supply in the city of Baía da Traição, PB, Brazil.

MATERIALS AND METHODS

Characterization of collection sites

The municipality of Baía da Traição is located on the northern coast of the state of Paraíba (PB), Northeast Brazil (Latitude: 06º 41 '18 "S; Longitude: 34º 56' 09" W). According to the Brazilian Institute of Geography and Statistics (IBGE),[18] Baía da Traição has a territorial area of 102,242 square kilometers; an estimated population in 2016 of 8,951 inhabitants; Human Development Index (HDI) of 0.581; Gini index 0.38; and average household income per capita of R$ 170 (compared to R$ 510 in João Pessoa, capital of the state).

The municipality of Baía da Traição has a population of 5,591 natives, with 23.61% (n=1320) of them distributed in the urban zone (downtown) and 76.39% (n=4271) in the rural zone (indigenous villages: Akajutibiró, Benfica, Bento, Cumaru, Forte, Galego, Lagoa do Mato, Laranjeira, Santa Rita, São Francisco, Silva, Tracoeira and São Miguel).[19]

Collection of water samples

In each site of interest (downtown and indigenous villages), three distinct and non-consecutive residences were selected for convenience, which served as representative points of collection sites (Figure 1). Water samples were collected from the following indigenous villages: Akajutibiró, Bento, Cumaru, Forte, Galego, Lagoa do Mato, Laranjeira, Santa Rita, São Francisco, Silva, Tracoeira and São Miguel. Samples (n=39) were collected between November 2015 and January 2016, once a month, on weekdays, identified with the location and date of the collection. The time interval



Figure 1: *Distribution of sample collection sites in Baía da Traição-PB: Downtown (n=1) and Indigenous villages (n=12), 2016. PhotoScape software was used for construction of the figure. The image taken on Google Maps (https://www.google.com/maps/).*

between the first and last collection of the respective points did not exceed 24 hours. After collection, the water samples were sent for laboratorial analysis.

Analysis of fluoride concentration

The analyses were performed using a fluoride ion-specific electrode (Orion Star Series, Thermo Scientific, Singapore) coupled to a potentiometer (Orion Star Series, Thermo Scientific, Singapore).[20] The calibration of the equipment was done in duplicate, in order to reduce the margin of error, taking into account the expected values for samples with standard solutions ranging from 0.2 to 1 mg/L. For this, standard solutions were obtained by serial dilutions from a standard solution of 100 mg/L. For the standard curve, a "blank" reference value obtained from a sample of distilled and deionized ultrapure water was considered, which is the first point of the curve to be analyzed. The reading range of the calibration curve was 0.2 mg/mL. The reading of the points of the calibration curve were obtained in triplicate from 750 µL of each of these points plus 750 µL of Total Ionic Strength Adjustor Buffer (TISAB II); a pH adjusting buffer, ionic strength and decomplexing. The mean values of the electrical conductivity (mV) were transferred to a spreadsheet in Excel software (Microsoft®) and the relationship between electrical conductivity (mV) and the fluoride concentration [log F^-] (r^2=0.999; Slope=-57.9) was determined by linear regression. There was no difference greater than 5% between the expected and the calculated, for each point of the curve.

Data analysis

The values obtained in duplicate, including the TISAB II-added groups (1:1 ratio), were transferred to a spreadsheet in Excel (Microsoft®) software, transformed from millivolts (mV) to mg/L, and analyzed descriptively.

A comparative analysis of the data obtained in the present study was carried out with the recommended limits for fluoride concentration as a function of the average daily maximum temperature recommended by the Ministry of Health, through Administrative Rule 635 / Bsb, as of December 26, 1975[14] (Chart 1). The mean maximum daily temperature of Baía da Traição was 28.83ºC,[21] with minimum, maximum and optimal fluoride concentrations of 0.6; 0.8; and 0.6 mg/L, respectively.

***Table 1**: Mean and standard deviation (SD) of drinking water fluoride concentrations during the respective months and quarter in the downtown area and indigenous*

Regions \ Month	Nov./2015		Dec./2015		Jan./2016		Average of the quarter	
	[F-] (mg/L)		[F-] (mg/L)		[F-] (mg/L)		[F-] (mg/L)	
	Average	SD	Average	SD	Average	SD	Average	SD
Downtown	0.32	0.02	0.11	0.00	0.09	0.01	0.17	0.13
Indigenous Villages	0.08	0.02	0.08	0.03	0.07	0.02	0.07	0.02
Akajutibiró Village	0.07	0.00	0.08	0.00	0.07	0.00	0.07	0.01
Bento Village	0.07	0.00	0.07	0.00	0.07	0.00	0.07	0.00
Cumaru Village	0.08	0.00	0.07	0.00	0.07	0.00	0.07	0.01
Forte Village	0.06	0.00	0.07	0.00	0.07	0.00	0.07	0.01
Galego Village	0.12	0.01	0.10	0.01	0.09	0.02	0.10	0.02
Lagoa do Mato Village	0.08	0.00	0.08	0.00	0.07	0.00	0.08	0.01
Laranjeira Village	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.00
Santa Rita Village	0.12	0.00	0.15	0.00	0.14	0.00	0.14	0.02
São Francisco Village	0.07	0.00	0.06	0.00	0.07	0.00	0.07	0.01
São Miguel Village	0.09	0.01	0.09	0.01	0.09	0.00	0.09	0.00
Silva Village	0.08	0.01	0.09	0.00	0.08	0.00	0.08	0.01
Tracoeira Village	0.04	0.01	0.05	0.00	0.06	0.00	0.05	0.01

Average daily maximum air temperatures (º C)	Recommended limits for fluoride ion concentration in mg/L		
	Minimum	Maximum	Optimum
10.0 - 12.1	0.9	1.7	1.2
12.2 - 14.6	0.8	1.5	1.1
14.7 - 17.7	0.8	1.3	1.0
17.8 - 21.4	0.7	1.2	0.9
21.5 - 26.3	0.7	1.0	0.8
26.4 - 32.5	0.6	0.8	0.6

***Chart1:** Fluoride concentration limits according to the average of the maximum daily temperatures.* Source: *Ordinance nº 635 / Bsb, of December 26, 1975.*[16]

RESULTS

In the months of November/2015, December/2015 and January/2016, the F- concentrations in the downtown area were 0.32, 0.11 and 0.09 mg/L, respectively, against 0.08 (±0.02), 0.08 (±0.03), and 0.07 (±0.02) mg/L in the indigenous villages (Table 1). It was observed that 100% of the samples (n=39) had concentrations below the limit recommended by the Ministry of Health to promote the anticaries benefit (<0.60 mg/L) (Chart 1). As seen in Table1 , the highest concentrations of fluoride were found in a region in downtown Baía da Traição, while the lowest concentrations were found in the Laranjeira and Tracoeira villages.

DISCUSSION

The city of Baía da Traição (PB) is one of the few municipalities in Paraíba state which has a water fluoridation system[5]. Initially, the present study aimed to identify the fluoride levels in the water supplies of the city, focused on a technical monitoring and also on the inequality of access to fluoridated water in urban and rural areas (indigenous villages). However, the study findings reveal that only residual levels of fluoride were detected in the water, which was incompatible to what had been disclosed about the city of Baía da Traição having access to fluoridated water.

After samples were collected, discontinuation of fluoridation took place in the downtown area in December 2015.[22] In addition, the Orientation Plan for Water Treatment of the Indigenous Villages does not advocate the fluoridation of the public water supply as a measure that should be used[23]. In this sense, it is necessary to reestablish the fluoridation of

the water in the downtown area of the city and implement it in the indigenous villages, calling the SAAE and the Sanitation Department of SESAI to their respective competencies.

Only after direct contact with the SAAE of the municipality did the authors have access to the information that fluoridation had been interrupted in December 2015.[22] However, the collections occurred between the months of Nov/2015, Dec/2015 and Jan/2016. Therefore, it is verified that the fluoridation system was not being conducted accordingly, with Nov/2015 values similar to those of Dec/2015 and Jan/2016. This aspect reinforces the need for external control and systematic evaluation of water quality. In addition, it points to the need to resume fluoridation, since the residual levels are insufficient to produce the anticaries benefit.

According to the SAAE reports, fluoridation of the public water supply in downtown Baía da Traição was in force in November/2015.[22] Thus, as expected, the highest observed concentration of residual fluoride (0.32 mg/L) was found in this collection period. During the other periods, in the months of December/2015 and January/2016, the public water supply in the downtown area presented decreasing residual fluoride concentrations (0.11 and 0.09 mg/L, respectively). The decrease in fluoride concentrations represents the period of interruption of fluoridation of the public water supply by the SAAE.[22] This finding reinforces the need to provide anticaries benefits to the population of Baía da Traição, since fluoride concentration was not maintained at ideal levels (0.6-0.8 mg/L).[7,9,16]

Similar conditions of low fluoride concentrations in the public water supply were observed in studies carried out in small, medium and large-size municipalities in the state of Piauí[23,24] and large-size cities in the State of São Paulo.[16] Such inadequate concentrations (<0.60 mg/L) can be regularized upon compliance to water quality surveillance techniques for human consumption.[15-17]

On the other hand, fluoride concentrations corresponding to the public water supply of the indigenous villages of Baía da Traição did not exceed 0.15 mg/L during the year's quarter. Hence, residual fluoride concentrations can be explained by the absence of fluoridation of the public water supply by the Sanitation Department of SESAI. In addition, the document Guidelines for Monitoring the Quality of Water for Human Consumption in Indigenous Villages (DMAQI) presents the protocol for the treatment of the public water supply of indigenous villages, but there is no indication to fluoridation as a necessary measure. [23]

The interruption or absence of fluoridation of the public water supply of Baía da Traição compromises the protection of the oral health of the people residing in this municipality.[6-8] In addition, interruption of water fluoridation has a negative effect on collective oral health, reflecting the increased prevalence and experience of dental caries, according to the results of a recent systematic review.[7]

The results of this study point to the need for epidemiological monitoring of the population involved, as well as to warning government agencies as to strategies to increase access to preventive measures against dental caries, in order to overcome political, financial and technical constraints due to collective benefit provided by this measure.[25] Therefore, the results should be monitored, disseminated and government measures should be taken accordingly to ensure that the framework in question is reversed and that fluoridation is resumed in the downtown area and implemented in the indigenous villages.[7,9]

According to current legislation in Brazil,[14] public water supply in the municipality of Baía da Traição (downtown and indigenous villages) presented fluoride concentrations below the recommended level to promote the anticaries benefit to the population (<0.60 mg/L) in the checkpoints analyzed. After verification of the fluoride concentration, the investigators of the present study made contact with the SAAE and the Department of Sanitation of SESAI, communicating the results and emphasizing the preventive importance of fluoridation. Thus, these public organs can check the current fluoride concentration and adjust the concentration accordingly to promote the anticaries benefit at a population-wide level.

The authors identified that the water quality is adequate for human consumption and allows for the implementation of the fluoridation system by accessing surveillance reports on water quality for human consumption *in loco*. However, this latter measure depends only on political desirability and government articulation on more than one level (municipal and federal, at least). It is known that the 'Brasil Sorridente' (Smiling Brazil) Program finances the installation and maintenance of public water supply fluoridation systems. Thus, the interruption process must be combated in view of the collective benefit generated from this action.

The population must be warned about the negative impacts of interrupting water fluoridation. Besides that, a wider governmental campaign should stimulate the installation and maintenance of public water supply fluoridation systems. Although there is a financial source that covers the system, there is not any movement pushing up municipalities to implement fluoridation systems. Periodic external control, which is very important to assess quality, should be performed by research centers like Universities. The most important measure, to our knowledge, would be education directed to population, in order to provoke

permanent changes in the way health public measures would impact the daily live of individuals.

According to Federal Decree nº 5440 of May 4, 2005,[26] the organs and entities responsible for public supply systems should frequently make available information on the characteristics of the water distributed through the use of understandable and easily accessible measures to consumers.[27] This reality, however, was not verified in the municipality of Baía da Traição, and may also be the reality of other Brazilian municipalities. The importance of fluoridation of the public water supply, as well as the adversities resulting from the deficiency of fluoride maintenance at ideal concentrations, should be disseminated to the population of Baía da Traição[6]. Thus, this knowledge will not only be restricted to dentists, health professionals and government, as the population may claim their rights to protection against dental caries arising from a continuous and regular process of fluoridation.[27]

CONCLUSION

In the period evaluated, the public water supply in the municipality of Baía da Traição presented fluoride concentrations below the levels capable of promoting the anticaries benefit. The fluoride concentrations observed in this study may assist in determining the remaining concentration for adequacy of the public water supply of the downtown area and indigenous villages.

Disruption of the fluoridation system may impact the caries prevalence of the population involved, and further protection measures are required. In this sense, effective fluoridation must overcome political, financial and technical constraints due to the collective benefit provided by this measure.

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PREVALENCE OF SELF-REPORTED AWAKE AND SLEEP BRUXISM AMONG DENTAL STUDENTS

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Palavras-chave: Bruxismo. Epidemiologia. Sono. Estudantes de Odontologia.

RESUMO

Objetivo: Avaliar a prevalência de bruxismo em vigília e do sono e sua associação com características do sono em estudantes de odontologia. **Métodos**: Ao todo 153 estudantes de uma Faculdade de Odontologia brasileira foram convidados a participar desse estudo transversal, respondendo a um questionário avaliando sexo, idade, endereço, realização de trabalho remunerado e/ou trabalho noturno remunerado, horas de sono por noite, tempo para adormecer, qualidade do sono, sono agitado e a presença de um colega de quarto. A ingestão de bebida energética e pílulas para dormir, o histórico de acordar durante a noite, acordar sentindo-se cansado e dificuldades de concentração nas atividades diárias também foram avaliadas. O diagnóstico de bruxismo baseou-se no auto-relato. Foi realizada a análise descritiva e teste qui-quadrado. **Resultados**: A média de idade dos participantes foi de 21 anos (±3,25) e 73% eram do sexo feminino. A prevalência do bruxismo em vigília foi de 36,8% e bruxismo do sono foi de 11,3%. A maioria dos participantes, 57,2%, classificou a qualidade do sono como boa, porém 52,6% relataram que acordavam cansados. O uso de medicamento para dormir nos últimos 30 dias (P=0.002), acordar durante a noite e demorar mais de uma hora para dormir novamente nos últimos 30 dias (P=0.005) e acordar sentindo-se cansado (P=0.012) foram fatores associados ao bruxismo em vigília auto-relatado. **Conclusão**: A prevalência de bruxismo em vigília foi maior que a prevalência do bruxismo do sono em estudantes de odontologia. O uso de medicamento para dormir, acordar durante a noite e demorar mais de uma hora para dormir e acordar sentindo-se cansado podem ser fatores indicadores da presença de bruxismo em vigília em estudantes de odontologia.

Key-words: Bruxism. Epidemiology. Sleep. Dental Students.

ABSTRACT

Objective: To evaluate the prevalence of self-reported awake and sleep bruxism and its association to sleep characteristics among dental students. **Methods**: A cross-sectional study was conducted with 153 students of a Brazilian Dental School. Students who accepted to participate answered a questionnaire evaluating their sex, age, place of living, paid work, nocturnal paid work, hours of sleep per night, time to fall asleep, sleep quality, if participant had a bedroom partner, if participant is quiet on bed while sleeping and intake of sleep medication. Information on intake of energy drink, if participant wake up overnight, if participant wake up tired and it has been difficult to concentrate on daily activities was also collected. Awake and sleep bruxism was based on self-report. Descriptive analysis and chi-square test were carried out. **Results:** Most students were female (73%) and mean age was 21 years old (±3.25). The prevalence of self-reported awake and sleep bruxism was 36.5% and 11.3%, respectively. Most participants rated their sleep quality as good (57.2%) and reported that they woke up feeling tired (52.6%). Intake of sleep medication in the last 30 days (P=0.002), waking up overnight and taking over an hour to sleep again in the last 30 days (P=0.005) and waking up feeling tired (p=0.012) were associated factors to self-reported awake bruxism. **Conclusion:** The prevalence of self-reported awake bruxism was higher than the prevalence of sleep bruxism among dental students. Intake of sleep medication, waking up overnight and taking over an hour to sleep again and waking up tired were can be indicators of the presence of awake bruxism in dental students.

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INTRODUCTION

The origin of the word bruxism is Greek (*brychen*), which means to crush[1]. The term *bruxomanie* was first used by Marie Pietkewicz in 1907.[1] Ever since, it has been employed worldwide to describe the behavior of grinding and/or clenching of teeth.[1] Bruxism is the result of facial muscle contractions involving mandibular movements and unpleasant noises controlled by the central nervous system.[2,3] It can affect children and adults.[3] There has been much divergence in the scientific literature regarding the prevalence of

bruxism and differences concerning sex and age have not been reported.[4]

According to the international consensus criteria, bruxism can be classified into three categories: possible (based on self-report and/or parent/guardian/third-party report); probable (based on reporting and oral clinical examination) and definite (based on reporting, oral clinical examination and polysomnography results).[2] The etiology of awake bruxism and sleep bruxism is multifactorial involving a strong association with emotional issues.[3,4]

Accumulation of routine duties creates stress and can adversely affect health.[5-7] Dental students not only have to focus on their daily tasks, but also contend with demanding academic workloads.[6] In general, they are exposed to many academic hardships, which influence their emotional behavior owing to stress-adaptation reactions.[7] Ultimately, stress can be associated with awake and sleep bruxism.[7] Therefore, the aim of this study was to assess the prevalence of self-reported awake bruxism and sleep bruxism among dental students of a Brazilian federal university.

MATERIALS AND METHODS

Participants, setting, recruitment period and eligibility criteria

The present study was carried out in Belo Horizonte, southeastern Brazil, at the Dental School of the Federal University of Minas Gerais. The Dentistry Program is a five-year accredited program leading to the degree of Bachelor of Dental Sciences. Students in the first, second and fifth years were recruited between March and June of 2016. Year one and year two were chosen because they represent the first contact of students with the university and clinical setting, respectively. In year five, individuals are at the end of the program and labor activities will take place shortly after. Those periods are supposed to be of great stress and anxiety for students.

Ethical issues

Students were invited to take part in this study. Those who accepted participating signed a statement of informed consent. Approval from the Institutional Ethics Committee on Human Research (protocol # 482/07) was obtained.

Data Collection

Participants answered a validated questionnaire used in a previous Brazilian study.[7] The questionnaire consisted of open-ended and closed-ended questions through which the following information was collected: sex, age, place of living, paid work (extracurricular activities), nocturnal paid work, number of hours of sleep per night, time to fall asleep, quality of sleep, if the participant sleeps with a bedroom partner, if participant is not quiet in bed while sleeping and intake of sleep medication. Information on the intake of energy drinks, if the participant wakes up overnight, if the participant wakes up tired and if it was difficult to concentrate during daily activities was also collected.

The diagnosis of awake and sleep bruxism was based on participants' self-report according to a consensus criterion.[2] For awake and sleep bruxism assessment, participants answered the following questions:[7]

1. In the last 30 days, did you grind your teeth whilst awake?
2. In the last 30 days, did anyone tell you that you grind your teeth during sleep?

The answers for both questions could be "yes" or "no". Awake bruxism was confirmed if individuals answered "yes" for the first question and sleep bruxism was confirmed if individuals answered "yes" for the second question[7].

Pilot Study

A pilot study was conducted with 18 dental students six months prior to the development of the main study. Participants in the pilot study were not included in the main study. Methods were adequate and changes in data collection were unnecessary.

Data Analysis

The Statistical Package for the Social Sciences (SPSS, version 21.0; IBM, Chicago, USA) was used for data analysis. For this study, descriptive analyses and Chi-square test, with a 5% significance level, were carried out.

RESULTS

Among the 180 students in the first, second and fifth years, 153 answered the questionnaires (response rate: 85%). Fifty-one were in the first year, 59 in the second and 42 in the fifth year. The mean age of the participants was as follows: first year - 19 years (±1.37), second year - 21 years (±3.96) and fifth year - 23 years (±1.59). Participants' overall mean age was 21 years (±3.25). Most dental students were female (73%) and lived with their parents (59.8%). The prevalence of self-reported awake bruxism was 36.8% and the prevalence of self-reported sleep bruxism was 11.3% (Table 1).

