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Malocclusion prevalence and its relation to facial type and muscular activity in school students from 7 to 12 years of age in Bahia, Brazil

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Abstract

Objective: Increasing cavity reduction has been directing the policies for oral health defined by care programs, to solve important challenges such as dental malocclusion. This study aimed to assess the prevalence of malocclusion using the Dental Aesthetic Index (DAI) and relate it with the facial type, using anthropometry, and muscle function, through the use of electromyography in young students.

Methods: The sample consisted of 324 schoolchildren, aged 7-12 years, residing and domiciled in São Francisco do Conde, Bahia. The occlusion was assessed by means of DAI, according to the methodology proposed by the World Health Organization. Facial pattern was analyzed using the Natural Head Position by the distances between the morphological facial height and bizygomatic width using a digital caliper. Yet muscle evaluation was taken from the acquisition of EMG – electromyography recordings.

Results: Differences were found statistically significant between the severity of occlusion and the type facial ($p=0.039$), dolicocephalic type being the most prevalent, whereas the comparison with the electrical potential of the muscles showed no statistically significant differences. According to the classification and criteria of FDI, 22.8% of patients had normal occlusion or mild occlusal change, 21% defined malocclusion, 20.1% severe malocclusion and 36.1%, very severe or deforming malocclusion.

Conclusion: the sample revealed a high percentage of malocclusions of varying degrees, reaching about 80% of young people who need orthodontic treatment, which reinforces attention to this pathology by institutional programs of oral health.

Key words: Malocclusion; Epidemiology; Odontology in Public Health

Malocusão, tipo facial e avaliação muscular em escolares de 7 a 12 anos de idade na Bahia, Brasil

Resumo

Objetivo: Avaliar a oclusão de escolares através do Índice de Estética Dentária (IED), do tipo facial utilizando antropometria, e a eletromiografia como recurso para avaliar a função muscular.

Metodologia: A amostra constou de 324 escolares do gênero masculino e feminino, com idades de 7 a 12 anos, residentes em São Francisco do Conde, Bahia. A oclusão foi avaliada por intermédio do IED conforme a metodologia proposta pela Organização Mundial de Saúde. Com a cabeça na posição natural, o padrão facial foi analisado mediante a determinação da distância entre a altura facial morfológica e a largura bizigomática através de um paquímetro digital. A avaliação muscular foi tomada a partir da aquisição de registros eletromiográficos.

Resultados: Verificaram-se diferenças estatisticamente significantes entre a severidade da oclusão e o tipo facial ($p=0,039$). A comparação com o potencial elétrico dos músculos não mostrou diferenças significantes. De acordo com a classificação do IED, 22,8% dos pacientes apresentaram oclusão normal ou leve alteração, 21% maloclusão definida, 20,1% maloclusão severa e 36,1% maloclusão muito severa ou deformadora.

Conclusão: Este estudo revelou alto percentual de maloclusões de variados graus, reforçando a importância da atenção a ser dada a esta patologia nos programas institucionais de saúde bucal.

Palavras-chave: Maloclusão; Epidemiologia; Odontologia em Saúde Pública

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Introduction

With the significant reduction of dental cavities in children and adolescents in last decades, more attention has been directed to other oral problems such as occlusopathies [1]. Dental occlusion is considered morphological integral part of a larger system, called stomatognathic system, composed of bone, teeth, muscles, nerves and vessels, creating a set of oral structures that perform common functions. Malocclusions represent then normality deviations of the dental arches, the facial skeleton or both, with reflexes both varied in the different functions of the stomatognathic system and in appearance and self-esteem of patients affected [2].

For public health, conducting constant research that addresses this issue helps greatly in the structure of government services and programs for population dental care [3], besides allowing real knowledge about the distribution and characteristics of malocclusion, which is of paramount importance for planning the treatment to be instituted for a certain population [4].

Therefore, as there are few studies that use indicators establishing parameters of severity in malocclusion, in view of its impact on the patients' quality of life, this study is intended to evaluate through the DAI the need for orthodontic treatment in schoolchildren 7-12 years of age in the Municipality of São Francisco do Conde, Bahia, by associating facial and muscle assessments through the use of electromyography, aiming to evaluate earlier, possible interference that may impair the functions of the stomatognathic system.

