LEONARDO RIGOLDI BONJARDIM

Cirurgião-Dentista

FATORES ASSOCIADOS À PRESENÇA DE SINAIS E SINTOMAS DE DISFUNÇÃO TEMPOROMANDIBULAR EM ADOLESCENTES

Tese apresentada à faculdade de Odontologia de Piracicaba da Universidade Estadual de Campinas, para obtenção do título de Doutor em Odontologia, área de concentração Fisiologia Oral.

Piracicaba-SP
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(a ser concedida pela Coordenadoria de Pós-Graduação após defesa)

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SUMÁRIO

RESUMO

Estudos epidemiológicos demonstram que sinais e sintomas de disfunção temporomandibular são comuns em adultos, constatando-se também, sua presença em crianças e adolescentes. O propósito deste estudo foi verificar a prevalência de sinais clínicos e sintomas de disfunção temporomandibular (DTM) em 217 adolescentes entre 12 e 18 anos, pertencentes a escolas da rede pública da cidade de Piracicaba e, também, as associações existentes com gênero (masculino e feminino), ansiedade, depressão e força de mordida. Os sinais clínicos foram avaliados através do *Craniomandibular Index* (CMI), o qual é composto de duas sub-escalas: *Dysfunctional Index* (DI) e *Palpation Index* (PI). Os sintomas subjetivos foram avaliados através de questionário. A escala *Hospital Anxiety and Depression Scale* (HADS) foi utilizada para avaliação dos níveis de ansiedade (HADSa) e depressão (HADSd). A força de mordida foi determinada em 40 voluntários, que apresentavam valores extremos (mínimo e máximo) para o CMI, os quais foram distribuídos em dois grupos: Grupo I – 20 adolescentes sem DTM (valores extremos mínimos do CMI e ausência de sintoma) e Grupo II – 20 adolescentes com DTM (valores extremos máximos do CMI e presença de pelo menos 1 sintoma). Para a obtenção da força de mordida foi utilizado um tubo pressurizado de fibra reforçada, conectado a um sensor de pressão. Os resultados para os sinais clínicos mostraram que (1) para sensibilidade à palpação dos músculos da cabeça e pescoço ocorreu grande variação na amostra total (0,9%-32,25%); (2) 10,6%, 10,6% e 7,83% dos adolescentes apresentaram sensibilidade à palpação nas regiões superior, dorsal e lateral da articulação temporomandibular, respectivamente; (3) 19,8% e 14,7% da amostra apresentaram ruído articular durante a abertura e fechamento bucal, respectivamente. Ruído articular (26,72%) e dor de cabeça (21,65%) foram os sintomas subjetivos mais prevalentes nos adolescentes. Não foram encontradas diferenças entre os gêneros na prevalência de sinais e sintomas de DTM, exceção feita à sensibilidade à palpação do pterigóideo lateral. As correlações entre os valores dos índices (DI, PI, CMI) e HADSa e HADSd foram estatisticamente significativas apenas entre CMI, PI e HADSa ($p<0,01$). O número de sintomas subjetivos associou-se

significativamente tanto com HADSa quanto para o HADSd ($p<0,01$). A força de mordida foi estatisticamente maior no grupo I (325,90 N) do que no grupo II (301,51 N), sendo que as meninas deste grupo apresentaram valores significativamente menores. Ocorreu correlação negativa significativa entre CMI e PI e a magnitude da força de mordida ($p<0,01$). Não houve correlações significativas nas variáveis corporais e etárias com a força de mordida. Concluiu-se que os sinais e sintomas de DTM, presentes em indivíduos jovens, podem ser influenciados pela ansiedade e depressão, bem como comprometer as funções do sistema estomatognático, como se comprovou com a redução da força de mordida, principalmente no gênero feminino.

Palavras-chave: Prevalência, Disfunção temporomandibular, Ansiedade, Depressão, Força de mordida, Adolescentes.

ABSTRACT

Epidemiologic studies have demonstrated that signs and symptoms of temporomandibular dysfunction (TMD) are common in adults, evidencing also its presence in children and adolescents. The aim of this study was to verify the prevalence of clinical signs and subjective symptoms of TMD in 217 adolescents aged from 12 to 18 years old from public schools in the city of Piracicaba and the associations with gender, anxiety, depression and bite force magnitude. The clinical signs were evaluated using the Craniomandibular Index (CMI), which is divided into two sub-scales: Dysfunction Index (DI) and Palpation Index (PI). The subjective symptoms were evaluated through a questionnaire. The levels of anxiety (HADSa) and depression (HADSd) were verified using the Hospital Anxiety and Depression Scale (HADS). Bite force was determined in 40 volunteers with lower and upper extremity values of CMI who were distributed in two groups: Group I – 20 adolescents without TMD (lower extremes values of CMI and absence of subjective symptoms) and Group II –20 adolescents with TMD (upper extremes values of CMI and at least one subjective symptom) Bite force was obtained with a transducer, which consisted of a pressurized rubber tube connected to a sensor element. The results for clinical signs showed that (1) tenderness in head and neck muscles, demonstrated a great variability (0.9%-32.25%); (2) temporomandibular joint tenderness, in the superior, dorsal and lateral condyle regions, occurred in 10.6%, 10.6% and 7.83% respectively, (3) the percentage of joint sounds in mouth opening and closing was 19.8% and 14.7% respectively. Joint sounds (26.72%) and headache (21.65%) were the most prevalent symptoms in the total sample. Gender differences were not found in the prevalence of TMD signs and symptoms, except for the lateral pterygoid muscle tenderness. The correlations between indexes values (DI, PI, CMI) and HADSa and HADSd were statistically significant only with CMI, PI and HADSa ($p<0.01$). The number of subjective symptoms showed a significant association with HADSa and HADSd ($p<0.01$). Bite force was statistically higher in group I (325.90 N) than in group II (301.51 N). Girls in Group II had the smallest bite force values ($p<0.05$). There was a significant negative correlation between CMI and PI and bite force magnitude. There were not significant correlations

between bite force and body variables and age. It was concluded that clinical signs and symptoms of TMD present in adolescents, can be influenced by anxiety and depression, decreasing the stomathognatic system functions as demonstrated by bite force reduction, primarily in girls.

Key-words: Prevalence, Temporomandibular dysfunction, Anxiety, Depression, Bite force, Adolescents

1 INTRODUÇÃO GERAL

O termo Disfunção Temporomandibular (DTM) refere-se a um grupo de condições orofaciais que afetam a fisiologia da articulação temporomandibular e/ou dos músculos da mastigação, bem como dos tecidos adjacentes (Liu *et al.,* 1999). Ainda com relação à sua definição, Phillips *et al*. (2001) citaram que a DTM engloba um grupo heterogêneo de desordens psicofisiológicas com características comuns de dor orofacial, disfunção mastigatória ou ambos.

A etiologia da DTM é considerada multifatorial, pois inúmeros fatores podem afetar o equilíbrio dinâmico dos componentes do sistema mastigatório. Isso inclui uma combinação de fatores físicos e psicossociais, sendo que alguns deles são pouco entendidos ou difíceis de se avaliar (Greene, 1995; Dao & LeResche 2000). A sensibilidade à palpação dos músculos mastigatórios e os ruídos da articulação temporomandibular (ATM) têm sido descritos como os sinais clínicos mais comuns (Nilner, 1992). Quando se verifica a prevalência de sintomas subjetivos, os mais comuns reportados são o ruído na ATM (Magnusson *et al*., 2000; Egermark *et al.*, 2001 Conti *et al*., 2003) e a dor de cabeça. (De Leeuw *et al*., 1994).

Pesquisas têm investigado o papel dos fatores psicológicos na DTM, tais como ansiedade e depressão (Wexler and Steed, 1998; Yap et al., 2001; Kino *et al*., 2001; Sipila *et al*., 2001; Yap et al., 2003). A respeito disso, Auerbach *et al*. (2001) sugeriram a associação entre estes fatores e DTM. Este fato pode ser explicado, pois pacientes com DTM, principalmente aqueles com sinais de dor, exibem uma variedade de alterações psicológicas e comportamentais incluindo somatização e aumento dos níveis de estresse, ansiedade e depressão (Pankhurst, 1997). Estudos de ansiedade de depressão em grupos de pacientes com dor crônica estabelecem que há maior prevalência de sintomas de ansiedade e depressão em indivíduos com dor crônica do que no grupo de indivíduos saudáveis (Krishnan *et al*., 1985; Brown, 1990).