A high percentage of dental students had no partner in their bedroom during sleeping (78.3%). Most participants reported that they sleep between 6-8 hours per night (84.9%). Forty-five percent of participants took between 10-20 minutes to fall asleep and 57.2% rated their sleep quality as good. However, 52.6% reported that they woke up feeling tired and 51.3% stated that it was difficult to concentrate on daily activities. The intake of sleep medication was reported by 5.9%, and 10.5% reported that they had used energy drinks and/or pills to stay awake at least once within the last 30 days (Table 1).

***Table 1**: Descriptive analysis of the study variables among dental students.*

Variables	Number	%
Sex		
Female	111	73.0
Male	41	27.0
Place of living		
With parents	91	59.8
Without parents	61	40.2
Paid work (extracurricular activities)		
Yes	11	7.2
No	141	92.8
Nocturnal paid work (extracurricular activities)		
Yes	9	5.9
No	143	94.1
Self-reported Awake bruxism		
Yes	56	36.8
No	96	63.2
Self-reported Sleep bruxism		
Yes	17	11.3
No	134	88.7

Note: Not all dental students answered all the questions.

Bivariate analysis between independent variables and self-reported awake and sleep bruxism are presented in Table 3. The variables "intake of sleep medication in the last 30 days", "waking up overnight and taking over an hour to sleep again in the last 30 days" and "waking up tired" were associated to self-reported awake bruxism. No association between independent variables and self-reported sleep bruxism was observed.

DISCUSSION

The prevalence of self-reported awake bruxism found in the present study (36.8%) is similar to the prevalence of 36.5% reported by another Brazilian study with dental students.[7] However, the prevalence of self-reported sleep bruxism (11.3%) herein was quite different from the prevalence reported by the same Brazilian study (21.5%).[7] The prevalence of awake and sleep bruxism among university students is still unclear in the literature and it may vary between 17.9% and 31.8% for sleep bruxism and between 2.3% and 37.9% for awake bruxism[5,7,8] depending on the country where the study was conducted. This variability regarding awake and sleep bruxism prevalence may be related to the cultural differences and different instruments used for data collection. It seems that sleep and awake bruxism prevalence is higher among university students compared to the general population.[5] This higher prevalence

***Table 2**: Descriptive analysis of sleep characteristics and daily activities of dental students*

Variables	Number	%
Sleep hours per night		
0 – 5	18	11.8
6 – 8	129	84.9
9 – 10	5	3.3
Minutes it takes to fall asleep		
1 – 5	38	25.0
10 – 20	66	45.3
25 – 40	38	25.0
60 – 90	10	6.7
Quality of sleep		
Good	87	57.2
Bad	65	42.8
Sleep with a bedroom partner		
No	119	78.3
Yes	33	21.7
Not quiet on bed while sleeping		
Yes	84	55.3
No	68	44.7
Intake of sleep medication in the last 30 days		
Yes	9	5.9
No	143	94.1
Energy drinks and/or pills to stay awake at night at least once in the past 30 days		
Yes	16	10.5
No	136	89.5
Woke up overnight and took over an hour to sleep again in the last 30 days		
Yes	42	27.6
No	110	72.4
Wake up tired		
Yes	80	52.6
No	72	47.4
Difficulty concentrating on daily activities		
Yes	78	51.3
No	74	48.7

Note: Not all dental students answered all the questions.

***Table 3**: Bivariate analysis of the association between studied variables and self-reported sleep bruxism and self-reported awake bruxism*

Variables	Self-reported Sleep Bruxism			Self-reported Awake Bruxism		
	Yes	No	*P*	Yes	No	*P*
Sex						
Female	13 (76.5)	97 (72.4)	1.000[2]	42 (75.0)	69 (71.9)	0.709[1]
Male	04 (23.5)	37 (27.6)		14 (25.0)	27 (28.1)	
Paid work (extracurricular activities)						
Yes	02 (11.8)	09 (06.7)	0.358[2]	04 (07.1)	07 (07.3)	1.000[2]
No	15 (88.2)	125 (93.3)		52 (92.9)	89 (92.7)	
Nocturnal paid work (extracurricular activities)						
Yes	02 (11.8)	07 (05.2)	0.268[2]	04 (07.1)	05 (05.2)	0.726[2]
No	15 (88.2)	127 (94.8)		52 (92.9)	91 (94.8)	
Sleep hours per night						
0 – 5	01 (05.9)	15 (11.4)	0.834[2]	05 (09.1)	11 (11.6)	0.733[2]
6 – 8	16 (94.1)	112 (84.8)		49 (89.1)	80 (84.2)	
9 – 10	0 (0.0)	05 (03.8)		01 (01.8)	04 (04.2)	
Minutes it takes to fall asleep						
1 – 5	03 (17.6)	35 (26.1)	0.749[2]	09 (16.1)	29 (30.2)	0.056[2]
10 – 20	07 (41.2)	58 (43.3)		26 (46.4)	40 (41.7)	
25 – 40	06 (35.3)	32 (23.9)		14 (25.0)	24 (25.0)	
60 – 90	01 (05.9)	09 (06.7)		07 (12.5)	03 (03.1)	
Quality of sleep						
Good	10 (58.8)	76 (56.7)	1.000[1]	28 (50.0)	59 (61.5)	0.179[1]
Bad	07 (41.2)	58 (43.3)		28 (50.0)	37 (38.5)	
Sleep with a bedroom partner						
No	15 (88.2)	103 (76.9)	0.366[2]	46 (82.1)	73 (76.0)	0.421[1]
Yes	02 (11.8)	31 (23.1)		10 (17.9)	23 (24.0)	
Not quiet on bed while sleeping	10 (58.8)	74 (55.2)	0.803[1]	36 (64.3)	48 (50.0)	0.094[1]
Yes	07 (41.2)	60 (44.8)		20 (35.7)	48 (50.0)	
No						
Intake of sleep medication in the last 30 days	01 (05.9)	08 (06.0)	1.000[2]	08 (14.3)	01 (01.0)	**0.002**[2]
Yes	16 (94.1)	126 (94.0)		48 (85.7)	95 (99.0)	
No						
Energy drinks and/or pills to stay awake at night at least once in the past 30 days						
Yes	01 (05.9)	15 (11.2)	1.000[2]	06 (10.7)	10 (10.4)	1.000[1]
No	16 (94.1)	119 (88.8)		50 (89.3)	86 (89.6)	
Woke up overnight and took over an hour to sleep again in the last 30 days						
Yes	06 (35.3)	36 (26.9)	0.566[2]	23 (41.1)	19 (19.8)	**0.005**[1]
No	11 (64.7)	98 (73.1)		33 (58.9)	77 (80.2)	
Wake up tired						
Yes	12 (70.6)	68 (50.7)	0.196[1]	37 (66.1)	43 (44.8)	**0.012**[1]
No	05 (29.4)	66 (49.3)		19 (33.9)	53 (55.2)	
Difficulty concentrating on daily activities						
Yes	08 (47.1)	70 (52.2)	0.799[1]	32 (57.1)	46 (47.9)	0.314[1]
No	09 (52.9)	64 (47.8)		24 (42.9)	50 (52.1)	

might be related to the highest levels of anxiety and stress faced by university students.

Stress and anxiety levels among dental students have been evaluated in other studies.[9-11] A study in Saudi Arabia found a prevalence of 66.8% and 54.7% for anxiety and stress, respectively.[9] Factors such as students' sex, emotional intelligence and clinical workloads may have influenced anxiety levels presented by the students.[6,10] A longitudinal study with dental students from the University of Jordan found that psychological stress levels increased as dental students moved forward from the first to the fifth year.[11] However, just a few students recognized that they sought professional assistance for management of stress.[6] Although the present study did not measure anxiety and stress levels, future research assessing those variables and their relationship with awake and sleep bruxism should be encouraged.

In our study, only 5.9% of students reported the use of sleeping pills. Despite the small percentage, this variable was associated self-reported awake bruxism, as well as the report of awakening overnight, waiting long periods to go back to sleep and waking up tired. Most dental students rated their sleep quality as good, although they also complained of fatigue in the morning and reported difficulty in concentrating on daily activities. Poor sleep quality, very frequently reported by dental students in other studies,[7,12] may be associated with bruxism, symptoms of anxiety and stress as well as lower academic performance.[7,12,13] Academic tasks during the dental program exert heavy demands on students, affecting their anxiety and stress levels along with their sleep duration and quality, contributing to higher sleeping pill intake and consequently higher prevalence of awake bruxism. Sleep plays an important role in individuals' psychological health and health complaints,[14] and a link between sleep characteristics, stress and anxiety levels and awake bruxism may exist. Future research assessing this relationship on a deeper level is encouraged.

In the present study, the percentage of students using energy drinks and/or pills to stay awake (10.5%) was higher than the intake of sleeping pills. Such a percentage was very similar to the percentage found among Chinese high school adolescents (10.5%)[15] and less than the percentage reported by Canadian adolescents and young adults (15.6%).[16] An American study stated that accomplishment of academic tasks was not a justification for increased energy drink consumption.[17] In our study, the reasons for energy drink and/or pills intake to stay awake were not investigated and were not associated with self-reported awake and sleep bruxism. Nevertheless, such an evaluation should be carried out in future research.

A small percentage of students in this sample reported that they engaged in paid work or nocturnal paid work. Moreover, most students lived with their parents. Individuals who need to share academic and labor activities may be overloaded with daily tasks, increasing the chances of stress.[18] Culture may also be taken into account. In certain countries, such as Brazil, university students still depend on their parents for making a living. In other countries, however, young adults are more used to engage in labor activities while in university.[19]

The present study used students' self-report to diagnose sleep bruxism and awake bruxism. In the international consensus, bruxism diagnosis has been categorized as follows: possible (based on self-report and/or parent/guardian/third-party reporting); probable (based on reporting and oral clinical examination) and definite (based on reporting, oral clinical examination and polysomnography results).[2] It is important to acknowledge that polysomnography is the gold standard tool for sleep bruxism diagnosis. However, it is a high-cost exam, thereby being more appropriate for small sample studies[2]. Self-report, though, has usually been used in large epidemiological studies[5,7,20,21] as an alternative parameter for clinical exam and polysomnography recording.[2]

The present study has limitations that should be acknowledged. The first limitation regards to the convenience sample restricted to dental students from one institution. The second limitation is in terms of the diagnosis of bruxism based, solely, on self-report. Future studies with a larger sample, including individuals from more than one institution, using other diagnoses strategies and also analyzing stress and anxiety levels among dental students are encouraged to better understand awake and sleep bruxism in this population.

The present study concluded that the prevalence of self-reported awake and sleep bruxism among dental students was 36.8% and 11.3%, respectively. Intake of sleep medication over the past 30 days, waking up overnight and taking over an hour to sleep again in the last 30 days and waking up tired were factors associated with self-reported awake bruxism among dental students. Healthcare providers should be aware of this information.

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ORAL HEALTH AND RISK FACTORS FOR DENTAL CARIES OF LOW-INCOME SCHOLARS ENROLLED IN A FULL-TIME EDUCATIONAL PROGRAM

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Palavras-chave: Cárie Dentária. Criança. Saúde Bucal.

RESUMO

Introdução: Muitos fatores estão associados ao desenvolvimento da cárie em crianças, incluindo o ambiente que estão inseridos. Poucos estudos avaliam a condição bucal em um ambiente educacional de tempo integral. **Objetivo**: identificar as condições de saúde bucal e os fatores de risco para cárie em crianças matriculadas em um programa educacional de tempo integral. **Métodos**: Os dados os pais e seus filhos de 3 a 12 anos que estavam matriculados no programa educacional de tempo integral no Rio de Janeiro, Brasil, foram coletados. Os pais responderam a um questionário com informações sociodemográficas, sobre higiene bucal, hábitos e dieta. As crianças foram submetidas a exames clínicos. Foram realizadas análises sobre possíveis associações entre cárie infantil e escolaridade dos pais; status socioeconômico; biofilme dentário; hipoplasia, sangramento gengival e maloclusão (teste do qui-quadrado ou exato de Fisher; p <0,05). **Resultados**: Trinta e oito pais participaram da entrevista. Os cuidadores predominantes foram mães, em sua maioria com ensino médio completo e pertencentes à família de baixa renda. A amostra foi constituída por 350 crianças, 38 (7,27 ± 2,22 anos) que foram examinadas durante nove meses. A maioria das crianças era do sexo feminino (63,2%) na dentição mista (69%) e sem cárie (61,9%). De acordo com o índice de cárie (dentes cariados, ausentes e preenchidos), a maior média foi encontrada na dentição decídua (dmf-t = 1,20 ± 2,12) enquanto na permanente a média do CPOD foi de 0,35 ± 0,86. **Conclusão**: Biofilme, hipoplasia, sangramento gengival e má oclusão não foram associados à cárie (p> 0,05). Os determinantes socioeconômicos e os demais fatores de risco não foram considerados fatores predisponentes para a cárie, sugerindo que os programas educacionais de tempo integral exercem influência positiva na saúde bucal das crianças.

Keywords: Dental Caries. Child. Oral Health.

ABSTRACT

Introduction: Many factors are associated with caries development in children, including the daily environment. Thinking that few studies evaluate oral condition in a full-time educational environment. **Objective**: identify the oral health conditions and risk factors for caries in children enrolled in a full-time educational program. **Methods**: Data were collected from parents and their children aged 3-12 years that were enrolled in the full-time educational program in Rio de Janeiro, Brazil. The parents answered a questionnaire with socio-demographic, oral hygiene, habits and diet information. The children underwent clinical examinations. The association between children's caries and: parents education level; socioeconomic status; dental biofilm; hypoplasia, gingival bleeding and malocclusion was performed (Chi-square or Fisher's exact tests; p<0.05). **Results**: Thirty-eight parents attended the interview. The predominant caregivers were mothers with a high school complete degree and belonging to low income family. From a sample of 350 children, 38 (7.27±2.22 years) were examined during nine months. Most of these children were girls (63.2%) in the mixed dentition (69%) and without caries (61.9%). According to the caries index (decayed, missing and filled teeth), the highest average was found in the primary dentition (dmf-t = 1.20±2.12) while in the permanent one the mean DMFT was 0.35±0.86. **Conclusion**: Biofilm, hypoplasia, gingival bleeding and malocclusion were not associated with caries (p>0.05). The socioeconomics determinants and the risk factors were not considered predisposing factors for caries, which suggest that educational programs of full-time study exert a positive influence on children's oral health.

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INTRODUCTION

Caries remains the most prevalent non-contagious disease in most industrialized countries, affecting 60–90% of schoolchildren and the vast majority of adults.[1] The last Brazilian epidemiological survey showed that five-year-old Brazilians children have a mean of more than two caries lesions and among these children, 80% of cavitated tooth surfaces remained untreated (Brazilian Oral Health Survey - SB Brazil Project 2010).[2] Especially about southeast region, the decayed, missing and filled teeth index (dmf-t) observed was 2.10 in this age group. The consequences of dental caries are usually pain and esthetic alterations, which affect the children's and caregivers' quality of life.[3] This has led to a greater search for aesthetic treatment and healthy smile, in both general and pediatric dental visits in recent years.[4] In addition to caries and its consequences, oral problems, including malocclusion, also have a negative impact on the quality of life of adolescents.[5,6]

Risk assessment is essential in decision-making for targeted caries prevention and management. Family caries experience, transmission-related behaviors especially good habits, dietary factors, health beliefs, and lower income were identified as risk factors for caries progression toward cavitation in very young children in a recent study.[7,8] Many factors are associated with caries development in children, including the daily environment that modulates the oral hygiene's habits of children. Despite of that there are few studies related to caries risk in children who stay in a full-time educational ambient, especially in public schools in metropolis of Brazil such as industrialized area such as Rio de Janeiro. Thus, the purpose of this study was to identify the oral health conditions and risk factors for the development of caries in children enrolled in a full-time public educational program in Rio de Janeiro, Brazil.

MATERIALS AND METHODS

The Human Ethics Committee of the Veiga de Almeida University (protocol number 149.814) approved this study. Informed consent was obtained from all participating individuals or parents/legal guardians.

Eligible children from 3 to 12 years of age (range of children enrolled in the full-time educational program called *Abrigo Tereza de Jesus* – ATJ) were included in the study using a cross-sectional design during the period of June 2013 to March 2014. ATJ is a non-economic association, located in Tijuca, Rio de Janeiro, Brazil, with religious character. Tijuca is a middle-class neighborhood surrounded by low-income communities. The children enrolled in ATJ were from public schools and received daily, scholar lessons and educational activities: library, informatics, reading, manual working, recreation and cultural visiting. Besides, they have medical and nutritional assistance. Although the dentist is important in the multi-professional team, the dental assistance was not provided due to its expensive cost for maintenance; however, the children received oral hygiene instructions by the nurses.

Parents or caregivers were contacted twice by a letter and they answered a questionnaire conducted about socioeconomic characteristics and children oral habits in distinct life moments. Breastfeeding practices, use of pacifiers, suck digital, biting objects and onychophagia data were collected. Oral hygiene information and preventive measures from caries, such as, toothbrush frequency, use of fluoride and dental floss were obtained through questionnaires. The socio-economic background of the studied sample was summarized in terms of family income, using the minimum wage as a unit (equivalent to USD 300-900). Families that receive more than 900 were classified as high family income and those who received < USD 900, were classified as low family income.

The clinical examination of the children was undertaken by trained post-graduate students with the professor's supervision. We evaluated the presence or absence of malocclusions such as overjet, overbite, open bite and abnormal midline. We also considered the presence or absence, providing the score "0" for absence and "1" for the presence of the following variables: visible dental plaque, gingival bleeding (using dental floss), hypoplasia and malocclusion as risk factors for dental caries. In addition, we evaluated the presence or absence of fluorosis in children with permanent teeth (mixed dentition).

Patients were seated in a dental chair, and the examiner performed the professional cleaning using a prophylactic paste and Robinson brush. Probe and dental mirror were used according to the criteria recommended by the World Health Organization.[9] Caries lesions were diagnosed in primary and permanent teeth by visual examination and registered if there was definite visual evidence with a breach in the enamel and extension into dentine. Dental caries was assessed using the DMFT and/or dmf-t indexes.[9]

The children were classified according to the caries experience level. We considered the mean number of dmf-t/DMFT in individuals with caries. The criteria were determined as follows: caries-free subjects had a complete absence of carious lesions in both dentitions; low caries experience subjects had 1 or 2 teeth decayed, filled, or missing due to caries lesions; and high caries experience subjects had 3 or more teeth decayed, filled, or missing due to caries lesions.

Data were analyzed using SPSS 19.0 software (IBM SPSS

Statistics for Windows, Version 19.0. Armonk, NY, USA: IBM Corp). The level of statistical significance was set at *p*d"0.05. Chi-square or Fisher's exact tests were used to determine if caries experience were associated with risk factors.

RESULTS

Of 350 children and adolescents enrolled in ATJ for one year, 150 informed consents were obtained from parents and legal guardians. However, only eighty four children were clinically examined (n = 84) and thirty-eight (n=38) parents/caregivers accepted our invitation and attended to interview. The mean age of the children was 7.27 (±2.22) and 63.2% were girls. The characteristics of this population were summarized in Table 1. The monthly family income of the majority of the children varied from less than 1 to 3 times the Brazilian minimum wage, equivalent to USD 300–900. The parent/caregiver education level and family's socioeconomic status were not associated with caries experience (p > 0.349), since 84.2% presented low family income and 59.4% from this universe were caries free. As well as, 50.0% of children with high caries experience presented high family income.

