

# The influence of temporomandibular dysfunction symptoms on maximum bite force in individuals with dentofacial deformity

## A influência de sintomas da disfunção temporomandibular na força máxima de mordida em indivíduos com deformidade dentofacial

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### ABSTRACT

**Introduction:** Individuals with dentofacial deformity (DFD) show impairment in dental occlusion, which may alter the masticatory performance and, consequently, the bite force. No research was found on the relationship between temporomandibular disorders (TMD) and bite force for this population. **Purpose:** To determine if the presence of TMD symptoms influence the maximum bite force (MBF) in individuals with DFD. **Methods:** Sixty individuals were evaluated, 30 with DFD (GDDF) and 30 with normal occlusion (CG). The TMD was assessed by an anamnesis questionnaire (AQ) containing 10 questions that allow classification of the presence and degree of signs and symptoms of TMD. MBF was assessed using a mandibular force sensor, of the EMG System 810c electromyograph. Three records of bite force were obtained, with 10-second duration each. The Spearman correlation coefficient was used, at a significance level of 5%. **Results:** The results of AQ showed higher prevalence of TMD symptoms in GDDF in relation to CG. Also, lower MBF was observed in subjects with DFD compared to CG. In addition, negative and significant correlations were found between scores obtained in the application of AQ and the MBF; therefore, the higher the severity of TMD symptoms, the lower the bite force. **Conclusion:** The presence and severity of TMD symptoms influenced the MBF in individuals with DFD, demonstrating the importance for interdisciplinary intervention during all stages of surgical-orthodontic treatment.

**Keywords:** Dentofacial deformities; Bite force; Temporomandibular joint disorders; Malocclusion; Stomatognathic system

### RESUMO

**Introdução:** Indivíduos com deformidade dentofacial (DDF) apresentam comprometimento na oclusão, que pode alterar o desempenho mastigatório e, conseqüentemente, a força de mordida, não tendo sido encontrados estudos que considerassem a relação entre disfunção temporomandibular (DTM) e força de mordida, nessa população. **Objetivo:** Verificar se a presença de sintomas de DTM influencia a força máxima de mordida (FMM) em indivíduos com DDF. **Métodos:** Participaram do estudo 60 indivíduos, 30 com DDF (GDDF) e 30 com oclusão normal (GC). Para avaliação da DTM, foi aplicado um questionário anamnésico (QA), contendo 10 questões que permitem a classificação quanto à presença e grau de sintomas da DTM. A FMM foi avaliada utilizando-se um transdutor de força mandibular, integrado ao eletromiógrafo EMG System 810c. Foram realizados três registros da força de mordida, com duração de 10 segundos cada. Foi aplicado o coeficiente de correlação de Spearman, com nível de significância de 5%. **Resultados:** Os resultados do QA demonstraram que, no GDDF, houve maior ocorrência de sintomas de DTM, em relação ao GC. Foi observado menor FMM em indivíduos com DDF, comparativamente ao GC. Além disso, foram constatadas correlações negativas e significantes entre os escores obtidos na aplicação do QA e a FMM, ou seja, quanto maior a gravidade dos sintomas da DTM, menor o valor da força de mordida. **Conclusão:** A presença e gravidade dos sintomas da DTM influenciaram a FMM nos indivíduos com DDF, demonstrando a necessidade de atuação interdisciplinar durante todas as fases do tratamento ortocirúrgico.

**Palavras-chave:** Deformidades dentofaciais; Força de mordida; Transtornos da Articulação Temporomandibular; Má oclusão; Sistema estomatognático

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**Funding:** Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), process 2009/04621-4.

**Conflict of interests:** No

**Authors' contribution:** DCBOFP and DGAP participated in the evaluations of the subjects of the research, tabulation and analysis of the data; HNF participated in the study design, diagnosed the patients regarding the type of malocclusion and approved the final version of the study; GBF guided the study, participated in the analysis and interpretation of the data, in the article drafting, and in the final approval of the version to be published.

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**Received:** 7/15/2016; **Accept:** 12/19/2016

## INTRODUCTION

Dentofacial deformity (DFD) is defined as a facial and dental disproportion that is sufficiently severe to affect the quality of life of an individual, the correction demands orthodontic treatment followed by orthognathic surgery<sup>(1,2)</sup>.