Estudos epidemiológicos como o de Egermark *et al*. (2001) e Thilander *et al*. (2002) mostraram que sinais e sintomas de DTM podem ser encontrados em todas as idades, no entanto, a prevalência tem sido considerada baixa em crianças, mas aumenta com a idade em adolescentes e adultos jovens.

O papel do gênero tem sido também extensivamente discutido na literatura. Alguns estudos têm verificado maior prevalência de sinais e sintomas de DTM no sexo feminino (LeResche, 1997; Barone *et al*., l997; Kapila e Xie, 1998; Alamoudi *et al.*, 1998). A DTM, segundo Biondi & Picardi, 1993 e McNeill, 1997, é uma disfunção relacionada ao sexo feminino, visto que as mulheres foram afetadas de três a seis vezes mais que os homens. No entanto, Widmalm *et al*. (1994), Sonmez *et al.* (2001) não observaram tais diferenças na prevalência de DTM entre os gêneros. Alguns estudos demonstraram que a severidade dos sintomas de DTM varia de acordo com a idade dos pacientes, aumentando após a puberdade, com o pico na fase reprodutiva da mulher entre 20-40 anos(Meisler, 1999) e, os mais leves sintomas acontecem entre crianças, adolescentes e idosos (Kuttila *et al*., 1998).

Os avanços para o diagnóstico e tratamento da DTM têm aumentado na última década. Exames como a verificação da força de mordida podem ser realizados com sucesso. A força de mordida é um dos componentes da função mastigatória e, durante o desenvolvimento do indivíduo, desempenha importante papel na maturação dessa função. Demes & Creel (1988) mostraram que a força de mordida depende tanto da magnitude da força muscular quanto da pressão oclusal (área do dente). Além disso, pacientes com DTM podem apresentar valores da força de mordida máxima menores do que indivíduos saudáveis (Chong-Shan, 1989). Dessa forma, a menor potencialidade dos músculos mastigatórios tem sido considerada como fator predisponente de DTM (Sheikholeslam *et al.,* 1980). Sonnesen et al. (2001) concluíram que os sintomas de DTM, principalmente sensibilidade muscular, estão associados à força de mordida reduzida. Com relação à influência das variáveis corporais na magnitude da força de mordida, Shiau & Wang (1993) verificaram que a força de mordida aumentou com a idade, altura e peso corporal. Braun *et*

al. (1996) encontrou uma fraca correlação entre força de mordida e a idade e as variáveis corporais.

Diante disso, O estudo da disfunção temporomandibular em pacientes jovens pode ser importante para determinar precocemente os problemas que predispõem às anormalidades de crescimento craniofacial, dor na ATM ou disfunção muscular na fase adulta.

2 PROPOSIÇÃO

O objetivo do presente trabalho foi verificar a prevalência de sinais clínicos e sintomas de disfunção temporomandibular em adolescentes de 12 a 18 anos de idade, e as prováveis relações destes com gênero, ansiedade, depressão, magnitude da força de mordida, que poderiam estar influenciando ou sendo influenciados por eles. Para tal objetivo, o trabalho foi dividido em três capítulos:

Capítulo 1- "Signs and symptoms of temporomandibular dysfunction in a group of Brazilian adolescents**".**

Capítulo 2- "Anxiety and depression in adolescents and their relationship with signs and symptoms of temporomandibular dysfunction."

Capítulo 3- "Bite force determination in adolescents with and without temporomandibular dysfunction".

O presente estudo foi realizado em formato alternativo, conforme deliberação da Comissão Central de Pós-graduação (CCPG) da Universidade Estadual de Campinas (UNICAMP) nº 001/98.

3 CAPÍTULOS

Capítulo 1 : Signs and symptoms of temporomandibular dysfunction in a group of Brazilian adolescents

Artigo submetido ao periódico Journal of Oral Rehabilitation

Capítulo 2 : Anxiety and depression in adolescents and their relationship with signs and symptoms of temporomandibular dysfunction

Artigo submetido ao periódico International Journal of Prosthodontics

Capítulo 3 : Bite force determination in adolescents with and without temporomandibular dysfunction

Artigo submetido ao periódico Journal of Oral Rehabilitation

Capítulo 1

Signs and symptoms of temporomandibular dysfunction in a group of Brazilian adolescents

TMD in adolescents

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Abstract:

The prevalence of clinical signs and subjectively perceived symptoms of temporomandibular dysfunction were studied in a sample comprising 217 subjects, aged from 12 to 18 years old. The subjective symptoms and clinical signs of temporomandibular dysfunction were evaluated, using a self-report questionnaire and the Craniomandibular Index, which has 2 subscales; the Dysfunction Index and the Palpation Index, respectively. The results of muscles tenderness showed great variability. In relation to the temporomandibular joint, tenderness of the superior, dorsal and lateral condyle regions occurred in 10.6%, 10.6% and 7.83% respectively, of the sample. The percentage of joint sound in mouth opening and closing was 19.8% and 14.7% respectively. Joint sounds and headache were the most prevalent symptoms. There was no statistical difference in the association between gender ($p>0.05$), except for the lateral pterygoid muscles, which presented more prevalence in girls. In conclusion, the evaluated clinical signs and subjective symptoms of temporomandibular dysfunction occur in adolescents, however gender influence was not perceived in this age.

Key words: temporomandibular dysfunction, craniomandibular index, adolescents

Introduction

Temporomandibular dysfunction (TMD) is a generic term for a number of clinical signs and symptoms involving the masticatory muscles, the temporomandibular joint (TMJ) and associated structures (1). Furthermore, TMD is among the most common orofacial pain conditions of non-dental origin (2, 3).

A number of studies have shown that signs and symptoms of TMD can be found in all age groups. However, prevalence in small children is low, but increases with age in adolescence up to young adulthood (4-9).

Signs and symptoms of TMD in children and adolescents have been studied since the beginning of the 1970's (10, 11). The most prevalent clinical signs are TMJ sounds (palpable), limitation of mandibular movements, TMJ and muscle tenderness (12). With

regard to subjective symptoms, headache, TMJ sounds, bruxism, difficulty in opening, jaw pain, facial pain are found (13).

The etiology of TMD has been considered to be one of the most controversial issues in clinical dentistry. At present, TMD is considered not as a single entity, but as comprising several diseases of varying etiology and pathology, and controversy still exists because of limited knowledge regarding the course of its etiology and natural history. (14).

The role of gender in TMD is also extensively discussed in literature, suggesting that TMD is considered to be 1.5-2 times more prevalent in women than in men (15), and 80% of patients treated for this disorder are women (16). However, the most prominent sex differences have been found in women aged 20-40 years, and the lowest among children, adolescents and elderly (2, 17, 18). The predominance of women is even higher in surveys of people seeking treatment for TMD pain (19, 20), with a ratio of 4:1 or 5:1 (14, 21-24). Furthermore, it has been shown that women need treatment for their TMD problems two to three times as often as men (18).

The purpose of this study was to estimate the prevalence of clinical signs and subjective symptoms of TMD in adolescents and its relationship to gender.

Material and Methods:

Adolescents aged between 12 and 18 years, were selected from public schools in Piracicaba, Brazil. Firstly, the parents/guardians and the adolescents were informed about the purpose of this research. Adolescents who had received any type of orthodontic treatment before or during the study or were suffering from systemic health disease could not participate in the research. Next, a total of 600 written informed consents were distributed. After that, parental and adolescent consent was obtained from 217 subjects (120 girls/97 boys) and they were examined. Prior to the examination for clinical signs and symptoms of TMD, an anamnesic questionnaire was filled out, including questions about the general state of health, illness, diseases, oral hygiene and occlusion characteristics. The Ethics Committee of the Piracicaba Dental School approved the research.

Subjective symptoms interview

A self-report questionnaire was used to assess subjective symptoms according to Riolo *et al*. (13), regarding pain in the jaws when functioning (e.g. chewing), unusually frequent headaches (more than once a week and unknown etiology), stiffness/tiredness in the jaws, difficulty in opening the mouth wide, grinding teeth, and sounds from TMJ. Each question could be answered with "yes" or "no".