***Table 1**: Demographic data of the parents/caregivers (N=38)*

Parents/Caregivers	**N (%)**
mother	32 (84.2)
father	2 (5.2)
grandmother	3 (7.8)
others	1 (2.6)
Age, years	**(%)**
15 - 30	10 (27.6)
31 - 50	27 (70.2)
> 50	1 (2.1)
Educational level	**N (%)**
Incomplete primary school	10 (27.7)
Complete primary education	2 (4.3)
Incomplete high school	5 (12.8)
Complete high school	17 (44.7)
Incomplete higher education	3 (8.5)
Complete higher education	1 (2.1)
Monthly income	**N (%)**
0 - 1 minimum wages	16 (46.6)
1 - 3 minimum wages	22 (57.4)

***Table 2**: Preventive measurements and oral habits data reported from parents/caregivers (N=38)*

Tooth-brushing	**N (%)**
1-2 times	19(50)
3 times or more	19 (50)
Tooth-brushing before sleep	38 (100)
Use of dental floss daily	
yes	11 (28.9)
no	27 (71.1)
Use of fluoride toothpaste	38 (100)
Responsible for Tooth-brushing	
child	23 (60.5)
caregiver	11 (28.9)
both	4 (10.6)
Breastfeeding	
yes	37 (97.4)
no	1 (2.6)
Digit-sucking habits	
previous	3 (7.9)
yes	1(2.6)
no	34 (89.5)
Pacifier	
yes	14(36.8)
no	24 (63.2)
previous	5 (13.2)
no	22(57.9)
yes	11(28.9)
Onychophagia	
previous	1 (2.6)
no	30 (78.9)
yes	7(18.4)

Table 2 presented the preventive measurements and oral habits data reported from parents/caregivers. Thirty eight children underwent a clinical oral examination for the assessment of caries, malocclusions and risk factors for caries

progression toward cavitation, such as, dental plaque visible, gingival bleeding and hypoplasia as show in Table 3.

***Table 3**: Characteristics of children dentition (N=84)*

Dental age	**N (%)**
Primary dentition	23 (27.4)
Mixed dentition	58 (69.0)
Permanent dentition	3 (3.6)
Malocclusion	
yes	39 (46.4)
no	45 (53.6)
Crossbite	
anterior	2 (2.5)
posterior	12 (14.2)
no	70 (83.3)
Open-bite	
yes	11 (13.1)
no	73 (86.9)
Overbite	
normal	75 (89.3)
alteration	11 (13.1)
Overjet	
normal	73 (86.9)
alteration	11 (13.1)
Abnormal Midline	
yes	14 (16.7)
no	70 (83.3)
Dental caries	
yes	32 (38.1)
no	52 (61.9)
Visible plaque	
yes	76 (90.5)
no	8 (9.5)
Gingival bleeding	
yes	40 (47.6)
no	44 (52.4)
Fluorosis	
yes	19 (22.6)
no	65 (74.4)
Hypoplasia	
yes	10 (11.9)
no	74 (81.1)

The mean dmf-t was 1.20 (±2.12) and DMFT was 0.35 (±0.86). In deciduous teeth we obtained a mean of 2.86 (±2.01) for the decayed component of the index, 0.12 (±0.43) for the missing component and 0.38 (±0.80) for the filled component. In permanent teeth we obtained a mean of 1.58 (±1.24) for the decayed component of the index, 0.00 for the missing component and 0.20 ± (0.63) for the filled component.

The mean dmf-t in children diagnosed with early childhood caries (ECC) (n=16) was 1.56 (±2.22). The percentage of caries-free children was 61.9%, 25.0% had high caries experience and 13.1% had low caries experience. The presence of biofilm (*P*=1.00), hypoplasia (*P*=0.73), gingival bleeding (*P*=0.26) and malocclusion (*P*=0.07) were not associated with dental caries.

DISCUSSION

Rio de Janeiro is a big city localized in southeast Brazil and is one densely populated and industrialized region of the country. Only 19.5% of the children and adolescents are attending at municipal public school in full-time period. We studied this population since we aimed to understand the oral hygiene and health of children from a full-time educational program.

In our study, it was possible to observe a lower prevalence of dental caries when compared to the data from the last survey carried out in the country. Analyzing the dmf-t and DMFT components, we found a higher number of decayed teeth in comparison with the filled and missing component. It is well known that untreated caries and its clinical consequences exerted a negative impact on the quality of life of the Brazilian schoolchildren.[10,11] It is suggested that these families have difficulties in accessing public services. In addition to that, lack of knowledge about oral hygiene and cariogenic diets could be a reason for this pattern observed in families with lower parents' educational level. In the present study, 61.9 % of children presented no caries lesions; a percentage value higher than the last national epidemiologic sense called SB Brazil that was 46.6 %.[12] Nova et al.[13] found a similar percentage (72 %) of caries-free child in a population from São Paulo.[13]

Our findings revealed a different situation compared to a recent study in Satão, Portugal,[14] since they obtained a moderate level of prevalence of dental caries in adolescents, with a higher number of filled teeth considering the DMF-T index applied. This condition indicates the differences of the two countries, since in the Brazil most of the adolescents do not have, during their lives, dental appointments for dental caries treatments and lower access to dental appointments. It is important to emphasize that relevant consequences of cavitated dentine lesions such as pain and chewing difficulties

can affect the child's learning and growth processes and are related to the need for children's hospitalization.[15]

It is important to analyze oral health behavior and risk factors, such as, enamel defects during clinical oral examination. There is evidence for a genetic component in caries susceptibility, and studies in humans have suggested that variation in enamel formation genes may contribute to caries.[16] Moreover, the susceptibility to caries results from gene-environment interactions.[17] A recent study with Brazilian children observed that caries experience was more common among children who had enamel hypoplasia in their posterior teeth than among those with none. The authors concluded that enamel hypoplasia appears to be an important risk factor for dental caries.[18] In our study, the prevalence of enamel hypoplasia was 11.9% and, contradicting the previous findings we not observed association between this alteration and caries, maybe this fact can be explained by the limited sample size. This can be justified by the fact that the majority of our sample consisted by children with mixed dentition and without caries experience. Besides it, the full-time study program can influence oral health status of these children.

Regarding dental fluorosis, the majority of children with permanent teeth did not present this alteration. All patients used fluoride toothpaste, and 39.5 % of them were supervised and/or had tooth brushing supervision by their parents. This fact can contribute for the reduced number of children with dental fluorosis compared with others studies in Brazilian population.[19,20] It is important to point out that many studies have been demonstrating that the use of fluoride in tooth paste supervised by an adult is crucial for caries control.[21] Thus, the caregivers from our study were advised about the importance of fluoride in reducing dental caries. We suggest that the caries experience was low in this population because the children spent the major day in the full-time educational program that presented a food and oral hygiene control.

Extensive dental decay probably results in unplanned extractions in the primary and mixed dentitions and, in many cases, could cause malocclusions. However, in the current study, it was not found association among dental caries and malocclusion, we suggest that it can be explained by the limited sample size. A rotated tooth may be difficult to clean and can cause increased plaque retention. A traumatic occlusion may result in direct damage to the periodontal support. Overbites may predispose to damage of the gingiva palatal to the upper incisor teeth. Similarly, severely retroclined upper incisor teeth may damage the labial gingiva of the lower teeth. In addition, malocclusion teeth lead psychosocial problems related to impaired dentofacial aesthetics and also disturbances of oral functions.[22] Considering the relevant conditions exposed above, we verified the occlusion in our population, and, we observed a moderate prevalence of malocclusions when compared with the epidemiological survey in Brazil in 2010.[2] According to Welbury all children from the age of 8 years should be screened for malocclusion.[23]

It is important to emphasize the relevance of the ATJ in these children´s development and health. Moreover, few studies assessing the oral health condition of children enrolled in a full-time educational program has been reported. Considering low income family in Brazil, full-time educational programs present a fundamental hole in general and oral health condition of children and adolescents, presenting a direct impact on school success, rescuing self-esteem and enabling him to effectively achieve learning and an adequate quality of life. Moreover, regarding oral health, ATJ presented a restrict diet and oral hygiene education that contributes to improve oral condition.

It is known that family caries experience, transmission-related behaviors, dietary factors, health beliefs, and lower income were identified as risk factors for caries progression toward cavitation in very young children.[8] The risk factors analyzed were not associated with dental caries and we observed a low prevalence of cavitation and malocclusions when compared with the most recent epidemiological survey in Brazil. We believe that the measures of oral hygiene and caries status in these children confirmed the adherence to preventive oral health orientations that probably had been reinforced during the ATJ period.

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ORAL HEALTH AND DENTAL CARE RELATED TO DIABETES STATUS IN YOUNG CHILDREN

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Palavras-chave: Criança. Diabetes Mellitus Tipo 1. Higiene Bucal. Cárie Dentária. Manifestações Bucais.

RESUMO

Objetivo: Este estudo compara a saúde bucal, os hábitos alimentares e higiene bucal e a experiência odontológica de crianças com diabetes tipo 1 (DG) e saudáveis (HG) com menos de seis anos de idade. **Métodos**: As crianças foram escolhidas pareadas por sexo e idade em cada grupo. O status de diabetes da DG foi determinado usando os níveis de HbA1c: <8,5% (69 mmol/mol) foi considerado controlado e >8,5% não controlado. Os responsáveis foram questionados sobre higiene bucal, hábitos alimentares e experiência em atendimento odontológico. O exame bucal foi realizado para avaliar índice de cárie (ceod), placa e cálculo, bem como manifestações orais em tecidos moles. Os dados foram descritos e analisados pelo software SPSS 20.0 por meio dos testes Qui-quadrado. **Resultados**: No total, 68 crianças foram incluídas neste estudo. Crianças com diabete diferiram das saudáveis em relação à língua geográfica, hálito cetônico e xerostomia (p<0,05). Apenas 23 % (n=7) dos GD foram considerados como apresentando estado de diabetes descontrolados. Diferenças estatísticas entre o estado diabético controlado e não controlado foram observadas em crianças, como idade no diagnóstico, duração da doença, consumo de açúcar, visitas ao dentista, tipo de experiencia durante a consulta, presença de língua geográfica, cárie dentária, pneumonia relatada e xerostomia (p<0,05). Odontalgia foi a principal razão da ida ao dentista para as crianças DG. **Conclusão**: A saúde bucal e os hábitos alimentares das crianças com diabetes diferiram dos saudáveis. A maioria das crianças com diabetes nunca haviam ido ao dentista antes. Manifestação bucal e hábitos bucais divergem entre crianças com diabetes descontrolados e controlados.

Keywords: Child. Diabetes Mellitus, Type 1. Oral Hygiene. Dental Caries. Oral Manifestations.

ABSTRACT

Objective: This study compares the oral health, dietary and oral hygiene habits and dental care experience of children with type 1 diabetes (DG) to healthy ones (HG) under six years old. **Methods**: The children were chosen matched by gender and age in each group. Diabetes status from DG was determined using HbA1c criteria levels: <8.5% (69 mmol/mol) was considered controlled and >8.5% uncontrolled. Guardians were asked about oral hygiene, dietary habits and dental care experience. Oral examination was performed in order to assess dental caries (dmft), plaque and calculus indexes, as well as oral manifestations in soft tissues. Data were described and analyzed by SPSS 20.0 software through Chi-square and T-tests. **Results**: A total of 68 children were enrolled in this study. Children with diabetes differed from healthy ones in relation to geographic tongue, breath acetone and xerostomia (p<0.05). Only 23% (n=7) of DG were considered as presenting uncontrolled diabetes status. Statistical differences between controlled and uncontrolled diabetic status were observed among children, such as age at diagnosis, disease duration, sugar consumption, dental visits, type of experience during dental appointment, presence of geographic tongue, dental caries, reported breath acetone and xerostomia (p<0.05). Toothache was the main reason that DG children had been to a dentist before. **Conclusion**: Oral health and dietary habits of children with diabetes differed from healthy ones. Most children with diabetes had never been to a dentist before. Oral manifestation and oral habits diverged from children uncontrolled and controlled diabetes.

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INTRODUCTION

Children with type 1 diabetes is considered a worldwide public health problem and is a serious endocrine-metabolic childhood disorder.[1-3] Its incidence is increasing in many countries, especially in children under five years old.[1-3] Good glycemic control is essential to avoid the progression of the disease, which can lead to many complications including blindness, renal insufficiency and death.[4] Measurement of glycosylated hemoglobin (Hb1Ac) is considered the gold standard for assessing long-term glycemic control. The lower the Hb1Ac value is, the better the control. [1,2] The Hb1Ac value for children under six years old is 8.5% (69 mmol/mol), although it

is usually around 6.5% (48 mmol/mol) for other age groups. The gold standard value is higher than in other age groups because a lower Hb1Ac means the patient has more hypoglycemia, which in small children is difficult to recognize and can lead to cognitive impairment and neurological damage.[1,2,4]

Regarding the oral manifestation of type 1 diabetes, the association between periodontal disease and diabetes is already well established in adults, [5-9] as well as the incidence of xerostomia [10] and breath acetone.[11,12] Diabetes-related parameters have been linked to periodontal problems in children[5,6,13] and also accelerated tooth eruption.[14] On the other hand, it is still controversial whether these parameters are associated with dental caries [15-19] and oral manifestations, such as geographic and coated tongue. [20-25] Several studies have investigated the oral status of children with diabetes in relation to metabolic control compared to healthy children. [6,18, 26-28] However, little is known about the oral health of children with diabetes aged under six years old. Thus, it is not clear whether metabolic control influences the oral health of these children.

Good oral health condition depends on many factors, including dietary and hygiene habits and also the access to dental care. Dental care offered to these children plays an important role in oral health. Children with diabetes visit so many different health professionals in order to manage their diabetes that their oral health is sometimes neglected and they tend to have poor oral hygiene practices.[29-32]

The aim of this study was to compare the oral health, dietary and oral hygiene habits and dental care experience of young children with type 1 diabetes to healthy ones and to investigate the role of diabetic status.

MATERIALS AND METHODS

Study population

A case-control epidemiologic study was performed after being approved by the local Ethics in Human Research Committee from HUCFF/UFRJ following the CEP 196/96 and received protocol number 482.780/2. It was conducted in full accordance with the ethical principles of the World Medical Association Declaration of Helsinki. [33] We obtained written informed consent from all parents/legal guardians. A total of 68 children with primary dentition were divided into two groups matched by age and gender. The group with diabetes (DG) was composed of children with type 1 diabetes under treatment at the Diabetes Ambulatory Clinic of the Pediatric Hospital of the Federal University of Rio de Janeiro (UFRJ), recruited from June, 2013 until June, 2014 while the healthy group (HG) were selected from the Pediatric Dentistry Clinic at the Department of Pediatric Dentistry and Orthodontics, UFRJ, and was composed of children with no history of systemic disease.

Parental reports

The parents/legal guardians were requested to provide information about *dietary habits* (sugar consumption frequency), o*ral hygiene habits*, *oral health perception* (dry mouth sensation and breath acetone) and dental care experience.

Diabetes – related variables

Medical data related to DG were obtained from the medical records, such as: capillary glucose values; duration of disease (years since diagnosis); the child's age at the moment of diagnosis of type 1 diabetes; history of complications associated with diabetes; insulin regimen (multiple daily insulin injections or continuous subcutaneous insulin infusion) and glycosylated hemoglobin values – Hb1Ac – whereby Hb1Ac<8.5% (69 mmol/mol) was considered controlled and >8.5% uncontrolled.

Clinical examination

Oral health assessment was performed in all 68 children by a single pediatric dentist (Oliveira, LRP) following international criteria in order to assess the following different conditions:

Oral manifestation: A complete intraoral soft-tissue examination was performed with a dental mirror and gauze square. The diagnosis of any oral soft tissue condition was established based on onset, duration, oral habits, clinical appearance, history of dental trauma and previous episodes. The locations and descriptions of the lesions were also recorded and photographed.

Dental caries experience: The condition of each surface was recorded using the decayed, missing, filled index (dmf-t). The diagnosis criteria followed those proposed by WHO. [34]

Oral hygiene: The O'Leary Plaque Index was used to assess presence of dental biofilm in four surfaces for each tooth. The presence or absence of plaque was evaluated, regardless of its amount, and the corresponding index was obtained as a percentage on summing the results and dividing by the total number of points explored. [35] As a result, below 25% is considered as a satisfactory hygiene score.

Presence of calculus: The calculus index scores were recorded on the four tooth surfaces (mesial, distal, buccal and lingual), and the quantity of calculus was assessed at the cervical area of every tooth. The numerical scores of the plaque index were calculated according to the formula: per person = sum of individual scores/number of teeth present for each person and expressed in percentage.

At the end of the examination, each patient received

oral hygiene instruction and a kit with toothpaste and toothbrush. A dental prophylaxis was offered. Every child was registered as a patient at the Pediatric Dentistry Clinic, UFRJ. Urgent dental care was immediately performed for those who needed it, while the others were scheduled for regular visits.

Data and statistical analysis

Data were described and analyzed through SPSS 20.0 software (IBM, Chigago, USA). First, we directly compared cases and controls using unadjusted Student's t- or Chi-square tests. Then we compared children with controlled and uncontrolled diabetes status using Student's t- or Chi-square tests.

RESULTS

In this study the age of the enrolled children ranged from 1 to 6 years, the mean age was 4±1.25 years old. In each group, 50% of the children were female (n=17). Table 1 shows the results in relation to the oral condition of children with diabetes, which differed significantly from healthy children regarding dental caries and oral manifestations ($p<0.05$). The children with diabetes showed lower scores of dental caries compared to the healthy children since the mean dmft index was 1.38±4.61 for DG while for HG, the mean dmft was 5.30±0.945 ($p<0.05$). Plaque and calculus indexes also varied between the groups, but with no significant difference ($p>0.05$). In soft tissues, oral manifestations were observed with a prevalence of 35.3% for DG, with only 9% among children from HG ($p<0.05$). Geographic tongue was the only oral manifestation of DG while HG presented 2.9% for geographic tongue and 6.1% for stomatitis ($p<0.05$).

Information reported by the DG guardians related to oral hygiene and dietary habits, oral health perception and dental care experience patterns showed differences compared to HG. Xerostomia showed a prevalence of 52.9% (n=18) and breath acetone 47.1% (n=16) ($p<0.001$). Regular sugar consumption and habits of eating snacks and candies also showed a difference between the groups, whereby 20.6% of children with diabetes (n=7), consumed less sugar than children from HG (n=1; 3%) ($p<0.05$).

Regarding the diabetes status, three children had recently been diagnosed with type 1 diabetes and there was not enough data about their Hb1Ac levels (69 mmol/mol) to allow their diabetes status to be established. These children were then removed from the analysis regarding the association between diabetes status and the other parameters investigated in this study. From those children with an established diabetes status, 23% (n=7) were considered uncontrolled. The mean duration of disease was 1.29±1.1 and 1.77±1.01 years for those controlled and uncontrolled, respectively. Age at diagnosis was 2.55±1.12 years old for those controlled and 1.78±1.06 years old for the uncontrolled ones. The vast majority (n=33) had an insulin regimen ranging from 3–5 shots a day, while one child had an insulin pump. Furthermore, diabetes status control showed some influence on the oral status of these children, as seen in Table 2, which shows the diabetes-related variables between the children with type 1 diabetes.