Orofacial muscular and functional alterations are common in individuals with DFD<sup>(3,4)</sup>. Masticatory function is one of the most impaired functions of the stomatognathic system, since individuals with DFD present occlusal disorders that alter the masticatory performance and consequently the bite force<sup>(5,6)</sup>. The dento-occlusal imbalance may be associated with temporomandibular dysfunction (TMD)<sup>(7,8)</sup>, which corresponds to the generic term to a clinical range of signs and symptoms involving the masticatory muscles, the joint itself and associated structures<sup>(9)</sup>.

Different authors observed predominance of signs and symptoms of TMD in individuals with DFD during presurgical orthodontic treatment compared to a control group<sup>(10,11,12)</sup>.

The literature demonstrates reduced bite force values in individuals with DFD during presurgical orthodontic treatment, compared to a control group with normal occlusion and absence of signs and symptoms of TMD<sup>(5,13,14,15)</sup>.

The relationship between pain and dynamic bite force control in individuals with DFD is not yet clear, since there is no consensus on how this dysfunction influences this aspect. Thus, it is necessary to conduct studies to demonstrate the results of these assessments in this population, using valid methods that may be effectively applied to enhance the clinical care and quality of life of individuals.

This study analyzed if the presence and severity of symptoms suggestive of TMD influenced the maximum bite force (MBF) in individuals with dentofacial deformity.

## METHODS

This study was approved by the Institutional Review Board of Bauru School of Dentistry, *Universidade de São Paulo* (process n. 049/2009) and all individuals signed an informed consent form.

The individuals were previously diagnosed by a maxillofacial surgeon, who performed facial, occlusal and cephalometric analyses and imaging examinations to define the type of malocclusion. All procedures were performed as part of the protocol before accomplishment of orthognathic surgery.

The study was conducted on 60 individuals aged 18 to 40 years (mean 27.27 years). The participants were divided in two groups, namely with DFD (GDFD) and control group (GC). The GDFD was composed of 30 individuals (mean 27.27 years) in final stage of orthodontic treatment for orthognathic surgery, being 19 females and 11 males. Among these, 18 presented facial pattern III (12 females and six males) and 12 exhibited facial pattern II (seven females and five males).

The inclusion criteria were accomplishment of presurgical orthodontic treatment and presence of DFD diagnosed by a maxillofacial surgeon.

The individuals could be classified as Pattern I, II or III. Pattern I is identified by facial normality; malocclusion, when present, is only dental, not associated with any sagittal or vertical skeletal discrepancy. The Patterns II and III are characterized, respectively, by positive and negative sagittal discrepancy between maxilla and mandible<sup>(16)</sup>.

A control group without deformity (CG) was composed of 30 individuals matched for gender and age with the GDFD. These participants were submitted to interviews and orofacial myofunctional evaluation, to check if they also met the following inclusion criteria: good general health, absence of DFD, good interarch relationship, overjet and overbite between 1 and 3 mm, natural teeth at least up to the second molar, medium facial type and nasal breathing.

The exclusion criteria for both GDFD and CG were: neurological and/or psychiatric disorders and/or syndromes, cleft lip and palate, partially or totally edentulous individuals, history of trauma to the face or previous orthognathic surgery.

The TMD was assessed by an anamnesis questionnaire (QA)<sup>(17)</sup> applied by a single examiner, containing 10 questions that allowed classification of the presence and degree of TMD.