Clinical signs examination

The signs of TMD were assessed according to the CranioMandibular Index (CMI), as described by Fricton and Schiffman (25) by two calibrated examiners (Kappa=0,936). The CMI produces 3 scores: an overall CMI score, a dysfunction index (DI) score, and a palpation or muscle index (PI) score. The CMI score is an average of the DI and PI scores. All 3 indexes are scaled from 0 to 1. The CMI measures tenderness and dysfunction in the stomatognathic system and includes all currently recognized signs of TMJ disorders (25, 27). The DI is designed to measure limitation in mandibular movement, pain and deviation in movement, TMJ noise, and TMJ tenderness. The PI measures the prevalence of muscle tenderness in the stomatognathic system. Thus, this index separates joint problems from muscle problems.

Statistical Analysis

The data were computerized and the SAS package (SAS Institute Cary, North Carolina, USA) was used for their analysis. The prevalence of clinical signs and subjective symptoms was calculated by percentage. The mean values obtained in CMI, PI, DI were compared for subjects with and without each symptom using T Test in the total sample. Data association between each subjective symptom/clinical sign and gender was done using Fisher's Exact Test. For all comparisons, p values <0.05 were considered to be statistically significant.

Results

Table 1 and 2, shows the prevalence of the different clinical signs of TMD, components of craniomandibular index, according to gender. Pterygoid lateral muscle tenderness was the most frequent sign of palpation index found in 32.25% of the total sample. The most frequent sign of dysfunction index was TMJ sounds (mouth opening) occurring in 19.8% of the total sample

The prevalence of subjective symptoms of TMD according to gender is presented in Table 3. The most prevalent symptom was TMJ sound (26.72%) followed by headache (21.65%).

There was no statistical association between genders for clinical signs and symptoms, except to pterygoid lateral muscle tenderness which presented more prevalence in girls ($p<0.05$).

Mean values for CMI, DI, PI among adolescents with and without each subjective symptom are presented in Table 4. Note that for subjects who reported facial/jaw pain, joint sounds and headache the CMI and PI had significantly higher scores than those adolescents that did not report any symptom ($p<0.05$), while for DI, those reporting TMJ sounds, presented a significantly higher mean value ($p<0.05$).

Discussion

This study evaluated the prevalence of signs and symptoms of TMD in adolescents through the frequency distribution of the data obtained from a questionnaire and physical examination. The decision to implement a dysfunction index in this study, specifically the CMI, was based on the possibility of objectively measuring the severity of problems in mandibular movements, joint noises, and muscle and joint tenderness, using clearly defined criteria, simple clinical methods and easy scoring. In addition, this index had a good intra and inter-examiner correlation (25,26). The symptom questionnaire showed itself to be a simple and suitable tool easily understood by the volunteers, thus allowing a smaller examiner influence on the individuals and their answers. The application of an anamnesic questionnaire for detecting TMD symptoms has the advantage of being easily used by

general practitioners or epidemiologists. Although, it has been proved to be a useful tool, a complete clinical examination is always mandatory to confirm subjective findings (27).

The CMI scores obtained in this study are lower than those presented by other studies (25,26), probably due to the fact that this sample was comprised by adolescents. Several studies have reported that severe dysfunction at a young age is rare, supporting the results presented (1, 28-30). Moreover, the study was carried out in a general, randomized population and not among people looking for treatment.

In this study, the majority of the patients, as considered below, exhibited myofascial tenderness, in line with findings in previous studies (31,32). The results of muscle tenderness showed that the most prevalent one was the lateral pterygoid muscle (32.25%), but this result must be carefully taken into account, due the low specificity for palpation. Nevertheless, this muscle has been part of many current examination schemes (1, 33), including the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) (14). It must be considered that the discomfort or pain elicited in response to palpation of the "lateral pterygoid area" may be caused by anatomical structures other than the lateral pterygoid muscle (34, 35). There was also high prevalence of tenderness in the posterior digastric (24.5%), medial pterygoid (intra-oral) (23.5%) and temporalis insertion (20.7%). The scores for intra-oral muscle palpation indicated that the frequency of tenderness of these muscles was higher than at the other sites, except for posterior digastrics. As may be noted, the intra-oral sites were extremely affected. According to Fricton and Schiffman (25), the intra-oral palpation technique may cause pain in normal subjects and thus false-positives that may lead to a wrong diagnosis, such as myofascial pain, and subsequently to unnecessary treatment (36).

As reported in the literature, the anterior temporalis region and masseter muscles have been extensively evaluated. In this research, the tenderness of anterior temporalis region was reported by 5.07% of the adolescents, while for the masseter muscle the correspondent value was 7.4%. These results are similar to other studies in adolescents (37) and young adults (38). Masseter and anterior temporalis area palpation can be considered to be reliable and valuable. This fact supports the belief that pressure pain sensation in these

muscles is not derived predominantly from the cutaneous tissues, but from the muscle itself (39).

The neck muscle tenderness was also evaluated as part of clinical signs exam in CMI, as shown in Table 1. Despite the low prevalence of tenderness in these muscles, their evaluation in TMD patients is important. Moreover, these findings support the theory that a complementary examination of this area should be performed, even when TMD patients do not report any neck problems. Fink *et al*. (40), corroborating this study, mentioned that the patients with TMD frequently show symptoms related to the cervical spine. Rantala *et al*. (41) found a prevalence of neck pain in 39% of subjects.

In relation to temporomandibular joint, tenderness of the superior and dorsal condyle region occurred in 10.6% of the sample, whereas for the lateral region, tenderness occurred in 7.83%. A number of studies have found prevalence of TMJ tenderness in adolescents varying from 7.1% to 22.5% (12, 37, 42, 43). Moreover, differences in palpation techniques and pressure make comparisons very unreliable. In addition, in the current research, TMJ palpation was conducted in three different sites, which could be the cause of disagreement among these results.

The percentage of joint sound on palpation in mouth opening and closing was 19.8% and 14.7%, respectively, lower than the study of Nassif *et al*. (38) (24.7% and 19.5%) performed in young adults. Farsi, (44) found a prevalence of 11.8% for joint sounds in children aged from 3 to 15 years old. It is interesting to note that the small differences among these studies could be due to the fact that the incidence of signs and symptoms generally increase and also fluctuate with age (8, 45).

With regard to subjective symptoms the current research found that the most prevalent were: TMJ sounds (26.72%), headache (21.65%), tooth grinding (17.98%), pain in the face or jaw regions (12.9%). Conti *et al*. (43) also found TMJ sounds followed by headache as the most commonly reported symptoms, although with lower values. Previous studies reported clicking in children and adolescents at a rate ranging from 6.8% to 65% (5, 12, 46). List *et al*. (31) found a prevalence of 21% for headache in adolescents (12-18 years-old) and Petersen *et al*. (47) found a prevalence of 23% (6-13 years old), which values are very close to those found in this study. Melis and Abou-Atme (48) and Conti *et*

al. (43) observed a prevalence rate of 27.2% and 20.5% respectively for tooth grinding. The prevalence of tooth grinding is difficult to estimate, since quite often the subjects are unaware of having the disorder, which can under or over estimate the amount of people affected (49). Pain symptoms in the face or jaw regions were perceived by 14.9% in a study by Rantala' *et al*. (41), which is slightly higher than the percentage in this study. The diversity of TMD prevalence among different studies has been attributed to the differences in the age groups studied, the sample sizes and their composition, the number of examiners as well as the diagnostic criteria used (44).

The findings showed no statistical difference in prevalence of signs and symptoms of TMD, between males and females. The lateral pterygoid muscles showed greater evidence in females, but as mentioned above, the findings for this muscle can be overestimated. Epidemiologic studies in this area have looked at gender differences, with authors repeatedly reporting that TMD is a female disease, with female-to-male ratios ranging from 3:1 to 6:1 (22, 24, 50). However, one problem in much of TMD literature has been the sparse number of men in comparison with women who seek treatment, resulting in studies that have small numbers of men or studies that limit their investigations to women (51). In this research, the lack of statistical differences between genders could be explained by the fact that the sample was comprised of adolescents, some of whom probably have not yet been affected by the effects of puberty. Signs and symptoms of TMD onset tend to occur more frequently in women after puberty and peaks in the reproductive years, and is lowest among children and adolescents, and the elderly (18, 52).