Table 1: *Differences between children with diabetes (DG) and healthy (HG) children regarding to oral examination, oral health perception, dietary and oral hygiene habits*

Group Parameters	DG (n=34)	HG(n=34)
dmft index (mean)*	1.38±0.46	5.30±0.94
Decayed teeth (mean)*	0.94±2.13	3.55±4.26
Missing teeth (mean)*	0.97±0.16	2.24±0.39
Filled teeth (mean)*	0.40±0.07	1.34±0.23
Caries-free children (%)*	64.7	31.3
Plaque (O´Leary Index) (%)	9.41±7.68	9.82±8.51
Dental hygiene	satisfactory	satisfactory
Calculus Index (%)	1.59±2.19	1.19±5.72
Presence of oral tissue manifestations (%)*	35.3	9
Reported xerostomia (%)*	52.9	0
Reported breath acetone (%)*	47.1	0
Regular sugar consumption (%)*	79.4	97
Eating snacks and candies between meals (%)*	73.5	97
Perform oral hygiene (%)	84.8	93.9
Children referred to Dental Care by medical staff (%)*	61.5	40
Dental Visits (%)*	27.3	81.8
Pain as the main reason of the visits (%)*	38.5	63
Restorative treatment performed (%)	12	35.7
Extraction or endodontic treatment performed (%)	24	32.1

*Note: * means p<0.05 T-Test*

Table 2: *Sample characteristics of DG regarding to diabetes status and the main variables which differed between controlled (HbA1C<8.5%) and uncontrolled (HbA1C>8.5%) diabetics.*

	Controlled - DG (n=24)	Uncontrolled - DG (n=7)
Diabetes Status*	67%	25%
Cappilary blood Glucose*	186±84.02mg/dl	280±115.45mg/dl
Hb1Ac* (%)	7.27±0.94%	9.48±0.64%
Duration of diasease (years)	1.29±1.1	1.77±1.01
Age at diagnosis (years old)*	2.55±1.12	1,78±1,06
Geographic tongue (%)*	29.2	57.1
Breath acetone (%)*	41.7	71.4
Xerostomia (%)*	45.8	71.4
Regular sugar consumption (%)*	79.2	100
Caries-free children (%)*	62.5	85.7
Dental visits (%)*	33.3	0%
Oral hygiene habbits (%)*	91.7	57.1

*Note: * means p<0.05 (T-Test) or Chi-square test*

DISCUSSION

To the best of our knowledge, this is the first study to assess dietary and oral hygiene habits, dental care experience and oral health perception related to oral status and diabetes status control in children with type 1 diabetes under six years old. Our data showed low dental caries prevalence among children with diabetes in comparison to healthy children while we observed that the findings in the literature are controversial. High caries levels in children with diabetes were found to be associated with age, plaque scores and decreased salivary flow rate, but were not associated with the level of metabolic control of diabetes. [16-17] On the other hand, Tagelsir *et al*. [15] compared a group of 52 children with diabetes aged 3- to 16 years old to a group of matched healthy controls and reported that there were no significant differences in the level of caries. An epidemiologic Brazilian study (SB-BRASIL)[36] in 2010 with 5-year-old children from Rio de Janeiro showed similar levels [36] (dmft: 1.14/ 77% caries-free) to those of the children with diabetes in our study (dmft: 1.38/64% caries-free), demonstrating that the children with diabetes are not more susceptible to caries at this age. Reported xerostomia and breath acetone differed between the groups, as did the dietary and oral hygiene habits and dental care access.

In this study, uncontrolled children aged under 6 years old made up 23% of the total number of children with diabetes enrolled, which is in accordance with previous studies. [5,6] A total of 54% poorly controlled diabetic children aged 6 to 12 years old were observed by El-Tekeya *et al*. (2012), which is confirmatory to studies with older children and adolescents . [18] Thus, age plays a role in the glycemic control of children with type 1 diabetes because the youngest children receive full-time mother's care in comparison with the older ones. Moreover, adolescents are frequently the ones who experience poor metabolic control.[28]

An association between an increased level of HbA1c with the presence of halitosis has been described.[12] Some authors have suggested breath acetone as a biomarker of poor metabolic control in children with diabetes, [11,12] since ketonic bodies are increased in uncontrolled patients. Our study corroborates the literature, as breath acetone and xerostomia were significantly increased in the uncontrolled children.

Our data showed that geographic tongue, also known as benign migratory glossitis, was the most prevalent oral manifestation among children with diabetes and this condition has previously been associated with type 1 diabetes patients. [20] The prevalence of geographic tongue was higher among those patients with diabetes, but the etiopathogenesis remains unknown. Greater prevalence of fungi has been described in patients with geographic tongue, especially those who do not brush the surface of the tongue. [26,27] It is important to have in mind that previous publication point out that benign migratory glossitis is common in young age between 6 to 12 mouth[24] and, the prevalence is 21% in 0-5 years old in Brasil. [25] Since we did not perform a fungi count in our study, we suggest that more studies should be performed to understand better the oral condition of children with diabetes, in order to prevent the complications related to the disease, such as burning sensation, xerostomia and severe periodontal disease in later age.

Regarding diabetes control, there was no difference among caries level but there were significant differences when related to low dental attendance among the children with diabetes and associated with a high level of untreated decayed teeth, which corroborated with previous studies, [15-19] showing that oral health is still a neglected area in diabetes care. We also observed that uncontrolled children had more geographic tongue, xerostomia and breath acetone than those with controlled diabetes, showing that deficient diabetes

control is linked to deficient oral health.

A limitation of this study was that there were few children with uncontrolled diabetic status. Good metabolic control for DG reflects how important the medical care offered to these children is and how good is the diabetes care is since their recruitment was from a reference center for pediatric diabetes management. Another limitation would be the recruitment of healthy children from a dental clinic, since most of them were in need of dental treatment. Blind longitudinal studies should be performed in the future in order to elucidate the presence of oral manifestation in children with type 1 diabetes.

In our study, low attendance to dental care was observed. Although, most of the DG guardians affirmed that they performed the oral hygiene of the children and many of them had already been instructed in oral hygiene, the information about oral hygiene comes from the medical staff and not from dental professionals. Physicians should refer the children with diabetes to a dentist for adequate evaluation of the buccal condition as well as to apply preventive measures. The present findings are in agreement with Dale *et al.*[30] who also reported that medical doctors are the first health professionals to warn the population with diabetes about the importance of oral health. Thus, it is crucial that physicians have knowledge about the importance of oral health and its relationship with general health. On the other hand, dental professionals should be able to recognize the signs and symptoms of diabetes and feel comfortable treating patients with diabetes, since there is a global burden of diabetes and, nowadays, it is more common to receive patients with such systemic conditions in the dental office.

Regarding the question of referral to a dentist, some guardians answered that they had been already requested to do it by their medical doctors. It is important to highlight that although they may be referred by the medical doctor, most children with diabetes do not follow through the instruction to attend a dentist's appointment. Of those who were referred, most guardians took their children to visit a dentist, showing how influential the physicians are in relation to the behavior of the parents/guardians. However, even with the recommendations and referrals made for the patients with diabetes and their families, and with these patients being placed in a reference center, most of the children have never been to a dentist. Consequently, the level of untreated dental decay among the children with diabetes was higher in those children who had never been to a dentist, reflecting the lower attendance of children with diabetes to dental treatment, corroborating the findings of Tagelsir *et al.*[15] It must be highlighted that of those children with diabetes who had already had dental treatment, toothache was the main reason for going to the dentist.

In terms of dental care, oral examination is one of the steps of the initial diabetes visit for diabetic children and adolescents as recommended by the American Diabetes Association.[1] Taken together, our data suggest that prevention, early treatment of oral manifestations and healthy dietary and oral hygiene habits in young patients with diabetes reconsidered to prevent further buccal complications, such as the occurrence of periodontal disease.[5-9,13] This may be important in creating healthy habits from childhood, because adolescents are known as a difficult population for managing metabolic control related to diabetes.[28] It is important to design a special oral health program for the daily care of children with diabetes as well as a professional approach to treating this special group.

In conclusion, the oral health of children with diabetes differed from healthy ones. Most children with diabetes have never been to a dentist before. Children with uncontrolled diabetes differed from those children with controlled diabetes both in oral manifestation and oral habits.

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NON-SURGICAL PERIODONTAL TREATMENT: CLINICAL AND MICROSCOPIC EVALUATION

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Palavras-chave: Periodontite. Microscopia Eletrônica de Varredura. Estruturas de Apoio Dentário.

RESUMO

Objetivo: Comparar a eficácia de duas terapias combinadas não-cirúrgicas periodontais a partir de uma análise da superfície dentária tratada usando microscopia ótica (MO) e microscopia eletrônica de varredura (MEV). **Métodos**: Trinta pacientes foram selecionados com doença periodontal moderada a severa e indicando pelo menos uma peça para extração devido ao mau prognóstico. Foi realizado um estudo clínico com desenho duplo-cego, randomizado, com boca dividida. Duas modalidades de tratamento combinadas foram comparadas: Cavitron Bobcat® + completamento com Gracey Curettes (G1); EMS® + conclusão com curetas de Gracey (G2). O tratamento foi realizado até que uma superfície lisa fosse obtida e nenhum cálculo residual estivesse presente, o que foi verificado por uma sonda periodontal. As peças extraídas foram analisadas por MO e MEV. As variáveis periodontais foram: índice de placa (IP), sangramento à sondagem (SS), profundidade de sondagem da bolsa (PSB), nível de inserção clínica (NIC), recessão gengival (RG) antes e 3 e 6 meses. O tempo operatório (TO) para cada método também foi analisado. Os resultados foram comparados por ANOVA seguido do teste de Tukey, estabelecendo o valor de significância em p<0,05. **Resultados**: PI, SS, PSB e NIC apresentaram desempenho semelhante nos dois grupos. O RG, determinado em mm, foi para G1 (0,31) e para G2 (0,46). TO, em minutos por dente, foi para G1 (3,21) e para G2 (3,12). **Conclusão**: Ambas as modalidades de tratamento favoreceram a resolução da doença periodontal. Ultrassom piezoelétrico combinado com curetas Gracey produziu maiores recessões gengivais. As superfícies analisadas por MO e MEV não apresentaram variações quantitativas ou qualitativas estatisticamente significativas.

Keywords: Periodontitis. Scanning Transmission Electron Microscopy. Tooth Supporting Structures.

ABSTRACT

Objective: To compare the effectiveness of two combined non-surgical periodontal therapies from an analysis of the treated tooth surface using optical microscopy (OM) and scanning electron microscopy (SEM). **Methods:** Thirty patients were selected with moderate to severe periodontal disease and indicating at least one piece for extraction due to poor prognosis. A clinical study with a split-mouth, randomized, double-blind design was performed. Two combined treatment modalities were compared: Cavitron Bobcat™ + completion with Gracey Curettes (G1); EMS™ + completion with Gracey curettes (G2). The treatment was performed until a smooth surface was obtained and no residual calculus was present, which was verified by a periodontal probe. The extracted pieces were analyzed by OM and SEM. Periodontal variables were: plaque index (PI), bleeding on probing (BP), probing pocket depth (PPD), clinical insertion level (CIL), gingival recession (GR) were observed before treatment, 3 and 6 months later. The operative time (OT) for each method was also analyzed. The results were compared by ANOVA followed by the Tukey test, setting the significance value at p<0.05. **Results:** PI, DP, PPD and CIL performed similarly in both groups. GR, determined in mm, was for G1 (0.31) and for G2 (0.46). OT, in minutes per tooth, was for G1 (3.21) and for G2 (3.12). **Conclusion:** Both treatment modalities favored the resolution of periodontal disease. Piezoelectric ultrasound combined with Gracey curettes produced greater gingival recessions. The surfaces analyzed by OM and SEM did not show statistically significant quantitative or qualitative variations.

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INTRODUCTION

Bacteria are one of the main etiological agents of periodontal diseases determined by the presence of biofilm and closely related to the host in terms of its response profile. [1]

The objective of periodontal therapy is elimination of a large number of bacteria and their degradation products to allow, in the short term, resolution of the installed pathology and the control of periodontal infection. [2,3]

The responsibility of microorganisms in the initiation and progression of gingival and periodontal diseases has been demonstrated in several studies. [4-6]

There are currently several methodologies for therapies that can be used individually or combined to achieve a change in the bacterial ecosystem and thus allow the treatment of hard and soft periodontal tissue. [7-9]

The present study evaluated the behavior of clinical periodontal parameters and microscopic variables of hard tissues (dental surfaces) subjected to two types of combined conservative periodontal treatments.

MATERIALS AND METHODS

A clinical and microscopical study was performed using optical microscopy and scanning electron microscopy. The sample consisted of 30 systemically healthy individuals. Inclusion criteria were patients with a diagnosis of moderate to severe periodontitis[10] with a loss of insertion of 4 to 7 millimeters in proximal faces that had not received periodontal treatment in the last two years and at least one specimen with indication of exodontia.

Individuals with systemic pathologies of known risk for periodontal disease were excluded from the study.

The variables that were taken were: plaque index (PI), bleeding on probing (BP), gingival recession (GR), probing pocket depth (PPD), clinical insertion level (CIL), time per tooth (TPT), a qualitative analysis of the surfaces treated (30 specimens in the mesial face in proximity to the LAC) by scanning electron microscopy and a quantitative analysis of residues after basic therapy by optical microscopy.

The quadrants receiving the treatments were divided into right and left, and the different treatments were assigned randomly by lot (one type of treatment for the right and another for the left).

The experimental design consisted of a split-mouth and double-blind inspection. Dental faces were taken as the unit of analysis, except for the working time, which was expressed in minutes per tooth. All periodontal clinical variables were analyzed before treatment and 6 months after treatment.

The quadrants were constituted as follows:

Treatment 1: Magnetorestrictive ultrasonic instrumentation (Cavitron™ Bobcat, TFI-10 tip) + root and scaling with conventional Gracey curettes (Hu-Friedy™ 7/8, 11/12 and 13/14); **Treatment 2**: Piezoelectric ultrasonic instrumentation (EMS™, Perio-tip) + R and A with conventional Gracey curettes (Hu-Friedy™ 7/8, 11/12 and 13/14).

The measuring instrument used was a Marquis periodontal probe (Hu-Friedy™ cp-12 screening color-coded probe).

Treatment of dental surfaces was performed by an experienced periodontist who considered the scaling finished when the dental surface was smooth and without any continuous solution on inspection with the periodontal probe (Hu-Friedy™ cp-12 screening color-coded probe). The teeth were treated and later extracted for analysis by optical microscopy (OM) and scanning electron microscopy (SEM).

Treatment of the samples for analysis by optical microscopy

Marking the gingival margin of the hopeless teeth: The extracted teeth were washed with sodium hypochlorite solution and water. Subsequently, they were immersed in a solution of 1% methylene blue for 2 minutes and finally washed in a stream of water for 3 minutes. They were observed by optical microscopy with a magnification of 6.3–12.5 with a cell count grid of 10×10 mm. All the dental faces were analyzed. In order to quantify the amount of residual calculus, the following equation was extracted from the available literature, [11] which uses in the numerator the total number of grids with calculus, and in the denominator the number of grids counted, with this result multiplied by 100, determining the total percentage of residual calculus found for each surface analyzed.

Treatment of the samples for analysis by scanning electron microscopy and its subsequent interpretation

Samples were washed with glutaraldehyde solution (2.5%), ethanol dehydration in increasing percentages (70, 85, 95 and 100%) and fixation with osmium tetroxide. Sputtering was performed with gold on aluminum wad. To obtain a standard pattern, positive (no calculus) controls were observed in third molars with cement not exposed to the light of the periodontal pocket, while the negative control was teeth affected by periodontal disease observed with

cement exposed to the light of the periodontal pocket. The observations were made on 30 specimens (15 of each therapeutic modality) in the mesial faces in proximity to the enamel cementum junction (LAC). Three examiners calibrated according to the positive and negative control patterns, and analyzed the samples of each treatment without informing which ones belonged to each one. Magnifications of 100× and 500× were used. We used a qualitative scale of measurement described in the literature. [12,13]

Cement surface analysis range:

A – Completely smooth surface without porosity and without loss of tooth substance.
B – Observable roughness and local areas confined to the cementum not showing evidence of porosity.
C – Surface porosity with a minimum width and depth.
D – Porosity with deep holes and high slopes with instrumentation into the dentin. Cementum is completely removed in large areas.

Permission for this study was obtained from the Ethics Committee of the School of Dentistry of the UNR.

Statistical analysis

Statistical analysis of the clinical variables was based on a one-way ANOVA with a Tukey test. The value to obtain statistical significance was set at $p < 0.05$.

The ranges of values for the analysis of the surfaces observed by SEM determined for the three examiners and their distributions were calculated using a Kruskal–Wallis test.

RESULTS

The results are expressed in separate tables (Tables 1,2,3 and 4) according to the clinical or microscopic evaluation as appropriate.

***Table 1**: Bleeding on probing, plaque index, gingival recession, probing pocket depth and clinical insertion level evaluated before and after 6 months post treatment.*

	Before treatment	Post treatment at 6 months
HS	70.60	31.90
IP	2.43	1.21
RG	3.09	3.43
PS	4.80	2.70
NIC	4.05	2.85

Analysis of dental surfaces by scanning electron microscopy (100×–500×)

The images (Figures 1 and 2) obtained by SEM were presented to the examiners for each mode of treatment at random at the lowest magnification (100×) and highest magnification (500×) on the left and right sides of the screen, respectively.

***Table 2**: Variables behavior: plaque index, bleeding on probing, gingival recessions, probing pocket depth, clinical insertion level and time spent per tooth, evaluated at 6 months after therapy.*

n =30	PI (Reduction in %)	BP (Reduction in %)	GR (Increase in mm)	PPD (Reduction in mm)	CIL (Gain in mm)	TPT (Minutes)
TREAT. 1 Cavitrón™ + Gracey curettes	44.60(CI 95% 40.17–48.83)	45.51(CI 95% 42.16–51.73)	0.31*(CI 95% 0.12–0.61)	1.09(CI 95% 0.88–1.31)	0.70(CI 95% 0.67–1.28)	3.21(CI 95% 2.90–5.16)
TREAT. 2 EMS™ + Gracey curettes	46.7 (CI 95% 41.42–53.98)	47.40 (CI 95% 44.24–50.56)	0.46* (CI 95% 0.20–0.77)	1.32 (CI 95% 1.12–1.52)	0.69 (CI 95% 0.45–0.83)	3.12 (CI 95% 3.05–4.94)

Tukey test. Significance level $p<0.05$
** Statistical significance among the different treatments (p=0.01)*

***Table 3**: Evaluation by optical microscopy of the residues post-periodontal therapy. Expressed by the percentage remaining on the tooth surface studied. (Negative control surfaces of untreated teeth).*

Untreated Control Parts	89% (CI 95% 85–94)
Treatment 1 Cavitrón™ Bobcat + Gracey curettes	16.3 % (CI 95% 12–18.4)
Treatment 2 Minipiezón EMS™ + Gracey curettes	15.8 % (CI 95% 12.2–17.8)

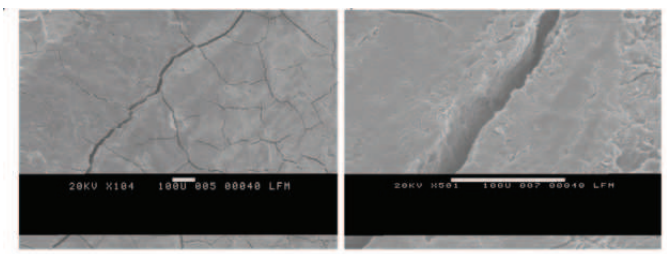

***Figure 1**: Image of the cement surface obtained from SEM after scaling and root planning performed with Treatment 1 (Cavitron® + R and A instrumentation with conventional Gracey curettes) Magnification of 100× and 500×*

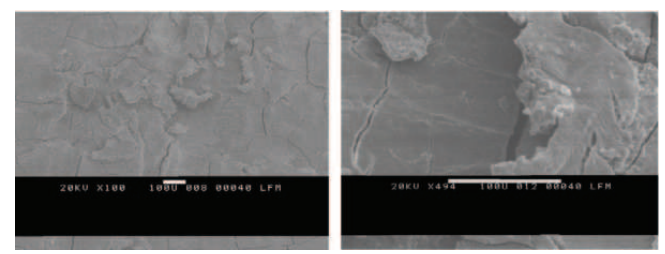

***Figure 2**: Image of the cement surface obtained from the SEM after the maneuvers of scaling and root planning performed with Treatment 2 (Instrumentation EMS® + R and A with conventional Gracey curettes) Magnification of 100× and 500× (REVISOR B)*

***Table 4**: Frequency results of the examiners' observations on the specimens analyzed by SEM*

	A	B	C	D
Treatment 1 Cavitrón™ + Gracey curettes	0.19	0.71	0.08	0.02
Treatment 2EMS™ + Gracey curettes	0.11	0.66	0.2	0.03

Note: Kruskal–Wallis test. Significance level p <0.05. Value of p=0.006

DISCUSSION

The present study demonstrates an improvement and acceptable control of the periodontal tissues in response to the treatment modalities.