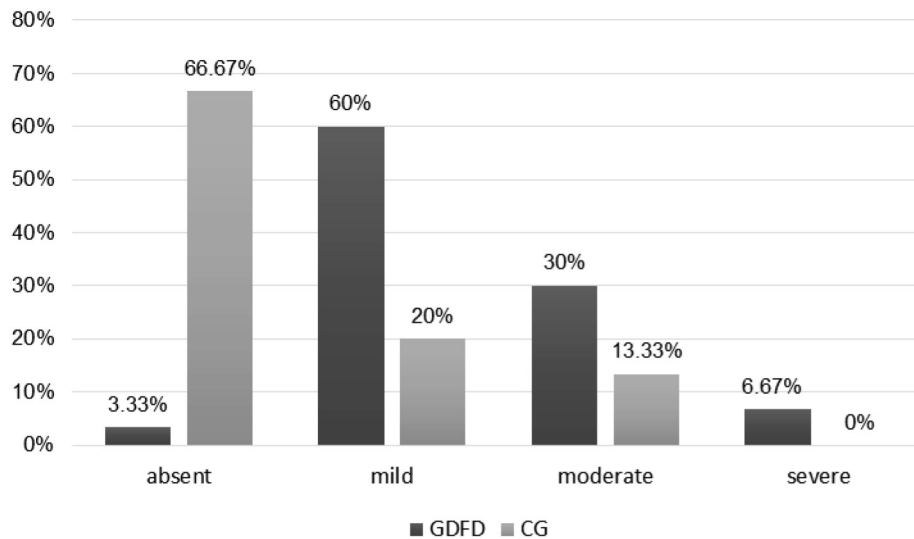
The questions comprised three possible answers: “yes”, “no” or “sometimes”. A value was assigned to each response. The sum of values achieved (scores) allowed classification of the sample in relation to TMD symptoms. Values from 0 to 3 indicated absence (0); 4 to 8, mild; 9 to 14, moderate; and severe, when the sum of values of responses ranged from 15 to 23.

The MBF was evaluated using a mandibular force sensor of the electromyograph EMG System 810c. The bite plate was positioned between the maxillary and mandibular occlusal surfaces of individuals, who were asked to bite on the plate as strong as possible. Three 10-second records of the bite force were obtained in kilogram force (Kgf), allowing one minute of rest between records, followed by achievement of mean of these records for posterior analysis.

The results of the AQ were analyzed considering the values obtained from the sum of responses (scores). The mean of the three records of MBF was calculated in Kgf. Comparison of the AQ and MBF data with the control group was performed by the Student t test. Correlation between the presence and severity of TMD (QA) and mean MBF between groups (GDFD and CG) was assessed by the Spearman correlation coefficient, at a significance level of 5%.

## RESULTS

Concerning the presence and severity of TMD symptoms, the results obtained on the AQ demonstrated predominance of absence or mild degree of TMD symptoms for CG. Conversely,



Subtitle: GDFD = group with dentofacial deformity; CG = control group

Figure 1. Percentage of individuals according to the presence and severity of temporomandibular dysfunction symptoms

predominance of mild degree was observed for the GDFD, followed by moderate and severe degrees (Figure 1).

Concerning the AQ scores and MBF values, significant difference was observed in the comparison between mean scores for the GDFD and GC, with greater presence of signs and symptoms of TMD in the GDFD, as well as statistically lower values of MBF for GDFD in relation to GC (Table 1).

Table 1. Means and standard deviations of maximum bite force and scores on the anamnesis questionnaire for individuals in groups with dentofacial deformity and control group

	Groups		Statistical analysis
	GDFD	CC	p-value
AQ	8.50±4.45	2.83 ±2.97	<0.01*
MBF	17.56 ± 4.75	23.80±4.93	<0.01*

\*Significant values (p<0.05) – Student t test

Subtitle: GDFD = group with dentofacial deformity; CG = control group; AQ = anamnesis questionnaire; MBF = maximum bite force

The results of the Spearman correlation coefficient indicated negative and significant correlation between AQ scores and MBF when the GDFD and CG were analyzed in combination, as well as specifically for GDFD, evidencing that the higher the severity of TMD symptoms, the lower the bite force, both for GDFD and CG, and for GDFD. However, there was no correlation between AQ and MBF for CG (Table 2).

## DISCUSSION

The importance of occlusion and its relationship with cause or maintenance of TMD cases has been widely discussed in the literature, especially in individuals with DFD<sup>(1,2,8)</sup>.

Recently, all accepted theories about the multifactorial etiology of TMD place less emphasis on occlusion as a predictive

Table 2. Correlation between AQ score and MBF in groups with dentofacial deformity and control

Variable	r	p
AQ (CG+GDFD) x MBF (CG+GDFD)	-0.53	<0.01*
AQ (CG) x MBF (CG)	-0.31	0.09
AQ (GDFD) x MBF (GDFD)	-0.40	0.03*

\*Significant values (p<0.05) – Student t test

Subtitle: AQ = anamnesis questionnaire; CG = control group; GDFD = group with dentofacial deformity; MBF = maximum bite force

factor<sup>(18)</sup>. Notwithstanding, there is no consensus between investigators. Some authors still consider that occlusal disorders contribute to the onset of TMD symptoms<sup>(19)</sup>, while others suggest that occlusal factors are among the several aspects that may be related with TMD<sup>(20)</sup>.