When the CMI, PI, DI values in subjects with or without each subjective symptom were compared, there were significantly higher scores for DI in those subjects who reported joint sounds. PI and CMI presented significantly higher scores in individuals with facial/jaw pain, joint sounds and headache. These results are in accordance with Kleinknecht *et al*. (53) who found correspondence between subjective reports of temporomandibular disorder symptoms and clinical findings after examining 65 volunteers. Katz and Heft (54) found that 53% of subjects with positive masticatory muscle tenderness also reported positive TMJ sounds and 25% of subjects reporting TMJ sounds also reported positive masticatory muscle tenderness. De Kanter *et al*. (55) found agreement between the

results of the clinical examination and the anamnestic dysfunction index. Conti *et al*. (43) found association between joint sounds and joint tenderness to palpation. This study supports the proposal that clinical signs and symptoms should be evaluated in combination. However, it is important to note that most of the population-based studies on TMD report a discrepancy between the frequency of symptoms and the frequency of signs of temporomandibular joint functional disturbances. In addition, studies have reported varying relationships between subjectively perceived symptoms and signs found on clinical examination.

Based on the above results it was concluded that clinical signs and symptoms of TMD are present in adolescents. Muscle tenderness and joint sounds were the most prevalent clinical signs and symptoms, respectively. In relation to gender differences, only lateral pterygoid muscle tenderness showed greater evidence in girls, but this finding must be interpreted carefully. The presence of clinical signs associated with subjective symptoms was also confirmed. Since signs and symptoms of temporomandibular dysfunction obviously make an early appearance, a routine dental examination should include evaluation of these signs and symptoms to identify patients who should be observed more closely. The results indicate that joint sounds and TMD symptoms are already common in adolescents and thus demonstrate a possible early onset of TMD.

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Table 1 - Percentage distribution of clinical signs (muscle tenderness) according to gender

Muscle tenderness	Female (%) n = 120	Male (%) n = 97	Total (%) n = 217
Anterior temporalis	6.7	3.1	5.07
Middle temporalis	1.7	0	0.9
Posterior temporalis	1.7	1.03	1.38
Temporalis insertion	24.17	16.5	20.7
Deep masseter	9.17	3.1	6.5
Masseter origin	6.7	4.1	5.5
Masseter body	5.8	9.3	7.4
Masseter insertion	9.17	5.16	7.4
Posterior digastric	25.8	22.7	24.5
Medial pterygoid (extra-oral)	12.5	8.25	10.6
Medial pterygoid (intra-oral)	25.83	20.6	23.5
Lateral pterygoid	38.33*	24.75	32.25
Superior esternocleidomastodeus	5	3.1	4.15
Middle esternocleidomastodeus	2.5	3.1	2.77
Inferior esternocleidomastodeus	5.83	1.03	3.7
Trapezius insertion	5.83	1.03	3.7
Trapezius Superior	5.83	7.22	6.45
Esplenius capitis	5.83	8.25	6.91

* statistical difference ($p<0.05$)

Table 2 - Percentage distribution of clinical signs (TMJ sounds and tenderness) according to gender

	Female (%) n = 120	Male (%) n = 97	Total (%) n = 217
Opening click	20.8	18.5	19.8
Closing click	16.6	12.4	14.7
Tenderness in condyle superior region	14.17	6.19	10.6
Tenderness in condyle lateral region	9.17	6.19	7.83
Tenderness in condyle dorsal region	13.33	7.22	10.6

$p>0.05$

Table 3 - Percentage of subjective symptoms according to gender

Symptoms	Female		Male		Total	
	n	(%)	n	(%)	n	(%)
Facial/jaw pain	17	(14.16%)	11	(11.34%)	28	(12.9%)
Difficult in opening	5	(4.16%)	2	(2.06%)	7	(3.22%)
Joint sounds	27	(22.5%)	31	(31.96%)	58	(26.72%)
Teeth grinding	19	(15.83%)	20	20.61%)	39	(17.98%)
Headache	28	(23.33%)	19	(19.58%)	47	(21.65%)

Table 4 - Means values for CMI, DI, PI among adolescents with and without each subjective symptoms

Symptoms	CMI		DI		PI	
	Without symptom	With symptom	Without symptom	With symptom	Without symptom	With symptom
Facial/jaw pain	0.075	0.155*	0.087	0.120	0.055	0.190*
Difficult in opening	0.082	0.186	0.089	0.168	0.068	0.204
Joint sounds	0.069	0.130*	0.086	0.108*	0.050	0.133*
Teeth grinding	0.082	0.098	0.091	0.096	0.067	0.100
Headache	0.078	0.111*	0.090	0.096	0.059	0.123*

* significant difference ($p<0.05$)

Capítulo 2

Anxiety and depression in adolescents and their relationship with signs and symptoms of temporomandibular dysfunction

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Abstract:

According to clinical studies, psychological factors play an important role in the etiology and maintenance of temporomandibular dysfunction (TMD) signs and symptoms. **Purpose:** The goal of this study was to verify the prevalence of anxiety and depression in adolescents and their relationship with signs and symptoms of TMD. **Methods**: The subjective symptoms and clinical signs of TMD were evaluated, respectively, using a self-report questionnaire and the Craniomandibular Index, which has 2 subscales, the Dysfunction Index and the Palpation Index. The Hospital Anxiety and Depression Scale (HADS), a 14-item self-administered rating scale, specifically developed to identify anxiety and depression in non-psychiatric medical outpatients, assessed levels of anxiety and depression. **Results:** In the total sample, anxiety and depression were present in 16.58% and 26.71% of subjects respectively, including all levels of HADS. The results showed that there were positive correlations between CMI and PI and anxiety (HADSa) ($p<0.01$), but not to depression (HADSd). Data association between number of TMD subjective symptoms and HADSa/HADSd were found ($p<0.01$). **Conclusion:** Anxiety and depression, even though of mild intensity, are common in adolescents. Both HADSa and HADSd were associated with the increasing number of TMD subjective symptoms. However, only anxiety was correlated with clinical signs of TMD (CMI), primarily muscle tenderness (PI).

Key words: Craniomandibular index, Hospital anxiety and depression scale, temporomandibular dysfunction, adolescents

Introduction

Temporomandibular dysfunction (TMD) is an all-inclusive term referring to a heterogeneous group of psychophysiological disorders with the common characteristics of orofacial pain, masticatory dysfunction or both.[1]

The etiology of TMD is considered to be multifactorial,[2-6] but the relative importance of individual factors is still controversial. Psychosocial variables may play an important role in adaptation to pain and eventual recovery. TMD patients exhibit a variety

of psychological and behavioral characteristics including increased somatization, stress, anxiety and depression.[2]

Some investigations have examined the relationship between psychological factors and TMD.[7-10] Studies of anxiety and depression in chronic pain groups have established that despite methodological problems, there is evidence of greater prevalence of anxious and depressive symptoms in chronic pain populations than in controls.[11,12] Since there is compelling evidence that chronic pain patients do not have a particular personality structure,[13,14] it seems likely that anxiety and depression develop as sequelae to pain. Mood may, however, contribute to the endurance and impact of pain.[15]

A small but clinically challenging population of children and adolescents become chronic pain patients who report not only pain, but also associated emotional distress and disability.[16,17] Evidence is amassing for the extent to which children and adolescents, who present for treatment of chronic pain, irrespective of medical diagnosis, report depressive,[18,19] and anxious symptomatology.[20] A picture is developing of the adolescent with chronic pain who also reports general emotional distress and a heightened sense of vulnerability.[21] Functional temporomandibular disorders are often accompanied by mental symptoms such as depression, anxiety and/or somatization on various levels.

This investigation was conducted to verify the prevalence and relationship of anxious-depressive symptoms and signs and symptoms of TMD and gender in adolescents. Furthermore, to identify if these psychological variables are risk factors for the development of this dysfunction. These analyses were necessary since psychological factors may be related to TMD.