It is universally accepted that the only effective treatment for the control of periodontal diseases is scaling and root planning, because it is the only one that controls or facilitates the elimination of infection with aerobic and anaerobic bacteria specifically. [14]

It is well known that periodontitis disease is responsible for the greatest amount of tooth loss among industrialized populations. [15,16]

As bacterial infection causes periodontal diseases, it is logical to assume that elimination and control of infection would be the main objective for non-progression of periodontal diseases, reduction of tooth loss and improvement of gingival health in general. [17-19]

Some studies evaluating cement surface alterations after manual, sonic and ultrasonic instrument treatment were not conclusive in demonstrating whether there were differences between non-surgical therapeutic modalities. [2,3,7]

The root surface termination is important for healing after treatment, which is favored by a smooth and polished surface. Another important consideration is the amount of cement removed and the roughness that results as a result of periodontal instrumentation treatment. An in vivo study in which the root surfaces were analyzed with SEM after separate treatment with piezoelectric ultrasonic instruments (Vector™, Enac™ and Gracey curettes) determined that the calculus remnant was similar in all three groups; however, the Vector™ system left softer surfaces with minimal loss of root substance. Although all mechanical instruments (sonic, ultrasonic, rotary or abrasive) were effective compared to curettes, these have disadvantages when compared to the latter in terms of tactile sensitivity and uncontrolled root surface damage. [20]

Manual instrumentation takes more time, is more painful and can cause gingival hemorrhages depending on the ability of the operator. [8,9]

Other methods were the Er: YAG laser [22,31] both in vivo and in vitro, with a similar result verified in terms of removal of the calculus and improvement of clinical parameters; however, observed surfaces in the SEM laser treatment are left with greater roughness compared to curettes. In addition, the working time was twice that required when using curettes. [21]

Several studies analyzed the different alternatives for the treatment of periodontal disease, concluding that the methods – sonic, ultrasonic and mechanical – did not obtain statistically significant differences in clinical parameters compared to curettes; however, the use of sonic instruments reduced the working time. [23-25]

Many practitioners disregard the effectiveness of ultrasonic instruments in deep pockets = 5 mm; however, [26] studies comparing the penetration of the periodontal probe, the EMS™ insert and a Gracey after five curettes in patients with chronic periodontitis in treatment and in individuals in periodontal maintenance therapy showed that for the group with chronic periodontitis, the tip of the EMS™ was more effective than the other instruments; however, in the periodontal maintenance group, the clinical parameters were similar.

Another study [27] compared Periosonic™ versus manual curettes, demonstrating that they were equally effective in reducing the depth of pockets when they were initially = 6 mm; however, the Periosonic™ showed an improvement in clinical insertion with less recession for the pockets with an initial probing depth of = 7 mm.

Regarding clinical and microbiological results after treatment with modified sonic instruments versus curettes, similar results were obtained in the clinical improvement with both methods at 4 and 6 weeks, but not in deep pockets, where less bleeding and reduction of probing depth were observed in the group treated with Gracey curettes. [28]

For the microbiological and clinical parameters, although some studies demonstrate that ultrasonic devices and manual instrumentation therapies did not show significant clinical differences, significant and important differences were obtained at 6 months with a reduction of *Tannerella forsythia* and *Treponema denticola* for the group treated with manual instrumentation. [29]

Attachment loss was observed in several studies comparing the ultrasonic instruments versus the curettes. In both cases, an attachment loss of 0.76 mm was initially produced by the trauma of the instrument, there was no difference between the two methods and there was not a greater reduction for one or the other method compared to the attachment loss improvement. [30,31]

Many of the studies compared some of the sonic and ultrasonic instruments with the curettes; however, few examined combinations of these for the treatment of periodontal disease, as with the present work.

Our working methodology is supported by the combination of mechanical and manual instruments. In the initial stage of the treatment for the removal of calculus deposits with greater adhesion to the cement surfaces, ultrasonic instruments allowed faster treatment, greater comfort for the patient due to a shorter operative time and a decrease in operator fatigue.

In the final stage of the treatment of scaling and root planning, the use of manual instruments such as Gracey curettes allows a greater tactile sensitivity, which returns a treated surface with less roughness, favoring, according to our working hypothesis, a better adaptation of the involved tissues and thus a more effective healing mechanism.

Obeid et al. carried out a similar study with a combination of instruments and analyzed the clinical response, taking as the gold standard the treatment of scaling and smoothing with Gracey curettes. We used ultrasound, ultrasound + Periopolisher™, Perioplaner™ + Periopolisher™ and Gracey curettes only, and we considered the time of work per tooth. There were no significant differences in the clinical outcome, nor did we find significant differences in the present study. [24]

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USER SATISFACTION ON THE HEALTH CARE PROVIDED BY THE PRIMARY HEALTH CARE PROGRAM IN A STATE IN NORTHEASTERN BRAZIL

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Palavras-chave: Pesquisa sobre Serviços de Saúde. Atenção Primária à Saúde. Satisfação do Usuário.

RESUMO

Objetivo: Verificar os fatores que influenciam na satisfação dos usuários quanto aos serviços de saúde ofertados na Atenção Básica em um estado do Nordeste do Brasil e suas macrorregionais de saúde. **Métodos**: Estudo transversal realizado a partir de dados secundários, desenvolvendo-se modelos de regressão logística tendo como variável dependente a satisfação do usuário (obtida por análise de agrupamento). O estado está dividido em quatro macrorregionais de saúde e as variáveis explicativas selecionadas abrangeram: sexo dos usuários; acesso aos serviços de saúde; acolhimento à demanda espontânea; marcação de consulta(s); atenção integral à saúde; vínculo, responsabilização e coordenação do cuidado; visita domiciliar; mecanismos de participação e interação dos usuários. **Resultados**: Verificou-se que as macrorregionais 1 e 4 apresentaram maiores percentuais de usuários que não se mostraram satisfeitos com o seu mecanismo de participação na unidade. O modelo de regressão demonstrou os fatores que influenciam negativamente a satisfação, sendo alguns deles: o horário de funcionamento da unidade não atender as necessidades dos usuários (OR=0,60), o usuário não conseguir fazer uma reclamação ou sugestão na unidade de saúde (OR=0,68), o usuário não conseguir marcar consulta para o mesmo dia (OR=0,83), os profissionais nunca perguntarem sobre os familiares do usuário (OR=0,81) e o Agente Comunitário de Saúde não visitar o usuário (OR=0,78). **Conclusão**: Com base nos dados sobre os serviços de saúde ofertados na Atenção Básica em um estado brasileiro, constata-se que existem fragilidades, a exemplo do relacionamento entre o usuário e o profissional de saúde, a coordenação do cuidado e a participação/controle social na unidade.

Keywords: Health Services Evaluation. Primary Health Care. Consumer Bahavior.

ABSTRACT

Objective: To verify the factors influencing user satisfaction regarding the healthcare assistance provided by the Primary Health Care (PHC) Program in a state in northeastern Brazil and its macro-regional health districts. **Methods**: A cross-sectional study was carried out based on secondary data, and logistic regression models were developed considering user satisfaction (obtained by cluster analysis) as a dependent variable. The state is divided into four macro-regional health districts, and explanatory variables selected included user gender; access to health services; receptivity to spontaneous demand; scheduling appointment at PHC facilities; comprehensive health care; bonding, accountability and coordination of care; home visit; mechanisms for user participation and interaction. **Results**: Macro-regional health districts 1 and 4 presented higher percentage of users who were not satisfied with their mechanism of participation in the facility. The regression model demonstrated the factors that negatively influence satisfaction, some of which are: facility work hours do not meet users' needs (OR=0.60); the user cannot file a complaint or suggestion at the PHC facility (OR=0.68); the user is not able to set up an appointment for the same day (OR=0.83); professionals never ask about the user's relatives (OR=0.81); and the Community Health Worker does not make home visits (OR=0.78). **Conclusion**: The data on assistance provided by the Primary Health Care Program in a state of Brazil indicate weaknesses, such as the relationship between user and health professional as well as those related to coordination of care and participation/social control in the PHC facility.

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INTRODUCTION

The Brazilian public healthcare system (*Sistema Único de Saúde* - SUS) is structured into three assistance levels, namely primary, secondary and tertiary care. Primary care services focus on families and communities with emphasis on health promotion and public health initiatives. Secondary healthcare centers provide medium complexity procedures, while tertiary healthcare centers are responsible for the most complex treatments.[1]

The Family Health Strategy (FHS) has been gaining prominence in the national scenario since its implementation, with a significant expansion in the number of teams over the years. The FHS program is the priority strategy for primary care and constitutes the main gateway to the SUS. In view of that, many initiatives, especially those aimed at the assessment of health services, have been developed in Brazil [2,3,4]. The process of health assessment and post-assessment actions improve user satisfaction on health services and have become an effective tool to identify factors that improve the quality of healthcare assistance. [4,5]

The Ministry of Health of Brazil has instituted some initiatives aimed at reorganizing the National Primary Care Policy, through the assessment of health services and the improvement of the quality of services in Primary Health Care (PHC).[6,7] In this scenario, the "Health closer to you - Access and Quality / National Program for Improving Access and Quality of Primary Care" (PMAQ-AB) program emerged. The reorganization and orientation of health services according to the user needs and opinion - based on the satisfaction assessment, is part of the program guidelines. One of the phases of PMAQ-AB is the "External Evaluation", which analyzes the conditions of access and quality of health services provided by teams that participate in the Program, through the supervision of indicators and improvement of quality and access to health services. In this assessment process, user perspective and satisfaction on the health service provided are taken into account. [8]

Thus, considering the data from the 2nd PMAQ-AB external evaluation cycle, this study aimed to identify the factors associated with user satisfaction on the care provided by the Primary Health Care (PHC) Program of Paraíba state, Brazil, so that to develop a decision-making model based on user perceptions on access to, and use of, health services.

MATERIALS AND METHODS

This study used secondary data generated by the Ministry of Health during the 2nd PMAQ-AB External Evaluation Cycle in 2013. [9] The data contained the responses of health service users, specifically four users from each PHC facility who were present at the unit. The questions used were obtained from the Instrument of External Evaluation: "Health Closer to You", which was applied by researchers / professors from several Universities / Education and Research Institutes in Brazil.

The primary study "Evaluation of primary care in Brazil: integrated multicenter studies on access, quality and user satisfaction" was submitted to, and approved by, the Research Ethics Committee of the Federal University of Rio Grande do Sul (UFRGS), under protocol No. 21.904 on 03/01/2012.

The collection instrument used by PMAQ-AB for external evaluation is divided into four modules and considers aspects related to structure, equipment and working conditions at the PHC facility; as well as work quality and investment in permanent education for workers; support given to teams for PHC management; access to and quality of the service offered to users; and, finally, user satisfaction on, and participation in, each of the PHC Programs surveyed. [6]

The Module III - Interview with the User at the Healthcare Facility, was used in this study. The interviews were carried out with users who were not in consultation with the physician, nurse or dentist on the day of the interview, who had attended the PHC facility in the previous year and who were present at the corresponding PHC facility on the external evaluation day.

Initially, the data were analyzed descriptively considering the macro-regional healthcare districts of Paraíba state (n=4). Criteria for the selection of data in the PMAQ-AB database included: variables with only up to 3% missing data; data referring only to users who had complete information on the selected variables.

A dependent variable was generated using the Two-Step Cluster Analysis method. This method was used based on the literature for identification of similar groups or the so called clusters of individuals or objects within large data sets, with two types of variables - categorical and continuous. [10,11]

Independent variables (n=12) that met the aforementioned criteria, and could possibly interfere with user satisfaction, were pre-selected. The variables were defined as follows: 1) Gender; 2) if the user would like the PHC unit to operate in the night shift; 3) whether the operation hours meet the users' needs; 4) if the Community Health Worker makes home visits; 5) what the user's perception about getting to the health unit; 6) if the user can search the PHC unit without an appointment; 7) if the user can schedule appointment for the same day 8) if the user is able to make a complaint or suggestion at the health unit; 9) if when the team professionals make the physical, throat and belly examination; 10) if professionals in the PHC suggest solutions

that are appropriate to reality of user; 11) if the user thinks that the time of consultation with the doctor is sufficient; 12) if health professionals ask about user's relatives;13) if it is easy to speak with professionals when users need to ask questions after consultations; 14) health professionals ask about the user's relatives; 15) if the user thinks that the time of consultation with the doctor is sufficient; 16) if the Community Health Worker (CHW) makes home visits; 17) if the user is able to file a complaint or suggestion at the healthcare facility.

Prior to the application of logistic regression, the chi-square test (with a significance level of 20%) was used and significant variables were included for logistic regression, with a 5% significance level. The associations were determined by Odds Ratio (OR) based on logistic regression, with a 95% Confidence Interval. Upon estimation of the initial model, the model validity was verified using the Hosmer-Lemeshow test.

RESULTS

Absolute and relative frequencies of variables were grouped into blocks and described as follows: a) Gender; b) Access to health services; c) Receptivity to spontaneous demand; d) Appointment scheduling; e) Comprehensive health care; f) Bonding, accountability and coordination of care; g) Home visit; h) Mechanisms for user participation and interaction.

Tables 1 to 3 demonstrate the results of the descriptive analysis based on variables contained in the Module III of the PMAQ-AB External Evaluation Instrument in Paraíba and its macro-regional health districts.

The total number of interviewees analyzed in Paraíba was 4,093, with 1,764 users in the macro-regional health district 1; 1,203 users in the macro-regional health district 2; 629 users in the macro-regional health district 3; and 497 users in the macro-regional health district 4.

Regarding the users' gender in the macro-regional health districts, the majority of respondents were female, with the largest percentage found in the health district 2, totaling 90.7% (n=1,091). In addition, a considerable percentage of users reported that, in order to facilitate service, they would like the PHC facility to operate in the night shift, particularly the macro-regional health district 3 - 37.4% (n=235). When asked if the work hours of the PHC facility met their needs, most users replied "Yes", in particular those from the macro-regional health district 4 - 92.2% (n=458). With regard to home visits, the macro-regional health district 4 was the one that presented the highest percentage of users whom answered "Yes", when asked if they received home visit of the Community Health Worker (CHW) - 93.6% (n=465) (Table1).

As for receptivity to spontaneous demand, the macro-regional health district 2 showed the highest percentage of users whom considered it "reasonable / difficult" to reach the PHC facility - 34.2% (n=411) and needed to go to the PHC facility without an appointment - 77.9% (n=937), as shown in Table 2. In terms of appointment scheduling, a higher percentage of users from the macro-regional health district 4 were able to set up same-day appointments - 83.7% (n=416).

It is worth noting that the macro-regional health district 4 presented the highest percentage - 83.0% (n=414) of users who answered "Never needed" when asked if they could file a complaint or suggestion at the health care facility.

Table 3 shows that in the macro-regional health district 3 there was a greater percentage - 88.6% (n=557) of users who reported "Always / Most of the time" when asked if team professionals performed physical, throat and belly examination in their consultations. The health district 2 had a higher percentage of users who reported that team professionals suggested solutions during the consultations that seemed appropriate to the reality - 92.3% (n=1111) and that professionals usually ask about the user's family - 53.6 % (n=645). The macro-regional health district 4 presented a higher percentage of users who reported that the time of consultation with the physician was "Not" sufficient - 30.4% (n=154) - Table 3.

In accordance with the aforementioned findings for the state of Paraíba, we developed a decision-making model using adjusted binary logistic regression, intervals for ß, p-values, Odds Ratio (OR) and confidence interval for OR were obtained. The number of users interviewed was n=4,093. Of the 17 variables entered into the regression model, 10 were associated with "user satisfaction on the health care service" outcome, as shown in Table 4. The proposed model was tested for adjustment using the Hosmer and Lemeshow test. A test value of 0.759 ($p>0.05$) was obtained, hence the model was considered as adjusted.

***Table 1**: Absolute and relative frequencies of socioeconomic features, access to services and home visits in the macro-regional health districts of Paraíba state, Brazil, 2013.*

		MACRO-REGIONAL DISTRICT 1		MACRO-REGIONAL DISTRICT 2		MACRO-REGIONAL DISTRICT 3		MACRO-REGIONAL DISTRICT 4	
Gender		n	%	n	%	n	%	n	%
	Male	248	14.1	112	9.3	85	13.5	64	12.9
	Female	1516	85.9	1091	90.7	544	86.5	433	87.1
	Total	**1764**	**100.0**	**1203**	**100,0**	**629**	**100.0**	**497**	**100.0**
Whether the user would like the PHC facility to operate during the night shift		**MACRO-REGIONAL DISTRICT 1**		**MACRO-REGIONAL DISTRICT 2**		**MACRO-REGIONAL DISTRICT 3**		**MACRO-REGIONAL DISTRICT 4**	
		n	%	n	%	n	%	n	%
	Yes	645	36.6	192	16.0	235	37.4	117	23.5
	No	1119	63.4	1011	84.0	394	62.6	380	76.5
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**
Whether the work hours of the PHC facility suit the user's needs		**MACRO-REGIONAL DISTRICT 1**		**MACRO-REGIONAL DISTRICT 2**		**MACRO-REGIONAL DISTRICT 3**		**MACRO-REGIONAL DISTRICT 4**	
		n	%	n	%	n	%	n	%
	Yes	1388	78.7	1066	88.6	531	84.4	458	92.2
	No	376	21.3	137	11.4	98	15.6	39	7.8
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**
Whether the community health worker (CHW) visit users' homes		**MACRO-REGIONAL DISTRICT 1**		**MACRO-REGIONAL DISTRICT 2**		**MACRO-REGIONAL DISTRICT 3**		**MACRO-REGIONAL DISTRICT 4**	
		n	%	n	%	n	%	n	%
	Yes	1469	83.3	1046	86.9	570	90.6	465	93.6
	No	277	15.7	137	11.4	53	8.4	29	5.8
	There is no CHW in the neighborhood	18	1.0	20	1.7	6	1.0	3	0.6
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**

***Table 2**: Absolute and relative frequencies of variables related to receptivity to spontaneous demand, appointment scheduling and mechanisms for participation and interaction of users from the macro-regional health districts of Paraíba state, Brazil, 2013.*

		MACRO-REGIONAL DISTRICT 1		MACRO-REGIONAL DISTRICT 2		MACRO-REGIONAL DISTRICT 3		MACRO-REGIONAL DISTRICT 4	
Easiness to access the health care facility		n	%	n	%	n	%	n	%
	Very easy/ Easy	1503	85.2	792	65.8	502	79.8	442	88.9
	Reasonable/ Difficult/Very Difficult	258	14.8	411	34.2	127	20.2	55	11.1
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**
		MACRO-REGIONAL DISTRICT 1		**MACRO-REGIONAL DISTRICT 2**		**MACRO-REGIONAL DISTRICT 3**		**MACRO-REGIONAL DISTRICT 4**	
Whether the user had to attend the PHC facility without an appointment		n	%	n	%	n	%	n	%
	Yes	1203	68.2	937	77.9	464	73.7	357	71.8
	No	561	31.8	266	22.1	165	26.3	140	28.2
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**
		MACRO-REGIONAL DISTRICT 1		**MACRO-REGIONAL DISTRICT 2**		**MACRO-REGIONAL DISTRICT 3**		**MACRO-REGIONAL DISTRICT 4**	
Whether the user can set up a same-day appointment		n	%	n	%	n	%	n	%
	Yes	1101	62.4	696	57.9	489	77.7	416	83.7
	No	663	37.6	507	42.1	140	22.3	81	16.3
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**
		MACRO-REGIONAL DISTRICT 1		**MACRO-REGIONAL DISTRICT 2**		**MACRO-REGIONAL DISTRICT 3**		**MACRO-REGIONAL DISTRICT 4**	
Whether the user can file a complaint or suggestion at the health care facility		n	%	n	%	n	%	n	%
	Yes	249	14.1	122	10.1	41	6.5	55	11.1
	Yes, but with difficulty	143	8.1	39	3.2	20	3.2	13	2.6
	No	254	14.4	114	9.5	68	10.8	15	3.0
	Never needed to	1118	63.4	928	77.1	500	79.5	414	83.3
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**