Methods

This research was reported in SISNEP / CONEP, under No. 111/09, and subject to review by the Ethics and Research Committee of Maternity Climério de Oliveira, Federal University of Bahia, leading to approval n. 005/2010.

The study sample consisted of 324 student, established following sample calculation using the following equation, $n=[DEFF * Np\ (1-p)] / [(d^2/Z^2_{1-\alpha/2} * (N-1)+p * (1-p)]$, where a minimum n of 319 patients was set. Among these, (163) were males and (161) female, aged 7-12 years, residing and domiciled in São Francisco do Conde, Bahia, predominantly black or brown, as referred themselves as, regularly enrolled in schools of public education in the year 2011. Adherence to the study of children was signed by the guardians through the Term of Free and Informed Consent. A single investigator, a graduate degree in Orthodontics, has been properly calibrated, having achieved the percentage of agreement on the order of 0.83%, according to the Kappa coefficient.

Occlusion was assessed by means of DAI, according to the methodology proposed by the World Health Organization (WHO) [5]. This index consists of three distinct groups of conditions: dentition (tooth loss upper and lower), space (crowding in the Incisal Segment, spacing in incisal segment, incisal diastema, anterior jaw misalignment and anterior mandibular misalignment) and occlusion (anterior maxillary overjet, mandibular anterior overjet, anterior open bite and molar ratio).

For each of DAI components described above, was assigned an absolute value (Table 1). So, after collecting data and running DAI calculations, a score was assigned for each patient, assigning it a rating of the severity of malocclusion and need for orthodontic treatment (Table 2).

Table 1. Occlusion components of DAI and their respective coefficients of regression

	DAI components	Weights
1	Dentition	6
2	Crowding in incisal segment	1
3	Spacing in incisal segment	1
4	Incisal diastema	3
5	Anterior jaw misalignment	1
6	Anterior mandibular misalignment	1
7	Anterior maxillary overjet	4
8	Anterior mandibular overjet	4
9	Anterior vertical open bite	4
10	Anteroposterior molar relationship	3
11	Constant	13
Total		DAI Score

Table 2. DAI Scores distributed in accordance with the severity of malocclusion.

DAI Scores	Levels of Severity Levels of Need for Orthodontic Treatment
< 25 (Degree 1)	Normal occlusion or mild malocclusion None or little need of treatment
26 a 30 (Degree 2)	Defined malocclusion Elective need of treatment
31 a 35 (Degree 3)	Severe malocclusion Highly desirable need of treatment
> 36 (Degree 4)	Very severe or deforming malocclusion Mandatory need of treatment

Besides the index used (DAI), the facial type of each patient was observed by using the standardized facial analyzes with Natural Head Position (NHP). Patients were classified according to facial morphology in Brachycephalic (78.9 to 83.9), Mesocephalic (84.0 to 87.9) and Dolichocephalic (88.0 to 93.0) [6,7]. This review took into account the centesimal relationship between the morphological facial height (nasion to the gnathion) and bizygomatic width (the distance between two zidio points), measured with a digital caliper Mitutoyo 0-150mm, serial code MT-00855 according to the equation below:

$$\text{Facial Morphological Index} = \frac{\text{Morphological Facial Height}}{\text{Bizygomatic Width}} \times 100$$

Eletromyography (EMG) was made using an equipment MIOTEC (Miotec Biomedical Equipment Ltd., POA, Brazil) surface electrode type Ag-AgCl mini med Kendal, with 4-channel MIOTOOL 400 software, Low Pass Filter, a specific function for calculating the Root Mean Square (RMS). For the electromyographic examinations, children remained seated with eyes open and natural posture. After the hygiene of muscle regions, followed by attachment of the electrode, they were positioned with the head oriented according to Frankfurt Horizontal Plane and unable to view the electromyographic records on the computer monitor [8]. A digital muscle palpation was performed during simultaneous bilateral isotonic contraction of superficial part of the masseter muscle – the muscle belly, 2 cm above the angle of the mandible, and the anterior part of the temporal muscle, ie, about 1.5 cm above and immediately behind the frontal process of the zygomatic bone. The electromyographic signal was collected during situations of mandibular rest, isometric contraction of the jaw elevator muscles for 5 seconds and during mastication with bread crumbs, for 10 seconds.