Material and Methods

Sample

Two hundred and seventeen adolescents (120 girls/97 boys), aged between 12 and 18 years, were randomly selected from public schools in Piracicaba, Brazil. Those who had received any type of orthodontic treatment were excluded before selection. The Ethics

Committee of Piracicaba Dental School approved the research. The parents/guardians and the adolescents were informed about the purpose of this research and signed informed consents were obtained.

Prior to the examination of clinical signs and symptoms, an anamnesis questionnaire was filled out including questions about the general state of health, illness, diseases, oral hygiene and occlusion characteristics.

Subjective symptoms interview

A self-report questionnaire was used to assess subjective symptoms according to Riolo et al.[22] , regarding pain in the jaws when functioning (e.g. chewing), unusually frequent headaches (more than once a week), stiffness/tiredness in the jaws, difficulty in opening the mouth wide, grinding teeth, and sounds from temporomandibular joint (TMJ). Each question could be answered with "yes" or "no".

Clinical signs examination

The signs of TMD were assessed according to the CranioMandibular Index (CMI), as described by Fricton and Schiffman.[23] The CMI has a 0 to 1 scale that measures tenderness and dysfunction in the stomatognathic system and includes all currently recognized signs of TMD.[23,24] There are 2 subscales: the Dysfunction Index (DI) and the Palpation Index (PI). The DI is designed to measure limitation in mandibular movement, pain and deviation in movement, TMJ noise, and TMJ tenderness. The PI measures the prevalence of muscle tenderness in the stomatognathic system. Thus, this index separates joint problems from muscle problems.

Hospital Anxiety and Depression Scale

The level of anxiety and depression was self-rated by Hospital Anxiety and Depression Scale (HADS). HADS consists of seven items for depression (HADSd) and seven items for anxiety (HADSa). The scale originated in the study of Zigmond and Snaith[25] and it was validated by Botega et al.[26] The main characteristic of HADS is that items covering somatic symptoms of anxiety and depression have been eliminated. By

defining cut-off values, the HADS subscales can give an indication of mental disorder: 0–7 normal, 8–10 mild, 11–14 moderate and 15–21 severe disorder.[25] HADS has been extensively tested and has well-established psychometric properties.[27]

Statistical Analysis

Data were computerized and the SAS package was used for their analysis. The presence of anxiety and depression in both genders was calculated by percentage. Correlation between CMI, PI, DI and HADSa and HADSd was done using Spearman correlation. Association between number of symptoms and HADSa and HADSd was done using Mantel-Haenszel Chi-Square test. The significance level was set at $p<0.05$ for all analyses.

Results

Maximum, minimum and mean values for CMI, PI, DI in both genders are expressed in Table 1. The mean scores for the indexes were low due to the fact the majority of the adolescents did not show significant signs and symptoms and this decreased the total mean. However, in Table 1 it can be seen that some subjects presented high scores. The presences of anxiety and depression distribution in both genders are presented in Table 2 and Table 3 respectively. In this study, anxiety was more prevalent in boys (24.7%) than in girls (10%). According to HADSd, depression was found to be higher in girls (27.4%) than in boys (24.7%). The majority of subjects presenting anxiety and depression were classified as mild according to HADS. The correlation coefficients for CMI, PI, DI and HADSa, HADSd are expressed in Table 4. A significant correlation was found between CMI, PI score and anxiety ($p<0.01$), but this correlation was not found for depressive symptoms. Thus, the correlation with anxiety was significant for muscle tenderness. The Mantel-Haenszel Chi-Square test was used to examine the association among HADSa, HADSd and number of subjective symptoms of TMD (Tables 5 and 6). The results showed that the number of subjective TMD symptoms was associated with anxiety and depression ($p<0.01$). It showed that the subjects with a larger number of subjective TMD symptoms could present more anxiety and depression symptoms.

Discussion

This study evaluated the presence of anxiety and depression in adolescents and their relationship with signs and symptoms of TMD. The HADS was chosen to assess anxiety and depression symptoms. The method used is considered an easy-to-use self-reporting questionnaire to detect anxiety and depression in medical outpatients, in a non-psychiatric hospital setting. It has been extensively researched and validated, and has a good reputation amongst doctors.[28] Furthermore, several studies have found good sensitivity, specificity and correlation between HADS, other questionnaires, and structured interviews used to diagnose depression and anxiety disorders.[29,30]

Free-anxious and free-depressive subjects comprised the majority of the sample (Tables 1 and 2). However, 16.58% and 26.71% presented anxiety and depression respectively, predominantly of mild intensity. These results show that there is an evidence of psychological disturbances in the general adolescent population. Statistics concerning the prevalence of anxiety and depressive disorders among adolescents are rare and imprecise. According to Wight et al.,[31] depressive symptoms are more prevalent among older adolescents, similarly persistent among adolescents and young to middle aged adults, and increasingly persistent among older adults. Anxiety and depressive disorders have been found in children and adolescents with the ratio ranging from 5.7% to 17.7%[32] for anxiety and from 3% to 40%[33,34] for depression, corroborating our results. In this study, 15.2% and 1.38% of subjects presented mild and moderate/severe anxiety symptoms. Since these results could be explained by the sample age, it may be considered that such anxiety symptoms might not yet be harming their lives. With regard to depressive symptoms, moderate/severe depressive symptoms were found in 9.67% of the subjects which is in agreement with Rushton et al.[35] who found that over 9% of 13,568 adolescents reported moderate/severe depressive symptoms. In this study the majority of the symptoms was mild, but it is important to consider that the most of subjects with minimal depression symptoms maintain their status and appear to be at low risk for depression; those with moderate/severe depressive symptoms warrant long-term follow-up and re-evaluation.[35] Whether mild depressive symptoms will develop into moderate/severe ones is difficult to predict. However, it is necessary to consider that adolescents experience many

developmental challenges as they strive to separate from their parents, become independent and establish their own identities. This period of bio-psychosocial maturation creates the conditions for experiencing a greater sense of hopelessness and despair than when they were younger.[36]

With regard to gender, anxiety symptoms were more prevalent in boys than in girls and the opposite was found for depressive symptoms. It is not absolutely known why the most common mental disorders, anxiety and depression, are more prevalent among women than men. In general, biological, psychosocial and artifact explanations have been proposed to explain the predominance of most psychiatric disorders in women,[37-39] but none of these explanations have been consistently supported with empirical data.[40-42] This failure has been largely attributed to the fact that we still lack comprehensive etiological models for these mental disorders.[43] These contradictory results might be explained by the age of this sample, comprised of adolescents. Moreover, as mentioned above, biological variables (e.g. hormonal characteristics) could not yet be interfering the higher prevalence of psychological alterations in women than in men.

Debates are still open to discuss the possible predisposing, triggering and/or worsening role played by some psychic disorders in TMD subjects.[44] There are also numerous reports of greater levels of depression and anxiety in persons presenting temporomandibular complaints as compared to normal controls.[45-47] TMD patients are more emotionally reactive to environmental challenge than normal subjects [47] and approximately one third of the persons seeking treatment for TMD were experiencing depression.[48] According to Glaros[49] the chronic pain of many temporomandibular disorders is associated with multiple changes in emotional function and daily living activities. A great correlation was found between CMI, PI but not for DI, and anxiety (HADSa), however the same results were not found for depression (HADSd). As the subjects examined were not looking for treatment, probably most of them did not present great evidence of clinical signs of TMD, which was found by the low mean CMI score = 0.085, on a scale of 0-1, and their lives were not yet affected. Consequently, the correlation between index values (CMI, PI, DI) and depression did not occur. Moreover, this research showed higher scores in both genders for CMI, PI, DI, as presented in Table 1. However, the scores for CMI and PI were greater

than those ones for DI in both genders, meaning that the muscle tenderness affected the adolescents more. Therefore, individuals with high CMI and PI scores also had the highest HADSa scores, showing that these score indexes, especially when involving muscle tenderness, tend to be enhanced in anxious subjects. It was found that the frequency of muscle groups painful to palpation increased in proportion to the frequency of reported anxiety symptoms. Sieber et al.[50] found the correlation between emotional stress and TMD signs and symptoms in 417 adolescents from 11 to 16 years old, and these data from clinical examinations have being used to construct two indices: 1) The number of muscle sites tender to palpation, and 2) signs of joint and restricted movement. Results of the study above show that overall stress was only significantly correlated with the muscle index, but not with the other index. The results of this research could be explained by the fact that emotional states such as anxiety elicit muscular tension and the persistence of this muscle tension results in pain. Furthermore, anxiety may be an important factor in the perception of pain, and anxious subjects may increase attention to pain, thereby amplifying their perceived intensity. This evidence was confirmed by other studies[51,52] who indicated that anxiety is related to increased pain reports in clinical settings. In addition, the evaluation of the psychological dimension of muscle tenderness and its associated disability could provide valuable information for the adequate management of these patients and for assessing treatment outcome. Nevertheless, the results of this research are in accordance with a number of studies who also suggest that the associations between myofascial pain and the anxiety disorders were stronger than this association for depression.[53-55] Moreover, according to Esenyel et al.[56]patients with myofascial pain syndrome had higher scores for anxiety than for depression corroborating the present results. Auerbach et al.[57]suggested a link between emotional factors and TMD and this finding is largely supportive of the conclusion that psychological factors play a more pronounced role when pain is of muscular origin. Madland et al.[15] showed that an anxious mood could be associated with several factors, including the belief that pain itself is worsened by negative mood.