***Table 3**: Absolute and relative frequencies of variables related to comprehensive health care, bond, accountability and coordination of care in the macro-regional health districts of Paraíba state, Brazil, 2013*

		Macro-Regional District 1		Macro-Regional District 2		Macro-Regional District 3		Macro-Regional District 4	
Whether the team members perform the physical, throat and belly examination during consultations		n	%	n	%	n	%	n	%
	Always/Most times	1468	83.2	1057	87.9	557	88.6	406	81.6
	Hardly ever/Never	296	16.8	146	12.1	72	14.4	91	18.4
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**
User's opinion as to whether the team members suggest solutions that are appropriate to their reality during consultations		Macro-Regional District 1		Macro-Regional District 2		Macro-Regional District 3		Macro-Regional District 4	
		n	%	n	%	n	%	n	%
	Always/Most times	1507	85.4	1111	92.3	575	91.4	435	87.5
	Hardly ever/Never	257	14.6	92	7.7	54	8.6	62	12.5
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**
Whether the user thinks that the time of consultation with the physician is sufficient		Macro-Regional District 1		Macro-Regional District 2		Macro-Regional District 3		Macro-Regional District 4	
		n	%	n	%	n	%	n	%
	Yes	1260	71.4	853	70.9	480	76.3	343	69.1
	No	504	28.6	380	29.1	149	23.7	154	30.4
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**
Whether the professionals at the PHC facility usually ask about the user's family		Macro-Regional District 1		Macro-Regional District 2		Macro-Regional District 3		Macro-Regional District 4	
		n	%	n	%	n	%	n	%
	Always/Most times	801	45.5	645	53.6	298	47.4	238	47.9
	Hardly ever/Never	963	54.5	558	46.4	331	52.6	259	52.1
	Total	**1764**	**100.0**	**1203**	**100.0**	**629**	**100.0**	**497**	**100.0**

***Table 4**: Logistic regression model of the data on the Paraíba state, Brazil.*

Variable	β	p-value	OR	CI 95%
1- *In your opinion, getting to the PHC facility is:*				
Very easy (reference)				
Easy	1.43	<0.0001	4.19	1.86 – 9.40
Reasonable	1.33	<0.0001	3.79	1.71 – 8.39
Difficult	0.89	0.03*	2.45	1.08 – 5.57
Very difficult	0.60	0.15*	1.82	0.79 – 4.23
2- *Do you like that the PHC facility operates at night?*				
Yes (reference)				
No	-0.63	0.03*	0.53	0.29 – 0.95
3- *Do the work hours of this PHC facility meet your needs?*				
Yes (reference)				
No	-0.50	<0.0001	0.60	0.48 – 0.75
4- *When you set up an appointment, is it usually for the same day?*				
Yes (reference)				
No	-0.17	0.03*	0.83	0.71 – 0.98
5- *During consultations, when the team members make the physical examination, do they examine your body, throat and belly?*				
Always (reference)				
Most times	0.31	<0.0001	1.37	1.05 – 1.69
Hardly ever	-0.24	0.04*	0.76	0.61 – 1.03
Never	-0.24	0.03*	0.78	0.63 – 0.99
6- *In your opinion, during consultations, do the health team professionals offer solutions that are appropriate to your reality?*				
Always (reference)				
Most times	-0.00	0.95	0.99	0.82 – 1.19
Hardly ever	-0.42	0.01*	0.65	0.47 – 0.91
Never	-0.73	<0.0001	0.47	0.32 – 0.71
7- *During treatment in this facility, does the physician allow sufficient time for you to talk about your concerns or problems?*				
Yes (reference)				
No	-0.69	<0.0001	0.50	0.40 – 0.61
8- *Do the professionals in this PHC facility usually ask about your family?*				
Always (reference)				
Most times	-0.11	0.36	0.89	0.70 – 1.13
Hardly ever	0.13	0.33	1.14	0.87 – 1.50
Never	-0.20	0.04*	0.81	0.66 – 0.99
9- *Does your community health worker (CHW) visit you at home?*				
Yes (reference)				
No	-0.28	0.01*	0.75	0.59 – 0.94
There is no CHW in this PHC facility or in my neighborhood	-0.06	0.862	0.93	0.45 – 1.91
10- *When you wish to file a complaint or suggestion at the health care facility, are you able to do so?*				
Yes (reference)				
Yes, but with difficulty	-0.41	0.04*	0.66	0.44 – 0.98
No	-0.38	0.01*	0.68	0.49 – 0.93
Never needed to	0.28	0.02*	1.33	1.05 – 1.68

*Note:*Significant at 5%.*

DISCUSSION

This study surveyed users from the macro-regional health districts of Paraíba state for their satisfaction on health care assistance. It was possible to identify distinct responses in each of the districts according to the variables analyzed. A high percentage of users from the health districts 1 and 4 were not satisfied with the time of consultation with the physician and with their mechanism of participation in the facility via suggestions/complaints and physical examinations during consultations. This approach, which subdivides the state of Paraíba into macro-regions, demonstrated the need for a differentiated care that considers the singularities of each health district across the state, with the elaboration of specific policies.

Studies on user satisfaction have been widely employed to determine the quality of health care services so that to subsidize the decision-making process. This type of study provides guidance to managers and influences and values the user's role within the health service through popular participation.[8,12-14]

With regard to the variable gender, there was a higher percentage of female users in all macro-regional health districts of Paraíba state. These findings are in line with the literature showing that the presence of men attending PHC services is lower than that of women.[14-16] This could be justified by the fact that men prioritize their work-related activities. As such, the search for health care would result in the need to be absent from their occupations, which could compromise their livelihoods.[17]

Although this study found no association between user's gender and satisfaction, studies have shown that women are more likely to criticize healthcare services due to the greater demand of females attending PHC facilities.[7,16]

The large majority of users from the macro-regional health district 1, which is more densely populated than the other districts, reported that the work hours of the public health care facilities did not meet their needs. This can be explained due to the fact that most of these users work during business hours and far away from their homes,[18] which would require an extended shift to facilitate access to health services. However, providing such an after-hours service in this area is difficult due to the high rates of crime and violence. For this reason, some PHC facilities restrict their practice time and modify after-hours arrangements or even withdraw from after-hours care. That difficulty was also found by urban Australian PHC teams, who have restricted or modified their practice and after-hours care because of the violence risk.[19-21]

In addition, the regression model indicated that user satisfaction decreases as the work hours of the PHC facility does not meet the user' needs, which is in agreement with other studies.[13,14]

There was a higher percentage of users from the health district 2 that consider the distance from their home to the PHC facility as "reasonable/difficult". This can be related to the percentage of the population that is not covered by the FHS Program in the city of Campina Grande (22.8% by August 2016), which is the city with the largest number of inhabitants included in the health district 2.[22] Of note, the greater the FHS coverage, the greater the number of PHC facilities and, as a consequence, the better the organization of demand and access to services. Such approach helps reducing the distance between the user's home and the PHC facility so that to increase responsiveness to their needs and expectations.[23] Therefore, the "easiness" to reach the healthcare facility increases the likelihood of user satisfaction. Protasio et al. analyzed user satisfaction on the PHC Program in different regions of Brazil and also verified, among other factors associated to satisfaction, the distance between the user's home and the PHC facility.[13]

Similarly, Viegas, Carmo and Da Luz pointed out that 71.1% of users reported attending the PHC facility on a frequent basis to meet their health needs / demands. They added that the reason for such an attendance was related to the proximity of the PHC facility to their households.[24] With regard to appointment scheduling, the likelihood of user satisfaction is decreased if the appointment cannot be set up for the same day.

A higher percentage of users from health district 4 reported that health professionals never perform physical, throat and belly examination during the consultations, which decreases the likelihood of user satisfaction. This health district comprises medium and small size municipalities located in the backlands of the state of Paraíba. This may also be related to the predominance of care practices based on the biomedical or mechanistic model, focused on the use of medications, request for exams and absence of closer contact with the patient.[25] It is known that physical examinations, together with anamnesis, are necessary tools for diagnosis, action planning, follow-up and evolution of the patient's clinical condition.[26]

A high percentage of users from the macro-regional health district 1 reported that team professionals never suggest solutions suitable for their reality, which decreases the likelihood of user satisfaction. Even if care is not provided within the facility premises, the user can feel satisfied with the health service. Thus, the health professional should use a

welcoming approach focused on the search for solutions; listen to complaints; and identify the users' needs.[27]

Regarding the bond/responsibility and coordination of care, a high percentage of users from the health district 4 considered the time of consultation with the physician insufficient, which decreases the likelihood of user satisfaction. As district 4 is also composed of small and medium-sized municipalities, it is possible that physicians working in PHC facilities dedicate less time to their consultations due to the fact that they may have other job positions, such as private offices. Therefore, a shorter time spent in consultation may be related to their high workload.[28]

The fact that professionals "never" ask about the users' relatives decreases the likelihood of user satisfaction. The bond between professional and user is essential and can influence the production of care in a relationship based on trust, which can serve as an exchange channel of knowledge between professionals and users.[13] It was verified that this relationship influences the satisfaction of users assisted in public health services. The search for the consolidation of interpersonal relationships with the user, such as investigating the reason that prevented them from returning to care, can help establish closer bonds to the patients' daily lives.[29]

Home visit is considered to be an important approach, as the lack of home visit by CHW decreases the likelihood of user satisfaction. A home visit is understood as a set of health actions carried out at home, aiming to introduce health teams into the context of the community's reality. The findings observed in our study reveal that home visits are an interface for the establishment of the health professional/user relationship, which strengthens the bond and supports users and their families, ultimately influencing their satisfaction with healthcare service.[30]

Regarding the mechanisms for participation and interaction of users, there was a high percentage of users from the health district 1 who reported not being able to file a complaint or suggestion at the health care facility, when desired, therefore negatively influencing satisfaction. These findings point to the role of popular participation in user satisfaction. Social control allows the individual to place himself in an active position in the process of health service evaluation offered by PHC facilities.[13,31]

The use of secondary data is a study limitation, which can generate biases due to the poor quality of information. It should be noted the possibility of selection bias, given that no randomization strategy was carried out to select users who answered the external evaluation questions. In addition, information bias could have occurred due to the extension of the questionnaire.

Nevertheless, PMAQ-AB provides generalized data due to its scope and has therefore a high level of accuracy. In view of that, the results presented herein can generate important subsidies for decision making, aiming to improve health management based on the information provided by users.

It is understood that the assessment of user satisfaction on health care assistance allows changes in the work process organization, in the decision making regarding professional practices and in the prioritization of certain resources.

Among the factors that had a negative impact on user satisfaction on primary care in the state of Paraíba, are: time of consultation with the physician does not meet the users' needs; users are not able to file a complaint or suggestion at the healthcare facility; users cannot schedule same-day appointments; professionals never ask about the users' family; and the Community Health Worker does not make home visits.

As an aid to the decision-making process, the present study points out strategies that can be adopted to increase user satisfaction on health care at the primary care level, such as: reorganization of services in order to facilitate access to health services in accordance with users' needs; respect towards users and towards their rights to exercise autonomy and participation in health decisions; and strengthening of the professional/user relationship through the consolidation of interpersonal relationships.

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TRANSIENT FUNCTIONAL CROSSBITE AND LIP BITING CAUSED BY ERUPTION OF THE FIRST PERMANENT MOLAR: A CASE REPORT

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Palavras-chave: Erupção Dentária. Odontopediatria. Oclusão Dentária Traumática.

Resumo

Introdução: A erupção dentária é um fenômeno fisiológico que costuma causar alterações locais. **Objetivo**: Relatar um caso incomum de mordida cruzada transitória e mordedura de lábio causadas pela erupção do primeiro molar permanente. **Relato do caso**: Uma garota de 5 anos buscou tratamento odontológico com a queixa principal de dor em região posterior inferior. No exame clínico, foram observados edema, acúmulo de biofilme, ulceração local e inflamação por trauma do tecido devido à erupção do primeiro molar permanente inferior esquerdo. Além disso, foram observadas mordida cruzada unilateral funcional e mordedura de lábio. Foi prescrita clorexidina a 0,12% e pomada analgésica/antiinflamatória (Triancinolona Acetonida) tópica por 10 e 7 dias, respectivamente, associada à higiene local na área afetada. No acompanhamento de 1 mês, observou-se a resolução da inflamação local, bem como a correção espontânea da mordida cruzada e da mordedura do lábio. **Conclusão**: Uma vez que os desvios oclusais funcionais podem ser causados pela erupção dentária, é importante que os profissionais saibam diagnosticar e tratar corretamente esta condição.

Keywords: Tooth Eruption. Pediatric Dentistry. Dental Occlusion, Traumatic.

ABSTRACT

Introduction: Tooth eruption is a physiological phenomenon that typically causes local changes. **Objective**: The aim of this paper is to report an unusual functional crossbite and lip biting caused by eruption of the first permanent molar. **Case report**: A 5-year-old female sought dental treatment with the chief complaint of pain in the posterior region. At the clinical examination, swelling, accumulation of biofilm, local ulceration and severe traumatic tissue inflammation due to eruption of the first permanent lower left molar were observed. Furthermore, functional unilateral crossbite and lip biting were observed. Local hygiene associated with chlorhexidine 0.12% and topical analgesic/anti-inflammatory ointment (Triamcinolone Acetonide) were prescribed for 10 and 7 days, respectively. At 1-month follow up, resolution of local inflammation was observed as well as spontaneous correction of the crossbite and lip biting. **Conclusion**: Since functional occlusal deviations can be caused by tooth eruption, it is important that dentists are able to diagnose and treat this condition.

INTRODUCTION

Tooth eruption is the displacement of the tooth from its initial site of development to its functional position in the dental arch.[1] There are different theories to explain this phenomenon, which include genetic, physical, hormonal, molecular and cellular control, the multifactorial concept being the most accepted.[1,2]

It is quite common that most children present systemic and local signs and symptoms associated with the period of tooth eruption, especially in primary dentition.[3,4] The most common alterations observed during this period are gingival irritation, irritability and drooling. It normally causes stress and a great deal of anxiety among parents due to the intense discomfort presented by children,[4] leading to a high demand for dental care, especially with pediatric dentists.[5]

It can also occur during permanent molar eruption, as this period is characterized by inflammation of the local tissues that generates pain and discomfort in patients, including other changes.[5] Thus, the aim of this report is to present a case of an unusual functional crossbite caused by the eruption of the lower first permanent molar.

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CASE REPORT

A 5-year-old female presented at the Department of Paediatric Dentistry and Orthodontics of Universidade Federal do Rio de Janeiro with a chief complaint of pain at the distal region of the second primary left lower molar. The patient's medical history was not relevant, but the patient had difficulty eating and brushing her teeth.

Clinical examination showed caries-free mixed dentition and unsatisfactory oral hygiene status. It was observed that the alveolar mucosa in the distal region of the second primary left lower molar presented with swelling, excessive accumulation of biofilm, local ulceration and severe traumatic tissue inflammation, associated with the eruption of the lower first left permanent molar (Figures 1a and 1b). In addition, it was observed that the ulcers were caused by direct occlusal contact of the first permanent left upper molar, already erupted, with this swollen soft tissue (Figure 1c).

A functional deviation from her normal occlusion was verified, as indicated by the occlusal closure in a different position of maximal habitual intercuspation to promote pain relief over this traumatized region. The presence of a functional unilateral posterior crossbite on the right side (Figure 1c) and parafunctional habit of lower lip biting (Figure 1d), leading to labial ulceration (Figure 1e) were observed.

The oral condition of the patient was explained to the mother and she was given instructions for improving oral hygiene, especially in the affected area, with an extra soft toothbrush. Mouthwash with 0.12% chlorhexidine was prescribed for 10 days and local use of analgesic and anti-inflammatory ointment (Triamcinolone Acetonide) only in the affected region for 7 days, to improve the ulcerations. Furthermore, the proposed treatment was to wait for the complete healing of the region and then verify whether the patient returned to her habitual occlusion. Despite her young age, the patient presented with cooperative behavior throughout the appointment.

At 1-month follow up, resolution of the inflammatory process, a significant improvement in her oral hygiene and a return to occlusion on maximal habitual intercuspation with spontaneous resolution of the crossbite and lip biting were verified. At the 6-month follow-up visit, maintenance of oral health, satisfactory oral hygiene and no occlusal alterations beyond the total eruption of the first permanent left lower molar were observed (Figure 1f).

In addition, the maintenance of a satisfactory occlusion relation on the posterior left region was observed (Figure 2).

DISCUSSION

Different local symptoms are related to tooth eruption. Among the most commonly observed are excessive

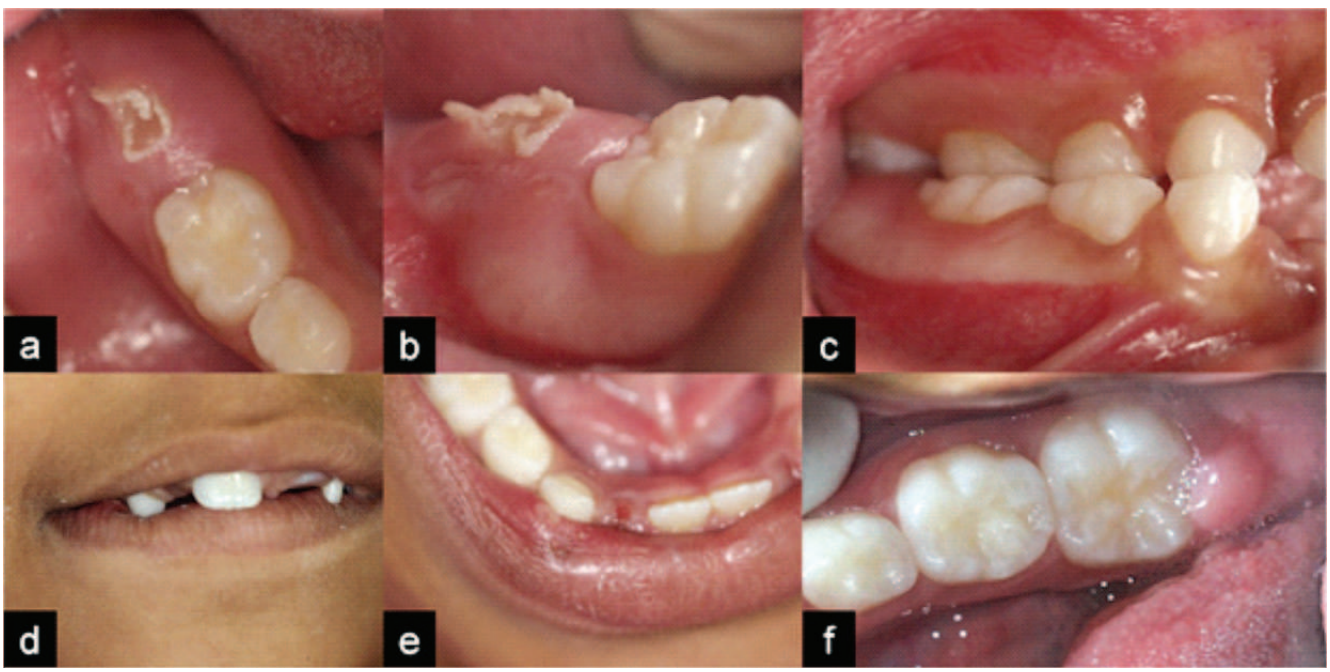

Figure 1: *(a) Occlusal and (b) vestibular view of the hyperplasic inflammatory tissue in the distal region of the second primary left lower molar. (c) Posterior functional crossbite and direct occlusal contact of the first permanent left upper molar in lower soft tissue. (d) Lower lip biting. (e) Lower lip ulceration. (f) Six-month follow-up evaluation showing the complete remission of the lesion.*



***Figure 2**: Lateral view showing a satisfactory occlusion in the left posterior region at the six-month follow-up appointment.*

drooling, inflammation of the gingiva overlying the tooth, gum irritation, increased biting and pain.[3-5] The theory of the role of the periodontal ligament in determining tooth eruption stipulates that this process occurs by the release of mediators and activation of cells directly involved in the inflammatory process.[2,7] It is also known that the incidence of physical forces influences the mitotic activity and collagen production by cells of the periodontal ligament, acting as a local adaptive response to repair damages.[7]

The teeth movement through alveolar bone that occurs during normal tooth eruption also causes biological responses such as osteoclastogenesis and the osteogenesis process, starting molecular and cellular events that leads to local inflammatory changes.[8] The occurrence of such local modifications may explain the excessive tissue inflammation and local pain that were observed in the present report.