Results were submitted to descriptive analysis to evaluate occlusal characteristics and their severity, the facial typology and electric potential of the masseter and anterior temporal. In order to correlate the malocclusion and facial type, the chi-square Person was applied and to assess the difference between the degree of severity of malocclusion and the muscle electric potential the paired T-student test was used, considered the level of confidence of 95%.

Results

Distribution of components of the Dental Aesthetic Index (DAI) according to the severity of malocclusion is found in Table 3.

Table 3. Dental Aesthetic Index (DAI)

Variable	DAI Classification										Value of *p*
	Normal/Mild		Defined		Severe		Very severe/ Deforming		Total		
	n	%	n	%	n	%	n	%	n	%	
Absent teeth											
Yes	74	23,4	67	21,2	64	20,3	111	35,1	316	100,0	$p^{(1)} = 0,135$
No	–	–	1	12,5	1	12,5	6	75,0	8	100,0	
Crowding											
0	49	29,9	27	16,5	34	20,7	54	32,9	164	100,0	$p^{(2)} = 0,010^*$
≥ 1	25	15,6	41	25,6	31	19,4	63	39,4	160	100,0	
Spacing											
0	43	30,9	36	25,9	22	15,8	38	27,3	139	100,0	$p^{(2)} = 0,001^*$
≥ 1	31	16,8	32	17,3	43	23,2	79	42,7	185	100,0	
Diastema											
0	59	30,9	43	22,5	31	16,2	58	30,4	191	100,0	$p^{(2)} < 0,001^*$
≥ 1	15	11,3	25	18,8	34	25,6	59	44,4	133	100,0	
Maxillary misalignment											
0 a 1	65	29,3	49	22,1	41	18,5	67	30,2	222	100,0	$p^{(2)} < 0,001^*$
≥ 2	9	8,8	19	18,6	24	23,5	50	49,0	102	100,0	
Mandibular misalignment											
0 a 1	23	29,5	11	14,1	18	23,1	26	33,3	78	100,0	$p^{(2)} = 0,172$
≥ 2	51	20,7	57	23,2	47	19,1	91	37,0	246	100,0	
Maxillary overjet											
0 a 2	70	54,3	36	27,9	16	12,4	7	5,4	129	100,0	$p^{(2)} < 0,001^*$
> 2	4	2,1	32	16,4	49	25,1	110	56,4	195	100,0	
Mandibular overjet											
0	74	23,1	67	20,9	65	20,2	115	35,8	321	100,0	$p^{(1)} = 0,631$
1	–	–	1	33,3	–	–	2	66,7	3	100,0	
Open bite											
Yes	–	–	2	10,5	2	10,5	15	33,4	19	100,0	$p^{(1)} = 0,001^*$
No	74	24,3	66	21,6	63	20,7	102	78,9	305	100,0	
Molar relationship											
Normal	65	30,4	56	26,2	47	22,0	46	21,5	214	100,0	$p^{(1)} < 0,001^*$
Abnormal	9	8,2	12	10,9	18	16,4	71	64,5	110	100,0	
Total Group	74	22,8	68	21,0	65	20,1	117	36,1	324	100,0	

* Significant difference at level 5.0%.
(1) Through the Fisher exact test.
(2) Through Pearson Qui-square test.

Data concerning the application of classification and type of DAI and type of assessed children's face are detailed in Table 4.

Table 4 – Classification of DAI and facial types

Variable	n	%
DAI Classification		
Normal occlusion or mild occlusal alteration	74	22,8
Defined malocclusion	68	21,0
Severe malocclusion	65	20,1
Very severe or deforming malocclusion	117	36,1
Type of face		
Brachycephalic	33	10,2
Mesocephalic	53	16,4
Dolicocephalic	238	73,5
Total	324	100,0

The results indicative of the electric potential of the masseter and temporalis muscles are described in Table 5.