This study revealed that 97% of individuals with DFD presented some TMD symptom, while in CG the percentage of occurrence was 33%. It was also observed that CG exhibited predominance of absence or mild degree of TMD symptoms, while GDFD presented one individual with absence of these symptoms, and the others presented mild degree of TMD symptoms, followed by moderate and severe degrees.

The statistical difference observed in the comparison of AQ scores between GDFD and CG agrees with the results of some studies that indicated predominance of signs and symptoms of TMD in individuals with DFD during presurgical orthodontic treatment compared to the control group<sup>(1,11,12)</sup>. It should be highlighted that no study has employed the anamnesis questionnaire used in this study, yet included clinical examination of the TMJ, visual analogue scale, anamnesis index and of dysfunction of Helkimo<sup>(21)</sup>, or applied the RDC/TMD protocol<sup>(22)</sup>.

The MBF was reduced in individuals with DFD compared to CG, in agreement with reports in the literature<sup>(5,6,13,14,15)</sup>. It should be considered that dentofacial deformities cause

important changes in the physiology of the masticatory system, especially during presurgical orthodontic treatment, when there is worsening of occlusion, with loss of the physiological adjustments acquired along the lifetime<sup>(14)</sup>.

Concerning the comparison of data of AQ with MBF, this study revealed negative and significant correlations between scores obtained on application of AQ and MBF when GDFD and CG were analyzed in combination, as well as specifically for GDFD, i.e. the higher the severity of TMD symptoms, the lower the bite force. However, there was no correlation between AQ results and MBF for CG, probably due to the homogeneity of the group in relation to AQ scores, since most individuals presented absence or mild degree of TMD symptoms.

Some authors reported correlation between TMD and MBF, when analyzed in individuals with signs and symptoms of this dysfunction and with absence of occlusal problems<sup>(23,24)</sup>. Conversely, other authors did not observe significant difference between the group with TMD and the group without dysfunction, in relation to MBF. These authors measured the MBF at the region of central incisors and first molars unilaterally, according to the masticatory preference<sup>(25)</sup>, thus it is important to consider the differences in methodology between studies. However, the relationship between MBF and TMD was scarcely investigated in individuals with DFD, highlighting the originality of the present findings.

The presence of muscle pain during mastication, muscle pain or on the TMJ and/or inflammation on the TMJ may influence the reduction of the maximum bite force of individuals with TMD<sup>(24)</sup>. Thus, evaluation of the bite force is relevant for the diagnosis and treatment planning, since the reduction in force is an important factor on the overload and hyperactivity of masticatory muscles and a common characteristic in individuals with TMD<sup>(26)</sup>. According to a previous study, one of the most frequent causes for reduction of the bite force is pain on the TMJ<sup>(26)</sup>, suggesting that the articular pain leads to a protective activity that controls the contraction of elevator muscles.

It is known that TMD is not inherent to the presurgical treatment period. Some studies demonstrated that the degree of dysfunction may be maintained, even after surgery<sup>(27,28)</sup>. This highlights the need of further studies relating the skeletal and functional disorders present in the presurgical stage, by assessment of the TMJ and masticatory function, to effectively assess the improvement in the postsurgical treatment.

This study revealed a relationship between presence of TMD symptoms and reduction of bite force in individuals with DFD, demonstrating that, besides the presence of malocclusion, the presence of TMD symptoms may also have contributed to the reduction of muscular force. However, studies on a greater number of individuals are warranted to analyze the influence of malocclusion as a factor worsening the TMD, thus collaborating with investigations in this field, contributing for the evaluation and treatment of individuals with DFD.

## CONCLUSION

The presence and severity of TMD symptoms influenced the maximum bite force in individuals with DFD, demonstrating the need of interdisciplinary work throughout all stages of orthodontic-surgical treatment.

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