Furthermore, this study found a significant association between anxiety/depression and the number of symptoms as shown in Tables 5 and 6 suggesting that as the number of subjective symptoms increases, the same happens with the proportion of individuals

presenting anxiety and depression complaints. According to clinical studies, psychological factors play an important role in the etiology and maintenance of TMD symptoms. On the other hand, chronic pain can cause depression.[58] There is no consensus in the literature about whether psychological factors are the cause or the consequence of TMD. Sipila et al.[58] also found that there is an association between depression and TMD symptoms, especially those related to pain. Such associations might be explained by the fact that TMD symptoms could have a psychosocial impact on the adolescent's quality of life. Segu et al.[59] showed that orofacial pain had an important impact on daily life and that its most common outcomes were psychological. Comparison with a "pain free" population clearly indicated that orofacial pain and associated symptoms negatively affect the quality of life of TMD patients. The number of non-specific pain conditions reported may be a predictor of psychosocial problems, depression, and somatization.[60] Furthermore, the results of the data associations in this study are important because, when treating patients with TMD, dentists should consider the possible presence of psychopathology and, if necessary, consult appropriate mental health professionals.

It has been observed that small elevations in anxiety, depression, and somatization have been consistently identified in TMD patients.[61] Although there is no consensus regarding the percentage of TMD patients in whom psychological factors play a role, it is clear that such factors need to be taken into account along with structural indicators to properly diagnose and plan management strategies.

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Table 1. Maximum, minimum and mean values for DI, PI, CMI

	BOYS		GIRLS	
	Mean	*Variation*	*Mean*	*Variation*
DI	0.083	0-0.214	0.097	0-0.428
PI	0.056	0-0.477	0.087	0-0.8181
CMI	0.075	0-0.582	0.093	0-0.532

Table 2. Gender distribution according to HASDa

Anxiety	*Boys*		*Girls*		*Total*	
	n	(%)	n	%	n	(%)
Free-anxious	73	75.3	108	90	181	83.4
Mild	22	22.7	11	9	33	15.20
Moderate	1	1.03	1	0.83	2	0.92
Severe	1	1.03	0	0	1	0.46

Table 3. Gender distribution according to HASDd

Depression	*Boys*		*Girls*		*Total*	
	n	(%)	n	%	n	(%)
Free-depression	73	75.3	86	71.6	159	73.2
Mild	20	20.6	17	14.1	37	17.04
Moderate	4	4.1	15	13.3	20	9.21
Severe	0	0	1	0.83	1	0.46

Table 4. Correlation between CMI, DI , PI and HADSa/HADSd (r value)

	HADSa	*HADSd*
DI	0.08299	-0.00898
PI	0.25448*	0.03251
CMI	0.28093^{+}	0.00283

* $p<0.0002$ $^{+}p<0.0001$

Table 5. Association between number of subjective symptoms and HADSa

Number of Symptoms	*Free-anxious*		*Mild*		*Moderate*		*Severe*	
	n	(%)	n	(%)	n	(%)	n	(%)
0	89	41.01	13	5.99	6	2.76		0
1	40	18.43	14	6.45	7	3.23	0	
2	21	9.68	3	1.38	4	1.84	.46	
3	8	3.69	6	2.76	2	0.92	0	0
4	1	0.46	1	0.46	1	0.46	0	0

p= 0.0013

Table 6. Association between number of subjective symptoms and HADSd

Number of Symptoms	*Free-depression*		*Mild*		*Moderate*		*Severe*	
	n	(%)	n	(%)	n	(%)	n	(%)
0	94	43.32	13	5.99	1	0.46		0
1	51	23.50	10	4.61	0	0		0
2	23	10.60	5	2.30	0	0		.46
3	11	5.07	4	1.84	1	0.46	0	0
4	2	0.92	1	0.46	0	0	0	0

p= 0.0232

Capítulo 3

Bite force determination in adolescents with and without temporomandibular dysfunction

Bite Force and TMD In Adolescents

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ABSTRACT

The aims of this study were to compare bite force in adolescents with and without temporomandibular dysfunction, and to investigate the influence of gender, age, height and weight on bite force magnitude. The temporomandibular dysfunction was evaluated using a self-report questionnaire and the Craniomandibular Index, which has 2 subscales, the Dysfunction Index and the Palpation Index. Subjects with lower and upper extremity values were used to integrate the control (Group I – n=20) and temporomandibular dysfunction (Group II – n=20) groups, respectively. In addition, the temporomandibular dysfunction group should have at least one subjective symptom. Bite force was determined with a transducer, which consisted of a pressurized rubber tube connected to a sensor element (MPX 5700 – Motorola SPS, Austin, TX, USA). Analysis of covariance, Pearson's coefficient, Mann-Whitney and *t* tests were applied to analyze the data. The results showed that Group II presented smaller values for bite force than Group I and boys had greater values than girls in group II ($p<0.05$). Bite force values were significantly smaller for girls between groups ($p<0.05$), whereas for boys there was no statistical difference. Weak positive correlation between bite force and weight, height and age ($p>0.05$) and significant negative correlation between bite force and Palpation and Craniomandibular Indexes ($p<0.05$) were found. It was concluded that decreased bite force was correlated with temporomandibular dysfunction in girls, primarily with muscle tenderness.

Key words: Craniomandibular index, bite force, temporomandibular dysfunction

INTRODUCTION

Bite force is one of the components of the chewing function and it is exerted by the jaw elevator muscles and regulated by the nervous, muscular, skeletal and dental systems (1). Measurement of the maximum bite force is an attempt to quantify the total force of the jaw-closing muscles (2).

In studies of occlusal forces, the results often show great variation. Facial structure, general muscular force and sex differences are only a few factors that may influence the results (3). Others such as state of dentition, location within the dental arch of the bite force recording, mental state during the experiment, attitude of the investigator and patient, malocclusions and signs and symptoms of temporomandibular dysfunction (TMD), as well as the extent of the vertical separation of the teeth and the jaws because of the bite fork, may influence the values found for bite force (4,5).

Some investigators have suggested that bite force could be a useful additional method for understanding masticatory function in patients with oro-facial diseases (6,7).

Individuals with TMD are expected to have decreased maximum bite forces. Hagberg (8) suggested that TMD patients use greater relative masticatory forces than normal subjects during chewing. On the other hand, the weakness of masticatory muscle has been considered to be a predisposing factor for TMD (9). An increase in bite force up to normal levels has been reported following successful treatment of TMD (10,11), this treatment having a positive effect on the masticatory function, because both masticatory efficiency and occlusal force endurance improved after treatment, although these parameters do not seem to be of clinical diagnostic value (12).

There have been few studies about the association between maximum bite force and the presence of TMD during adolescence. Since reduced strength is an important factor in overload and hyperactivity of masticatory muscles and a common feature of patients with TMD, assessment of bite force is relevant in the diagnosis and treatment plane (13). Moreover, epidemiologic studies have shown that signs and symptoms of TMD can be found in all age groups (14,15,16). According to Egermark *et al*. (17) the prevalence is low in small children but increases with age in adolescence up to young adulthood.