This case also presented an unusual occlusal deviation and lip biting associated with severe gingival inflammation due to the eruption of the first permanent left lower molar. There are no reports of tooth eruption as a causal factor of functional occlusal changes. However, it is known that posterior crossbites that result from a functional shift of the mandible should be treated as soon as clinically feasible after they are found.[6,9-11]

Tooth eruption is a period that requires special attention from dentists. It is extremely important to understand the mechanisms involved and all possible associated alterations in order to provide the most appropriate patient care.[2,12] Treatment should enable the control of pain and discomfort, which are the main complaints from patients during this period.[3-5] However, treatment can also be simple and achieved using a minimally invasive approach. Moreover, in the present case, the resolution of the inflammatory process was sufficient to remove the etiological factors and solve the transitory functional alterations.

It can be concluded that conservative management of a functional crossbite and lip biting due to eruption of a first permanent molar is shown to be an excellent treatment option.

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RESTORATION OF AN AMALGAM-STAINED TOOTH WITH BULK-FILL COMPOSITE RESIN: A CASE REPORT

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Palavras-chave: Materiais Dentários. Polimerização. Resinas Compostas. Corantes. Descoloração de Dente.

Resumo

Introdução: Recentemente, foram lançadas no mercado resinas compostas que apresentam baixa contração e baixa tensão de polimerização, as chamadas resinas compostas Bulk-Fill. Estas oferecem ao cirurgião-dentista a possibilidade de inserir incrementos de até 4 mm, tornando o procedimento restaurador mais rápido. **Objetivo**: relatar um caso clínico de restauração de um dente posterior com substrato escurecido utilizando uma resina composta Bulk-Fill de média viscosidade associada a um agente opacificador. **Relato do caso**: após exame clínico e radiográfico, um paciente do sexo masculino com 50 anos de idade foi informado sobre a necessidade de substituição de uma restauração de amálgama de prata insatisfatória na superfície oclusal do dente 16. A restauração foi removida e, em seguida, foi realizada a técnica adesiva para a restauração da cavidade utilizando-se um sistema adesivo autocondicionante de dois passos clínicos (AdheSE, Ivoclar Vivadent, Schann, Liechtenstein). Devido ao substrato dentinário escurecido, foi aplicado no fundo da cavidade um agente opacificador (IPS Empress Direct Opaque, Ivoclar Vivadent, Schann, Liechtenstein) e este, então, fotoativado por 40 s. A restauração foi executada com uma resina composta Bulk-Fill (Tetric N-Ceram Bulk-Fill IVB, Ivoclar Vivadent, Schann, Liechtenstein) em incremento único que foi fotoativado por 40 s. Acabamento e polimento foram realizados com auxílio de borrachas abrasivas. **Resultado**: ao final, obteve-se, com o auxílio do agente opacificador, uma restauração esteticamente satisfatória. **Conclusão**: é possível executar restaurações de maneira mais rápida com resina composta Bulk-Fill de média viscosidade. Entretanto, por se tratar de um material essencialmente translúcido, é recomendado o uso de um agente opacificador em dentes com substrato escurecido a fim de se obter um resultado esteticamente satisfatório.

Keywords: Dental Materials. Polymerization. Composite Resins. Coloring Agents. Tooth Discoloration.

Abstract

Introdution: Recently, composite resins that have low shrinkage and low polymerization stress have been released, the so-called Bulk-Fill composites. These offer the dental surgeon the possibility of inserting increments of up to 4 mm, making the restorative procedure faster. **Objective**: to report a clinical case of a posterior tooth restoration with discolored dentin substrate using a medium viscosity Bulk-Fill composite resin associated with an opacifying agent. **Case report**: upon clinical and radiographic examination, a 50-year-old male patient was informed about the need to replace the defective silver amalgam restoration on the occlusal surface of tooth 16. The unsatisfactory restoration was removed and then the bonding technique was performed to restore the cavity using a two-step self-etching adhesive (AdheSE, Ivoclar Vivadent, Schann, Liechtenstein). Due to the discolored dentin substrate, an opacifying agent (IPS Empress Direct Opaque, Ivoclar Vivadent, Schann, Liechtenstein) was applied to the bottom of the cavity, and then was photoactivated for 40 s. The restoration was performed with a single increment of Bulk-Fill resin composite (Tetric N-Ceram Bulk-Fill IVB, Ivoclar Vivadent, Schann, Liechtenstein) that was photoactivated for 40 s. The finishing and polishing procedures were performed using abrasive rubbers. **Result**: at the end, an aesthetically satisfactory restoration was obtained with the aid of the opacifying agent. **Conclusion**: it is possible to perform restorations faster with medium viscosity Bulk-Fill composites. However, as it is an essentially translucent material, the use of an opacifying agent in discolored tooth substrate is recommended, in order to obtain an aesthetically satisfactory result.

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INTRODUCTION

Recent researches in the field of composite resins have developed new materials that can be used in single increments instead of the traditional incremental technique.[1-3] The manufacturers claim that these new compounds exhibit low volumetric shrinkage, lower polymerization stress, and increased depth of cure.[1-3] This allows for the placement of a single increment of up to 4 mm thickness.[1-3] The advantages of the Bulk-Fill composites are that they simplify clinical techniques and save time.[1-3] In addition, the single increment method prevents the incorporation of bubbles and contamination between the layers of material, resulting in a more compact filling.[2] Due to the increased translucency, light transmission through

the material is made possible.[1-3] Moreover, the Bulk-Fill composites provides a modulation of the polymerization stress, due to the use of specific monomers that "relieve" this stress.[3]

Bulk-Fill composites can be classified into two categories according to their viscosity: low viscosity (flowable) and medium viscosity (sculpted).[2,4-6] Low viscosity Bulk-Fill composites are better suited to the cavity walls when compared to medium viscosity, especially on irregular surfaces.[5,6] On the other hand, they show higher polymerization shrinkage, and generally have lower amounts of fillers, leading to lower mechanical properties.[5,6] Hence, when restoring occlusal surfaces with low viscosity Bulk-Fill composites, it is necessary to place a 2 mm thick cover layer of medium viscosity conventional composite.[2,5,6]

Medium viscosity Bulk-Fill composites are more resistant, and contain a greater amount of inorganic fillers, allowing them to restore cavities up to 4 mm deep in a single increment.[5,6] However, they exhibit limitations, such as monochromaticity and high translucency.[6] This implies poor aesthetic restoration properties.[6] The increased translucency may be inconvenient in discolored tooth substrate cases, such as sclerotic dentin or dentin stained by the corrosion products from amalgam restorations, as discussed in this case report.

Since this is a new material, there has been little time for clinical follow-ups to be made, and literature to be developed. Therefore, the objective of this study is to report a clinical case that demonstrates the restoration technique using Bulk-Fill medium viscosity resin composite in discolored substrate tooth.

CASE REPORT

A 50-year-old male patient was presented at the Federal University of Rio de Janeiro's Department of Clinical Dentistry. Upon clinical and radiographic examination, a dental amalgam restoration presenting marginal defects was found on the occlusal surface of tooth 16 (Figure 1).



Figure 1: *Initial aspect of tooth 16, with the unsatisfactory amalgam restoration.*

Informed about the need to replace the defective restoration, the patient requested to replace the amalgam restoration with a composite resin restoration. After being informed of the details of the treatment, the patient agreed and signed the consent form.

After tooth prophylaxis, color selection and occlusal contacts verification, the rubber dam isolation was completed. The unsatisfactory dental amalgam restoration was then removed with a high rotation 1045 spherical diamond bur, under abundant cooling, forming a cavity of approximately 4 mm depth (Figure 2).

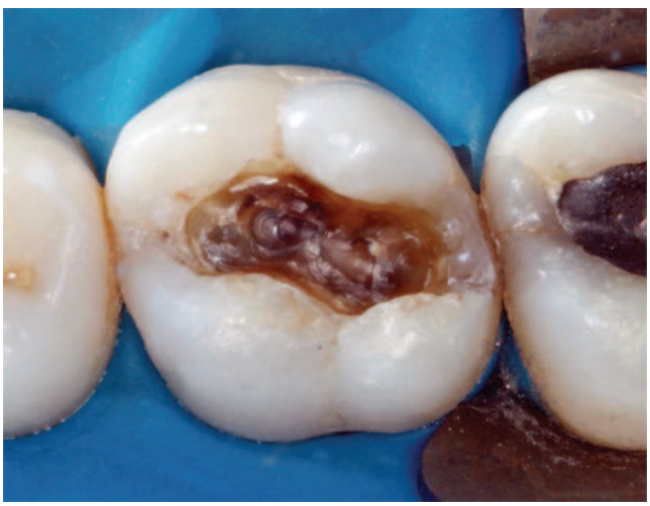

Figure 2: *Tooth cavity after removing the amalgam restoration, showing a discolored dentin.*

The enamel was etched with 37% phosphoric acid gel (N-Etch, Ivoclar Vivadent, Schann, Liechtenstein), and rinsed for 30 s with an air-water spray. Excess water was removed with sterilized absorbent papers. A two-step self-etching adhesive system (AdheSE, Ivoclar Vivadent, Schann, Liechtenstein) was selected to complete the hybridization of the dental structures. The acidic primer was actively applied on the dentin for 30 s with a disposable brush, followed by a mild air jet. The adhesive was then applied in enamel and dentin with a disposable brush and, after a mild air jet, it was photoactivated for 20 s (Bluephase N, Ivoclar Vivadent, Schann, Liechtenstein).

Following cavity preparation and dental hybridization, the opacifying agent (IPS Empress Direct Opaque, Ivoclar Vivadent, Schann, Liechtenstein) was applied to the bottom of the cavity, and was photoactivated for 40 s (Figure 3).

A single increment of Bulk-Fill composite (Tetric N-Ceram Bulk-Fill IVB, Ivoclar Vivadent, Schann, Liechtenstein) was inserted and compacted against the cavity walls with a condenser (M1, Cosmedent, USA). The final sculpture was performed with a spatula (Suprafill No. 1, SS White, Brazil) to achieve the better definition of principal sulcus and correct

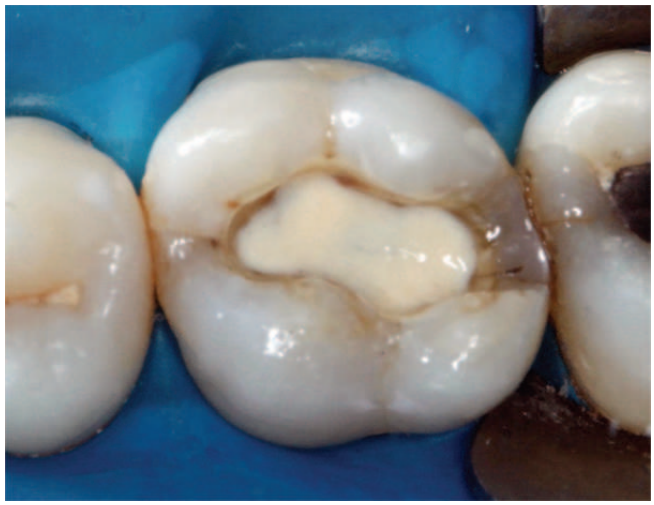

Figure 3: *Placement of the opacifying agent (IPS Empress Direct Opaque, Ivoclar Vivadent).*

inclination of cuspids, followed by 40 s of photoactivation (Bluephase N, Ivoclar Vivadent, Schann, Liechtenstein).

After the restoration was complete, the rubber dam isolation was removed. The occlusion was checked with an articulating paper (Accufilm, Parkell, USA) and occlusal adjustment was performed with a fine diamond bur (2200 F, KG Sorensen, Brazil). After 48 hours, the restoration was finished with an ultra-fine diamond bur (2200 FF, KG Sorensen, Brazil), and abrasive rubbers in medium and fine granulations (Astropol, Ivoclar Vivadent, Schann, Liechtenstein). The composite was then polished with a brush impregnated with silicon carbide (Astrobrush, Ivoclar Vivadent, Schann, Liechtenstein) (Figure 4).



Figure 4: *Aspect of the Bulk-Fill resin restoration after sculpture and photoactivation.*

DISCUSSION

The main advantage of Bulk-Fill resin composites is the possibility of a single increment placement, rendering the conventional incremental technique redundant. The use of a single increment decreases the clinical time to perform the restorative procedure, and reduces the sensitivity of the technique. [7,8]

Manufacturers claim these new composites have low polymerization shrinkage, low polymerization stress and increased polymerization depth, allowing for the insertion of a single increment of up to 4 mm thick. [3]

The polymerization shrinkage of composite resins occurs due to the conversion of monomers into polymers, which results in a reduced volume of material. The higher the degree of conversion, the greater the polymerization shrinkage. This process can cause failures in the margin integrity and postoperative sensitivitie.[7]

Bulk-Fill composites allow for the placement of increments that are more than 2 mm thick, which is the recommended limit for conventional composite resins. The insertion of increments up to 4 mm is possible for the Bulk-Fill composite due to technologies developed by the manufacturers, which aim to minimize the polymerization shrinkage.[6] One of these technologies seeks to reduce the polymerization stress by means of a "relief", that functions as a spring between the polymers. Another technology allows for the fragmentation of the polymer chains and, consequently, relieves the polymerization shrinkage stress, without impairing wear resistance.[1,6] According to Hirata et al.[7], Bulk-Fill composites present a reduction of the polymerization shrinkage, which reduces the possibility of gap formation between the restoration and the cavity walls.

Polymerization shrinkage alone is not responsible for the failure of composite resin restorations. The stress developed by the shrinkage when resin is bonded to dental structures is the main causal agent. This stress is directly related to the elasticity modulus of the material, a phenomenon explained by a parallel to Hooke's law, where stress is the product of polymerization shrinkage versus modulus of elasticity.[9] Kim et al.[5] confirmed a strong linear relationship between shrinkage stress and debonding at the tooth-composite interface. In terms of polymerization shrinkage stress and tooth-composite interfacial debonding behavior, it was shown in the same paper that medium viscosity Bulk-Fill composites do not seem to be advantageous compared to the medium viscosity conventional composite, while low viscosity bulk-fill composites demonstrated superior results compared with the low viscosity flowable conventional composite.[5]

The higher polymerization depth of the Bulk-Fill composites is mainly achieved through their higher translucency, when compared to conventional resins. Generally, this translucency is justified by the reduction of

the amount of fillers, and the increased size of these fillers. This results in a lower light scatter and, consequently, deeper penetration of the light.[10,11] Zorzin et al.[11] demonstrated that the Bulk-Fill composite achieved sufficient polymerization at 4 mm depth, by showing that there was no significant difference between the conversion degree at the top and the bottom of the specimens. On the other hand, Yap et al.[12] verified that the polymerization depth, which in Bulk-Fill composites is dependent on the product, was higher when compared to conventional resins. Despite this, Bulk-Fill composite resins did not reach the adequate polymerization in depth of 4 mm. Based on the results of this study, Bulk-Fill composite resins should not be placed in single increments with more than 2.5 to 3 mm thickness.

Bulk-Fill composites do not represent a uniform category of material.[12] According to the manufacturers specifications, Bulk-Fill composites have different types of monomers with different reactivity, and different volumetric filler concentrations, with unknown degrees of silanization. In addition, Bulk-Fill composites also have different photoinitiator systems, affecting the photocure degree.[13]

Light-cured resins contain photoinitiators, which decompose after the visible blue light irradiation, releasing free radicals that activate the polymerization.[6] Two types of photoinitiators are used in Dentistry: type I and II. Type I has a higher quantum yield, and requires fewer photons to generate a free radical than type II. Type I is, therefore, more reactive and has greater quantum efficiency.[14] The Bulk-Fill composite used in this study, Tetric N-Ceram Bulk-Fill (Ivoclar Vivadent, Schann, Liechtenstein), presents greater depth of cure according to its manufacturer. However, this is not caused by the greater translucency of the material. It is due to the presence of Ivocerin, a type I photoinitiator patented by Ivoclar Vivadent. That makes the restauration with increments of up to 4 mm possible, without compromising the composite optical properties, such as translucency and color.[15]

Ivocerin is more reactive within the range of 390 to 445 nm of the light spectrum. Therefore, it is activated by the radiation located between the blue and violet range. This led manufacturers to incorporate another color into the LED, providing a simultaneous combination of violet and blue wavelengths. Thus, considering that the Bulk-Fill composite used in this case report contains Ivocerin, the third-generation LED Bluephase N was used.[16]

In the present case, the cavity pulp wall was discolored due to deposition of amalgam corrosion products. Since the Bulk-Fill has a great translucency, the use of an opacifying agent (IPS Empress Direct Opaque, Ivoclar Vivadent, Schann, Liechtenstein) was indicated to cover discolored dentin substrate. Opacifiers are fluid resin-based materials with high value, and they are applied to the tooth surface in thin layers. These materials can prevent the light to pass and, consequently, can mask the unpleasant colors of the dental substrate.[17,18] However, the excessive opacity of the restoration results in an artificial appearance. On the other hand, the excessive translucency turns the restoration into a greyish color by decreasing the value.[19]

Although the medium viscosity Bulk-Fill composite allows for a single increment placement, simplifying the technique, the restoration can be difficult to sculpt. The larger volume of this material makes it difficult to reproduce the anatomical details of the tooth.[7] In this context, it becomes imperative that the professional develops an adequate restorative technique, in order to obtain the best functional results for the restoration.

Based on this case report, it is possible to observe that Bulk-Fill composites are a significant technological progress. These materials simplify the technique for surgeons, reducing clinical time and the sensitivity of the technique. Its best feature is certainly the low polymerization shrinkage. Other advantages, such as the possibility of restoring up to 4 mm increments or single increments, are consequences of this new technology. However, the technique must be well indicated, and still have limitations such as the translucency and monochromaticity of the material. This can make it difficult to obtain a pleasant aesthetic result. This material is also difficult to sculpt, due to the larger volume of resin used for the restoration. In this way, it is possible to obtain satisfactory results with Bulk-Fill resin composites, once their characteristics and indications are known.

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THE DENTIST AS A CHILD ABUSE INFORMER: A CASE REPORT

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Palavras-chave: Maus-tratos Infantis. Violência Doméstica. Odontopediatria.

RESUMO

Introdução: A violência doméstica contra as crianças interfere no seu desenvolvimento psicológico, levando a sequelas que se manifestam e persistem até a idade adulta. A evidência física da violência doméstica é facilmente observada no complexo orofacial e, eventualmente, é detectada pelos dentistas. **Relato do Caso**: Relatamos o caso de uma vítima de maus-tratos, de 9 anos de idade, que foi diagnosticada durante o tratamento odontológico. Um odontopediatra, durante as consultas de rotina, após identificar injúrias físicas (hematoma na órbita esquerda e queimaduras na mão esquerda e lábios), suspeitou tratar-se de maus tratos, levando o caso às autoridades responsáveis. A custódia da criança foi concedida à avó por uma decisão judicial, o que permitiu a recuperação da saúde e qualidade de vida. **Conclusão**: Os profissionais devem conduzir adequadamente os casos de abuso, a fim de proteger as crianças de ocorrências futuras.

Keywords: Child Abuse. Domestic Violence. Pediatric Dentistry.