The elements which express the comparison between the results due to severity of malocclusion as type face are shown in Table 6, while a comparison of the degree of impairment of the occlusion with the electrical potential of the anterior.

Discussion

The occlusal evaluations conducted among schoolchildren in São Francisco do Conde, BA, revealed a high incidence of malocclusion. About 80% had significant changes in dental occlusion. These findings corroborate the high prevalence of malocclusion found in several populations of Brazil, whose percentage of 85.17%, reaches the age group 6-10 years of age [9]. Correlation between the results of this research and this national reality is ratified by national percentages found in certain municipalities, as the indices assigned to children considered in the transitional period of mixed dentition, ie 71% in Salvador, BA [10], 62% in Belo Horizonte, MG [11], 95.73% in the municipality of Miranda, MS [12], 63, 5% in João Pessoa, PB [3] and 53% in Feira de Santana, BA [13]. This understanding reinforces the importance of early intervention to prevent further damage to oral health buccal [14].

There is little doubt that access to orthodontic treatment in public health could benefit about 90% of Brazilian children who depend of it [9], besides contributing to define the criteria for care at the Center for Dental Specialties [15], given the high prevalence of malocclusion identified in this study and confirmed by previous studies [13,3,9,12,14,10]. Understanding how and which malocclusions have a negative impact on children's lives, since most of the referrals for orthodontic treatment occurs during mixed dentition, can greatly contribute to reducing the time and costs related to their more complex treatments later [16].

Table 5. Standard muscle

Variable	Statistics	Side		Value of *p*
		Right	Left	
EMGT	Average	106,83	112,36	$p^{(1)} = 0,032$*
	Median	99,18	105,33	
	Standard Deviation	52,38	55,21	
	Minimum	4,95	5,60	
	Maximum	481,10	382,70	
EMGMA	Average	128,14	130,36	$p^{(1)} = 0,479$
	Median	114,70	114,25	
	Standard Deviation	73,76	73,49	
	Minimum	15,95	9,85	
	Maximum	454,90	438,10	

* Significant Association at level 5.0%.
(1) Through the Paired Student-t test.

Table 6. Muscular Standard x DAI classification.

Muscular standard	DAI Classification				Value of p
	Normal/Mild Average±DP	Defined Average±DP	Severe Average±DP	Very severe/Deforming Average±DP	
EMGT – right	101,14±42,66	108,76±56,41	101,95±38,89	112,03±61,31	$p^{(1)}$=0,445
EMGT – left	105,18±46,63	118,23±71,31	108,96±39,49	115,37±57,04	$p^{(1)}$=0,457
EMGMA – right	117,40±65,77	127,79±78,20	132,29±69,90	132,85±78,05	$p^{(1)}$=0,523
EMGMA – left	121,45±65,85	126,04±70,29	131,27±72,38	137,98±80,27	$p^{(1)}$=0,462

(1) Through F test (ANOVA).

Over the years, several indices have been developed to assist practitioners in categorizing malocclusion, according to the degree of treatment needed. For the development of this study Dental Aesthetic Index (DAI) was elected to perform occlusal evaluations, since it is pointed by WHO as an instrument capable of measuring the occlusal characteristics, demonstrating validity and reliability in studies [17], besides being an index widely used and already consolidated in literature [13,3,9,12,14,10]. Moreover, DAI shows stratified results by degree of severity, which facilitates the planning of specialized public services[2]. Thus, the occlusion based on three groups of different conditions (dentition, area and occlusion) was evaluated in this study through DAI, according to the methodology proposed by WHO [5].