Relating to the influence of body variables on bite force magnitude, Shiau and Wang (18) verified that the bite force increased with ageing, height and weight. Braun *et al*. (19) found a low correlation between bite force and body variables.

Thus, the aims of this study were to compare bite force between adolescents with and without TMD, and to investigate the influence of sex, age, height and weight in the magnitude of the bite force.

MATERIAL AND METHODS

The subjects were selected from Public Schools in the city of Piracicaba/Brazil. The parents and the adolescents were informed regarding the purpose of the study and written and verbal consent was obtained. The Ethics Committee of Piracicaba Dental School approved the research. Adolescents who received any type of orthodontic treatment prior to or during the research examination period were excluded from the study. The subjects were recruited after a screening questionnaire verifying the absence of systemic disturbance, which could compromise the masticatory system. Initially, the signs of TMD were assessed in 217 adolescents (120 girls/97 boys) aged 12-18 years, according to the CranioMandibular Index (CMI), as described by Fricton & Schiffman (20). A self-report questionnaire was used to assess subjective symptoms according to Riolo *et al*. (21), regarding pain in the jaws when in function (e.g. chewing), unusually frequent headaches (more than once a week), stiffness/tiredness in the jaws, difficulty in opening the mouth wide, grinding teeth, and sounds from TMJ. Each question could be answered with “yes” or “no”.

The CMI has a 0 to 1 scale that measures tenderness and dysfunction in the stomatognathic system and includes all currently recognized signs of TMJ disorders (20,22). There are 2 subscales: the Dysfunction Index (DI) and the Palpation Index (PI). The DI is designed to measure limitation in mandibular movement, pain and deviation in movement, TMJ noise, and TMJ tenderness. The PI measures the prevalence of muscle tenderness in the stomatognathic system. In this way, this index separates joint problems from muscle problems.

After all parameters had been checked, the median score in the CMI was determined. Forty adolescents of the 217 subjects were selected to dichotomize the data in order to compare "extreme" groups, and the lower and upper extremity values were used to integrate the control group (Group I – 10 boys/10 girls) and the TMD group (Group II –10 boys/10 girls), respectively. In addition, the TMD group might have had at least one subjective symptom of TMD.

The body weight and height and age were determined and correlated with bite force.

Bite force evaluation

Bite force was determined with a pressurized transducer, which consisted of a pressurized rubber tube connected to a sensor element (MPX 5700 – Motorola SPS, Austin, TX, USA). The tube and the sensor were connected to a converse analog/digital electronic circuit, fed by an analogic signal coming from the pressure-sensitive element. The system was connected to the computer and the software for the reading the pressure sign was developed in Basic language. This software generates a text file in column form with the pressure data that is easily read by Excel.

Three bite force evaluations were conducted in each patient, who bit the tube with maximum force three times successively for 5 s, with a 10s interval among each bite. The tube was placed between the posterior maxillary and mandibular first molars bilaterally. To obtain the highest bite values possible, the adolescents were trained before the test and they were urged to do their very best. They were seated in chairs with their heads fixed, keeping the Frankfort plan approximately parallel to the floor. In relation to numeric results, the minimum values were obtained, which corresponded to the initial pressure in the pressurized tube, and the maximum values corresponded to maximum bite force. The difference between maximum and minimum pressures for each evaluation was calculated and the mean value of the three, for each patient, was selected. The values from the pressurized tube transferred to Excel were obtained in pounds per square inch (psi) and later they were converted into Newtons (N), taking in account the area of the tube, since force is equal pressure x area. Thus, it was considered that:

1 psi = 29,792 N

STATISTICAL ANALYSIS

Data were analyzed by conventional statistical methods, i.e. arithmetic mean and standard deviation (s.d.). Mann-Whitney and *t* test were used to compare index values between groups and gender. The analysis of covariance was used to determine if the differences in bite force between groups were statistically significant after controlling for gender, age, height and weight. The correlation between bite force and weight, height, age and index values was determined by Pearson's coefficient. The significance level was set at $p<0.05$.

RESULTS

Table 1 shows individual values, means and s.d. for DI, PI and CMI for both groups separated by gender. The differences in index values were statistically significant between group I and II ($p<0.05$). Relating to gender, girls in group II showed higher CMI scores than boys ($p<0.05$), as demonstrated in Table 1.

Maximum bite force was significantly higher in group I than in Group II (Table 2), as demonstrated by covariance analyzes, meaning that signs and symptoms of TMD were the determinant factors, since the covariables did not show differences between groups. Boys, in group II, presented higher values for maximum bite force than girls ($p<0.05$). Girls in group I presented higher bite force values than that ones in group II. The same was not observed for boys in both groups (Table 2, Fig 1). There was no significant difference between groups and between genders for weight, height and age ($p>0.05$) (Table 2).

Table 3 presented the correlation coefficients between bite force and weight, height, age, showing weak positive correlations in both groups without statistical significance ($p>0.05$).

It was obtained negative significant correlations for bite force with PI and CMI ($p<0.05$), as showed in table 4.

DISCUSSION

In this study, a sample composed of adolescents with and without TMD was selected, with the aim of associating them with bite force magnitude. The subjects were trained before the experiment, all collaborated with the methods, and their mental state was considered good to do the exam. The average bite force values of all the three measurements were in line with the maximum values, indicating good reproducibility of the method. In addition, this method was already tested in our laboratory with good results as stated by Rentes *et al*. (23). There were significant statistical differences between the groups, demonstrating that TMD in adolescents affected the magnitude of the bite force, since after controlling covariables the difference between groups remained. The results of this study are in agreement with Shi (24), Bakke *et al*. (13), Kroon & Naeije (25), who observed that patients with TMD have been reported to have lower maximum bite force values than healthy subjects. Nevertheless, Waltimo & Könönen (26) and Lyons & Baxendale (27) found negative TMD and bite force correlations in adults. The subjects' age could explain the differences in the results of this study, as far as methodology is concerned.

The maximum bite force could be reduced by pain in jaw-closing muscles or in the TMJ (13, 26, 28). In 1972, Molin (29) had already observed that the manifestation of the mandibular pain dysfunction syndrome in females determined lower forces, as a result of the more intense pain that they experienced on the affected side. We found a significant negative correlation between the signs and symptoms of TMD and bite force. Table 4 shows the association among maximum bite force and the DI, PI and CMI scores. The statistical analysis was applied separately for each group and there was evidence that TMD was associated with lower maximum bite force values, since Group I did not present significant correlations among the respective scores and the maximum bite force values.

These reported results above indicate that muscular tenderness was an influencing factor to reduce the maximum bite force. These results agree with Sonnesen *et al*. (30), who found that a high score on Helkimo's Clinical Dysfunction Index was associated with a lower bite force, and had considered the magnitude of the associations to be from low to moderate, but muscle tenderness was the main factor related to reduced bite force. The findings of this study showed the presence of TMD in Group II was determined at 29% and 32% of the variation in maximum bite force, and this could be explained by PI and CMI scores, respectively. As the DI in the present study was not correlated with the bite force these results are corroborated by those of Shiau *et al*. (31), meaning that pain in the masticatory muscles prevented the patients from exerting maximum bite force. Following hypertonic saline injection in the masseter muscles of subjects, Svensson *et al*. (32) found a decrease in maximum occlusal force and weakness of jaw closing muscle EMG activity. Thus, it must be considered that many physiological factors, like size, composition and mechanical advantage of jaw-closing muscles, sensitivity of the teeth, muscle and TMJ can influence the generation of maximum bite force (33). Thus, the subject's sensory feedback may limit willingness to exert the maximum effort (2).

In principle, the strength of the mandibular elevator muscles in terms of maximum bite forces varies in much the same way with age and gender (5,34). In this study, gender difference in bite force magnitude was observed for Group II, boys being stronger than girls (Table 2, Fig. 1). Nevertheless, maximum bite force for boys in group I was not significant lower than boys with TMD (Table 2, Fig.1). In contrast, girls from group II had significantly lower maximum bite forces than those from group I (Table 2) suggesting that they were more affected than boys. These outcomes could provide consistent evidence of gender differences in pain perception, since women have been reported more clinical pain, lower pain threshold and tolerance levels than men and are vulnerable to the development and maintenance of musculoskeletal pain conditions (35, 36, 37, 38, 39). These differences are particularly noteworthy for numerous forms of musculoskeletal pain, including fibromyalgia, TMD, and myofascial pain, even into old age (40). The masticatory muscle pain induced by chewing was significantly greater in female control subjects than in males, persisting longer and suggesting higher susceptibility in women (41). There was a

hypothesis that the higher prevalence of chronic orofacial pain in women is a result of sex differences in generic pain mechanisms and of as-yet unidentified factors unique to the craniofacial system (42).