ABSTRACT

Introducition: Domestic violence against children interferes in their psychological development, leading to sequels that manifest and persist up to adulthood. Physical evidence of domestic violence is easily observed in the orofacial complex and eventually becomes detected by dentists. **Case Report**: We report the case of a 9-year-old victim of maltreatment who was diagnosed during dental treatment. The existence of physical injuries (a hematoma in the left orbit and burns on the left hand and in the lips) aroused the attention of the pediatric dentistry, whose brought the case to the responsible authorities. Custody of the child was granted to the grandmother by a court decision, which enabled the recovery of health and quality of life. **Conclusion**: Professionals must properly conduct cases through complaints in order to protect children from future occurrences.

INTRODUCTION

Child maltreatment is recognized internationally as a serious public health, human rights, legal, and social problem. It is linked to other forms of violence including intimate partner violence, community violence involving young people, and suicide.[1] As stated by the World Health Organization (WHO), five subtypes can be distinguished: physical abuse; sexual abuse; neglect and negligent treatment; emotional abuse; and exploitation.[2] All types are potentially harmful to one's health, development, and dignity.[3] The prevalence of children physical abuse in Brazil is 18%, while it ranges from 12% in Europe to 26% in Easter Mediterranean region.[4] The anatomic region most affected in domestic violence against children involving physical manifestations is the face,[5] with an estimated prevalence rate of 58-85%.[6,7] Thus, it is an important region of the orofacial complex in dentistry,[7] which is examined regularly in the clinical routine. Unintentionally, dentists may face clinical signs of domestic violence on a daily basis. However, many dentists complain about the lack of training to interpret suspicious cases and report them to the authorities. Consequently, children maltreatment expands as an underreported social problem.[8] Brazilian laws determine the notification of cases of child abuse by health professionals [9]

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On the basis of this information and through the report of a case of child maltreatment, the aim of this paper is to provide elements that may assist dentists, especially pediatric dentists, in the diagnosis and management of child abuse cases.

CASE REPORT

A 9-year-old female leukoderma child sought the pediatric dentistry clinic of a private university in the city of Rio de Janeiro for treatment. In the anamnesis, the patient was reported to have lived with her father, stepmother, and three brothers. The mother, alcohol dependent, abandoned the child when she was a baby. The intraoral examination revealed five caries lesions in dentin of deciduous molars.

The patient always attended dental treatments with her paternal aunt, and her parents never appeared at the clinical appointments. She was a shy, withdrawn child with a sad, shy look and did not interact with the dental team. In the fourth appointment, the following lesions were observed: a hematoma in the left orbit (Figure 1) and burns on the left hand (Figure 2) and in the lips (Figure 3).



***Figure 1**: Hematoma in the left orbit.*



***Figure 2**: Burning with laceration of the epithelium in the left hand.*

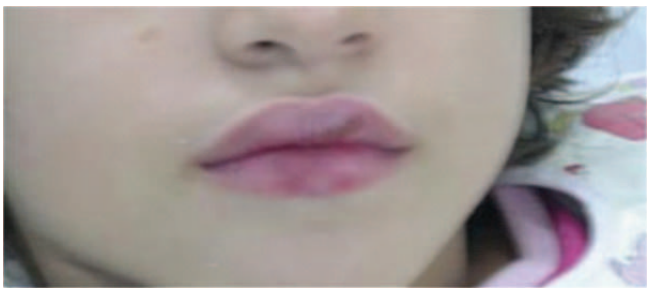

***Figure 3**: Burning in the lips with loss of epithelium.*

When asked about how these injuries happened, the child reported that she had fallen off the school ladder. After a few minutes, she said that her brother kicked her eye. Not convinced with the answer, the dentist asked the pediatric dentist (coordinator of the clinic) to talk with the child. Using behavior guidance techniques[10] the coordinator achieved interaction with the child. Therefore, she felt confident and willing to report that one day, her stepmother had beaten and burned her with a hot spoon while the father was aware and conniving with the situation.

Notification of the case

After the victim's report, her aunt was questioned by the dentist if she was aware of the observed physical lesions. She was aware of the lesions but not knowledgeable about what happened. The coordinator explained the mistreatment and requested the presence of a social worker at the university, who advised the aunt to seek the Guardianship Council immediately and make a complaint.

Getting there, the Council sent the aunt to the police station for the Department of Protection of Children and Adolescents (DPCA) to record the occurrence. According to the present Brazilian legislation, the child was referred for corpus delicti exam in an appropriate institution. Them the case was referred directly to the Public Ministry, which requested the testimony of the dentist, school bus driver, and teacher. The dentist presented to authorities, the images made during the consultation as well as the dental documentation produced during the dental care of the patient. According to the school bus driver, she had observed marks on child's body, constant delays in reaching the bus, and consecutive absences to school. The teacher did not testify, but the school board sent a letter about the child, which included a drop in school performance and lack of concentration in class but made no mention of the aggressions.

In an informal report, the teacher warned the child's aunt that she had already seen marks on the child's body. Thus, the father had been called to the school, where he denied any type of aggression. The judge decided to take the necessary measures to transfer child's custody to the paternal grandmother. It has been emphasized that the testimony of the pediatric dentist was essential for the final decision.

When the child returned for dental treatment, it was possible to observe her behavioral changes. She was more expressive and was talkative, happy, and quite participative.

DISCUSSION

Craniofacial, head, face, and neck injuries occur in more than half of the cases of child abuse. Oral injuries are

usually caused by instruments such as eating utensils or bottles during forced feedings, hands, and fingers and also by scalding liquids or caustic substances.[7]

The abuse may result in contusions, burns, or lacerations of the different oral soft tissues, as well as lesions in hard tissues (fractures or displacements of teeth or bones).[7] The lips were the most common site for inflicted oral injuries, followed by the oral mucosa, teeth, gingivae, and tongue.[11] In the present case, there were burn signs in the lips caused by a hot spoon, besides a hematoma in the orbital region.

A careful and thorough intraoral and perioral examination is necessary in all cases of suspected abuse.[7] In addition, the child should be fully evaluated because the presence of lesions in other parts of the body may confirm the maltreatment. Moreover, in cases of physical abuse, it is common to find other indicators besides bodily injury. These include insensitivity to pain during clinical appointments, social isolation, low self-esteem, dejection, shyness, guilt, inattention, and incomprehension.[12] In the present case, there were bodily injuries in the child's hand, which led the professional to suspect even more of the maltreatment, and the child was shy and dejected.

Child abuse results from a complex interaction among the child, caregiver, and environmental factors. Although child physical abuse affects children of all ages, ethnicities, and sociodemographic backgrounds, particular factors in life history can increase maltreatment vulnerability.[13] In this case, we recognized some risk factors such as being an unwanted baby, the mother's abandonment; and consumption of alcohol or drugs by the mother during her pregnancy.[1,14]

In general, girls are more susceptible to sexual abuse[1] and boys are at greater risk of harsh physical punishment.[1,14] Furthermore, children with health problems and those living in families with concomitant intimate-partner violence are at greater risk.[14] In this case, the victim was a girl and only reported physical abuse. We didn't have any information about sexual abuse or concomitant violence.

Some characteristics and attitudes of the aggressor can help identify victims of abuse. Among them are the fact that persons different from the parents or guardians take the victim to the clinic, which may constitute self-incriminating behavior on the part of the agressor.[15] It's known that children are several times more likely to be victims of extreme abuse and homicide in the hands of step parents than genetic parents,[16] and one parent is usually the abuser while the other parent assumes a passive position, allowing the abuse to continue.[17] It is in accordance with the case reported since the parents never attended appointments with the child and the stepmother was the abuser while the father was conniving.

On the basis of the researched literature,[12,18,19] we compiled some indicators to help in child maltreatment identification (Figure 4). Facing the evidence, the professional in this case suspected mistreatment. Thus, using behavior guidance techniques that reduced the child's anxiety, as a "reassuring touch"[20] simultaneously with a paused voice, the professional could interact with the child and allow her to feel comfortable to tell the truth.

The procedures to be adopted by dentists in mistreatment cases are (1) documenting in detail (recording and photographs) the lesions and/or signs observed; (2) notifying the competent local authorities; and (3) being available to testify when requested. In the present case, the violence was reported by the child herself, and the aunt, who was responsible for her care during the appointments, signed the dental chart, recognizing the information provided by the dentist. The aunt was then advised by the social worker to make a formal complaint to the competent local authorities. A study[21] found that reporting a suspicion of child maltreatment is a clinical and ethical dilemma for dentists since there are contradicting professional roles, difficulties confirming suspicions of maltreatment, and perceived shortcomings in the child-protection system.[21] Besides that, a systematic review[8] that investigated the perception, knowledge, and attitude of dentists toward the detection and management of domestic violence against children cases concluded that more attention must be given to forensic education in dentistry. Usually, many dentists complain about the lack of training for detect suspicious cases and reporting them to the authorities.[22,23] Proper training is necessary to support dentists on the detection and management of pediatric patients under domestic violence.[8] In the present case, the dentist conducted the case correctly, doing her duty; that is, in specific countries such as the United States and Brazil, dentists are required by law to report suspicious cases of domestic violence against children observed in the dental practice.[8] In Brazil, the criminal code define maltreatment as the exposure to danger of life or health of a person subordinated to the causative agent, since it is under his authority, custody or surveillance for the purpose of education, teaching, treatment or custody. The obligation of the dentist to report a case of maltreatment is determined both by the Statute of the Child and the Adolescent[9] as by the Ethic Dentistry Code.[24]

It is important for health care providers to be aware that physical or sexual abuse may result in oral or dental injuries or conditions. Pediatric dentists are more likely to attend a victim of abuse; thus, they must be aware about their important role in making a trust link between the child and themselves to obtain the child's report of the

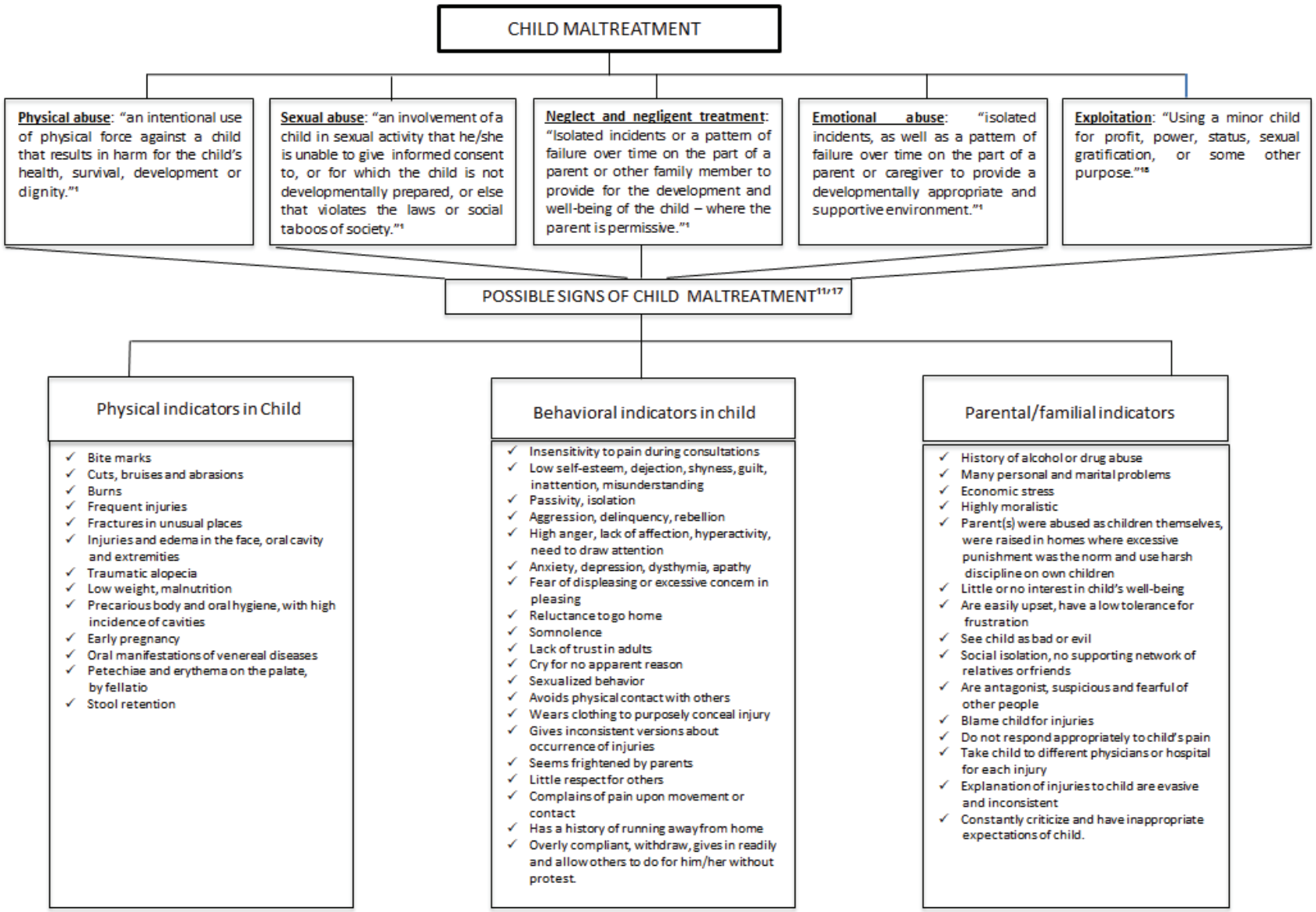

***Figure 4**: Child maltreatment definitions and possible signs.*

maltreatment and notifying the case to the authorities. Therefore, professionals protect children by breaking the cycle of violence, giving them the opportunity for better lives.

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O que o CRO-RJ faz pelo Cirurgião-Dentista?

É muito comum ouvirmos o cirurgião-dentista formular a pergunta acima, sobretudo no início do ano quando se vê obrigado a pagar a anuidade. Mas, de fato, qual é a função do CRO-RJ? O que o CRO-RJ faz em meu favor?. O objetivo deste breve informativo é justamente conscientizar, você, cirurgião-dentista de algumas atribuições e realizações do CRO-RJ e, assim, responder ao questionamento: afinal, o que o CRO-RJ faz pelo cirurgião-dentista?

De acordo com o art. 11 da Lei 4.324/1964, uma das principais atribuições do CRO-RJ é a fiscalização do exercício profissional (letra "b"). A fiscalização do exercício profissional se aperfeiçoa de diversas formas. Uma delas, evidentemente, é o combate ao exercício ilegal da profissão. E como o CRO-RJ atua neste sentido?

I. Concurso Público
O CRO-RJ, por exemplo, realizou em 2017 o 1º Concurso Público de sua história para a contratação de diversos empregados, sobretudo, para a função de fiscais! Tínhamos, até o ano de 2015 um total de 06 fiscais. Com o Concurso Público chegamos a um total de 19 fiscais que percorrem todo o Estado fiscalizando o exercício profissional.

II. Canal Direto ao Setor de Fiscalização
Você sabia que toda e qualquer violação ao Código de Ética pode ser comunicada e deflagrada imediatamente através de denúncias diretamente ao Setor de Fiscalização? O CRO-RJ coloca a sua disposição o telefone nº 3505-7676 e o e-mail - *sefis@cro-rj.org.br* para fins de prestar um serviço de forma mais eficiente e presente aos seus jurisdicionados.

III. Sistema Alferes
O Projeto Alferes é um modelo de atuação que gerencia e aperfeiçoa as atividades do setor de Fiscalização. O aplicativo instalado em smartphones aumenta a eficiência e assertividade do setor. A implantação do sistema permite que o chefe da fiscalização acompanhe todas as denúncias e visitas, gere relatórios automatizados, aumenta o número de locais visitados, entre outras coisas. Tecnologia e eficiência na Fiscalização do CRO-RJ.
O art. 11, letra "i" da Lei 4.324/1964 prevê que cabe ao CRO-RJ promover por todos os meios ao seu alcance o perfeito desempenho técnico e moral de odontologia, da profissão e dos que a exerçam, mas o que o CRO-RJ tem feito neste sentido?

IV. Não Obrigatoriedade do Curso de Proteção Radiológica
Em 2016, após intensas negociações entre todas as partes envolvidas, o CRO-RJ conseguiu fechar acordo para que a exigência do curso de proteção radiológica para os cirurgiões-dentistas, que era necessária a cada dois anos, deixasse de ser obrigatório

V. Projeto Interior Ativo
O CRO-RJ ciente que a classe odontológica vai muito além da cidade do Rio de Janeiro criou e desenvolve o chamado Projeto Interior Ativo que consiste, basicamente, em ministrar e oferecer cursos com professores conceituados visando a atualização acadêmica e profissional do cirurgião - dentista. No ano de 2017 o CRO-RJ se fez presente através do Projeto Interior Ativo em 19 municípios.

VI. Acervo de Periódicos Acadêmicos - Consulta On - Line e Gratuita
De forma totalmente inovadora, o CRO-RJ no ano de 2016 firmou uma parceria com a Editora ELSEVIER e passou a oferecer a todos os seus jurisdicionados o acesso gratuito a publicações, artigos acadêmicos e e-books.

VII. Cursos On-Line
Entre os anos de 2016 e 2017, foram oferecidos um total de 87 cursos transmitidos gratuitamente pelo nosso canal do Youtube e da nossa fanpage e disponibilizados em nossa biblioteca virtual, sepados por especialidades.

VIII. Projeto Sorrir
O Projeto Sorrir lançado neste ano de 2018 tem como escopo promover políticas de saúde bucal em parcerias com as Prefeituras locais focado em prevenção e saúde bucal de crianças (0 à 12 anos), além de palestras dirigidas à população.

De acordo com o art. 4o da Lei 12.514/2011, cabe ao CRO-RJ a cobrança de anuidades. Mas o que o CRO-RJ tem feito neste sentido?

IX. Anuidade 2018 sem reajustes
O CRO-RJ votou em Assembléia Conjunta no CFO, no ano de 2017, a manutenção do valor da anuidade para o exercício 2018 sem qualquer reajuste.

X. Cartão de Débito e Crédito
O CRO-RJ visando o maior conforto do cirurgião-dentista, desde o ano de 2016, aceita o pagamento das anuidades em aberto por meio do Cartão de Débito e Crédito, inclusive através do próprio site do CRO-RJ (on line).

À luz do art. 1o do Decreto n. 68.704/1971 cabe ao CRO-RJ também zelar e trabalhar pelo conceito da profissão. Logo, o que o CRO-RJ tem feito no sentido de valorizar a odontologia?

XI. Dia do Dentista
Em 2016 foi realizado um grande evento para comemorar a data, que aconteceu no hotel *Grand Hyatt* onde tivemos um talk show com a presença do jornalista Ricardo Boechat. Em 2017 o CRO-RJ propiciou o maior evento da Odontologia Fluminense, entre os dias 25 e 28 de Outubro, no Riocentro, que contou com um time de palestrantes nacionais e internacionais, além de shows. Para este ano de 2018 o CRO-RJ está preparando uma nova festa com o objetivo de valorizar a profissão.

As eleições para o CRO-RJ, de acordo com o art. 22 da Lei 4.324/1964, são realizadas por meio de voto pessoal, secreto e obrigatório.
XII. Votação On-line
O CRO-RJ envidou todos os esforços no sentido de realizar a primeira votação on-line para a escolha da Diretoria 2017-2019. O cirurgião-dentista pela primeira vez pode votar através de seu computador, *tablet* ou smartphone.

XIII. Parceria com a Secretaria Estadual de Saúde
Com essa parceria, o CRO-RJ se engaja nas grandes campanhas de imunização do estado do Rio de Janeiro, colaborando na vacinação dos profissionais da odontologia fluminense em ações como a campanha contra a febre amarela, quando disponibilizou vacinas em sua sede Centro para todos os portadores da carteira do CRO-RJ.

Como visto acima, o CRO-RJ fez e faz muito por você! Venha nos visitar e participe deste movimento de valorização constante da Odontologia!

CRO RJ