According to the normative criteria of the index in question, it was found the prevalence of children with malocclusion "very severe or deforming" (36.1%), followed by those who held "severe malocclusion" (20.1%), "defined malocclusion" (21%) and, finally, the students who have revealed to have "normal occlusion or mild occlusal change" (22.8%). Those results are similar to those found by Onyeaso et al. [18], Onyeaso e Begole [19], Santos [20], Poonacha et al. [21] e Santos et al. [3] The most prevalent types of malocclusion in the study were misalignment mandibular anterior (75.92%), overjet (60.18%), anterior segment spacing (57.09%), crowding in the incisal segment (49.38%), presence of diastema (41.04%) and maxillary anterior misalignment (31.48%), similar to what is reported in previous studies[22,23,20,3]. According to these data, we highlight the fact that children are in the mixed dentition period, marked by several changes in the dental arch, as the appearance of some transitional occlusal characteristics. A characteristic period of this stage is the "ugly duckling's" where the upper incisors are vestibular projected, with divergence from the long axis of the incisors from apical to incisal, deep overbite and diastema. Another feature of this step is the presence of misaligned lower incisors, which usually is self correcting for the change to permanent dentition [24].

Among the less prevalent occlusal changes were anterior open bite, present in 5.8% of cases and anterior mandibular overjet diagnosed in 0.9% of the children assessed. Results are similar to findings of Marques et al. [11], in which the anterior open bite was present in 3.3% of patients examined and mandibular anterior overjet was present in 1.0% of cases. Despite the low values found, these children deserve special treatment, considering that the anterior open bite and anterior mandibular overjet left to the course itself, may provide inadequate growth of the bone bases, making future treatment more difficult and complex, requiring, in some cases, association with orthognathic surgery for its success.

Evaluation of facial types, in turn, contributed as a tool of comparison with the severity of malocclusion, since the determination of facial type and correlation with stomatognathic functions, muscles and occlusion are an important factor for the clinical practice [25]. Thus, it was observed that among the patients examined, the dolicocephalic showed a higher prevalence of malocclusion (p=0.039) in comparison with brachycephalic and mesocephalic. Those results agree with the findings of the work by Queiroz et al. [26], who made a comparison between malocclusion, using the Index of Orthodontic Treatment Priority (IOPT) and type of face. Results also showed that dolicocephalic patients, regardless of age, gender or ethnicity, had an average of IOPT increased relative to other facial types. This association may be present in dolichofacials, because they are individuals characterized by a predominance of vertical growth, long face, narrower arch, "V", deep palate and, in general, have problems breathing. Moreover, long narrow faces are related to vertical maxillary excess or dental protrusion with dental interference that lead to open bite.

Considering those aspects, this study included also muscle reviews by electromyography. A comparison of the electrical potentials of the anterior temporal and masseter muscles between the right and left sides of the patient showed statistically significant differences for the anterior temporal muscle ($p = 0.032$). This result, however, is not reflected in the stomatognathic system abnormalities, since the asymmetry is a normal characteristic for humans and morphology of paired organs differs in right and left sides of the body, according to scientific literature records[27]. The muscle asymmetry of the main muscles of mastication demonstrates that subjects evaluated when young adults have a mean asymmetry within normal limits previously established for several populations [27]. The results of this study showed that the masseter muscle demonstrated no noteworthy asymmetry values.

In contrast, the use of electromyography in order to compare the electrical potentials determined in masseter and anterior temporal muscles, to the severity of malocclusion identified by DAI showed no statistically significant differences. A possible explanation is that DAI classifies patients into 4 categories according to the severity of malocclusion, which may mask the differences between patients with "normal occlusion or mild occlusal change" and those who have a malocclusion "very severe or disabling" for example.

In this context, the search for orthodontic therapy can not be considered mere vanity, since the occlusal disorder can affect chewing, speaking, swallowing, temporomandibular joint disorders and bring and promote psychological disorders by also compromising facial harmony. Often children and teenagers are stigmatized and suffer greatly by becoming object to constraints - bullying - due to occlusal condition. Thus, there is no doubt that a public health policy that includes dental orthodontics should take into account the psychological, social and cultural factors that affect the individual [28].

Conclusions

According to the results of this study, we can conclude that: a malocclusion "very severe or deforming" was the

predominant form in the sample studied, all other categories showed similar percentages. The most prevalent type of face was the dolichocephalic. There was no correlation between the functioning of the anterior temporal and masseter and the degree of severity in occlusal disorders.

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