In group I, girls presented slightly higher bite force values than boys, although without significant difference. In the literature, it is widely reported that gender differences in bite force increases in ages up to adolescence, with the difference between the sexes being first seen at puberty. Boys became stronger than girls after 13 years of age (18). Garner and Kotwal (34) observed that the increase in muscle mass during puberty influenced by androgenic steroids creates the difference between male and female muscle strength. They found that males over 17 years of age bite harder than females, but that the average bite force values for females 11-16 years old were equal to or even higher than those for males, probably because females have pubertal growth spurts earlier than males, corroborating the results of this study. Furthermore, there was no correlation between age and bite force in groups I and II, and this could be explained by the fact that there was a great variation in subjects' age and the hormonal state was not taken into account. For this reason, some of the subjects could have already presented the influence of estrogens while others did not. The gender and age distribution of TMD suggests a possible link between its pathogenesis and the female reproductive system (43). The correlation coefficients for weight and stature in this study were low, as showed in table 3, which is in agreement with Braun *et al*. (19). The weight and height factors were not been correlated with the bite force magnitude. The notion that persons with larger body build size and/or weight exhibit a greater bite force was not confirmed in this study. This outcome agrees with an earlier study by Linderholm & Wennström (44) and other more recent one by Waltimo & Könönen (26), who observed that the maximum bite force was not correlated with body variables in themselves, and considered that bite force evidently depends on more complex factors than body size, such as the cross-sectional area of masticatory muscles and jaw biomechanics (45).

From this study, it may be concluded that maximum bite force is reduced in girls with TMD. Body variables, as well as age, had weak correlation with the bite force

measurements. The muscle tenderness was correlated to decreasing bite force. However, since skeletal facial morphology was not measured in this study, the factor of facial morphology on the effect of bite force in this age group could not be explained and such details will form the basis for another research. Future studies on this should be undertaken and related to bite force measurements.

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Table 1

Individual values, means and standard deviation for DI, PI and CMI in groups I and II

	Group I			Group II		
Subjects	DI	PI	CMI	DI	PI	CMI
Girl	0.071	0	0.0355	0.428	0.636	0.532
Girl	0.107	0	0.0535	0.142	0.363	0.2525
Girl	0.0214	0.068	0.0447	0.285	0.068	0.176
Girl	0.0714	0	0.0357	0.142	0.318	0.23
Girl	0.0357	0	0.01785	0.0357	0.431	0.233
Girl	0.0714	0	0.0357	0.0357	0.704	0.369
Girl	0.071	0	0.0355	0.107	0.363	0.235
Girl	0.0714	0	0.0357	0.321	0.25	0.2855
Girl	0.0357	0.0681	0.0519	0.25	0.227	0.2385
Girl	0.035	0	0.0175	0.107	0.295	0.201
Mean	0.0591	0.0136	0.0364	0.1853	0.3655	0.2752
s.d.	(0.0261)	(0.0287)	(0.0120)	(0.1300)	(0.1887)	(0.1041)
Boy	0.107	0	0.0535	0.214	0.045	0.129
Boy	0	0	0	0.142	0.477	0.3095
Boy	0.0714	0	0.0357	0.214	0.25	0.232
Boy	0.0357	0	0.01785	0.0357	0.318	0.176
Boy	0.0357	0	0.01785	0.107	0.318	0.2125
Boy	0.0357	0	0.01785	0.0714	0.409	0.2402
Boy	0.0714	0	0.0357	0.142	0.272	0.207
Boy	0.0714	0	0.0357	0.142	0.09	0.116
Boy	0.0714	0	0.0357	0.0714	0.136	0.1037
Boy	0.0357	0.0227	0.0292	0.142	0.2045	0.17325
Mean	0.0535	0.0023	0.0279	0.1282	0.2520	0.1899*
s.d.	(0.0303)	(0.0072)	(0.0148)	(0.0586)	(0.1371)	(0.0637)
Total mean	0.056452	0.00794	0.032331	0.149995*	0.321395*	0.232583*
s.d.	(0.026985)	(0.021171)	(0.013531)	(0.100609)	(0.165492)	(0.094699)

* ($p<0.05$)

Table 2

Average (s.d.) for the maximum bite force (BF) (N), weight (Kg), height (m) and age (years) for the groups I and II

	Group I			Group II		
	Girls	Boys	Total	Girls	Boys	Total
BF	331.782[a] (19.060)	320.008[a] (27.783)	325.90[a] (23.96)	281.321[b] (29.164)	321.691[a] (40.637)	301.51[b] (40.17)
Weight	55.990[a] (9.342)	50.820[a] (10.252)	53.41[a] (9.91)	54.090[a] (10.612)	53.660[a] (17.784)	53.88[a] (14.25)
Height	1.636[a] (0.076)	1.608[a] (0.100)	1.622[a] (0.090)	1.585[a] (0.104)	1.603[a] (0.144)	1.59[a] (0.12)
Age	14.3[a] (2.214)	13.7[a] (1.830)	13.9[a] (2.05)	14[a] (1.826)	13.5[a] (2.461)	**13.75[a]** (2.12)

Pairs of values having different superscript letters in the same horizontal line are significantly different ($P < 0.05$)

Table 3

Correlation between bite force and weight, height and age

	Group I				Group II			
	Boys		Girls		Boys		Girls	
	R	p	R	p	R	p	R	p
BF x Weight	0.220	0.541	0.258	0.472	0.343	0.332	0.185	0.610
BF x Height	0.208	0.564	0.340	0.337	0.588	0.073	0.154	0.671
BF x Age	0.279	0.436	0.491	0.15	0.512	0.131	-0.316	0.374

Table 4

Correlation between bite force and Index values

	Group I			Group II		
	R	P Value	R^2	R	P Value	R^2
Bite force x DI	0.272	0.247	0.074	-0.147	0.535	0.021
Bite force x PI	-0.233	0.323	0.054	-0.543	0.013*	0.295
Bite force x CMI	0.094	0.695	0.008	-0.569	0.009*	0.324

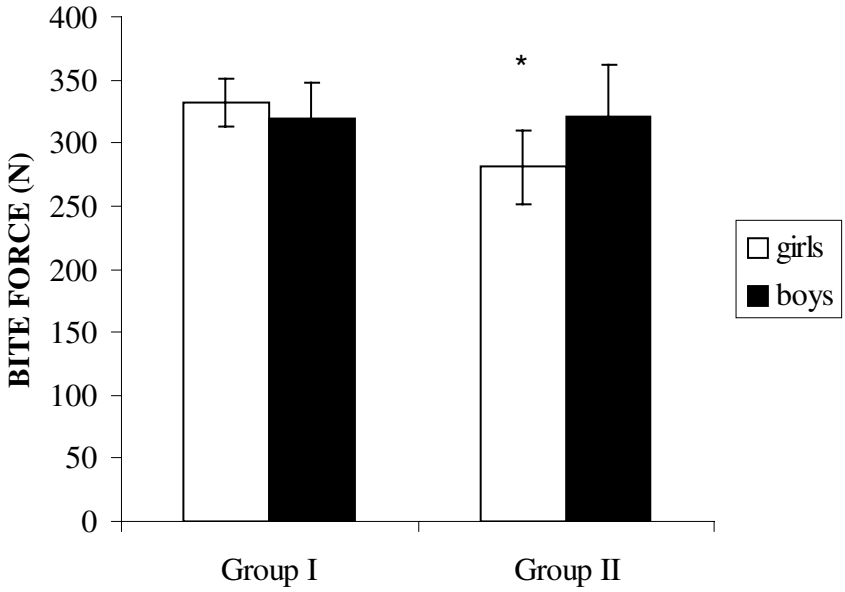

Fig.1. Means of the maximum bite force for the Group I ($p>0.05$) and II ($p<0.05$)

4 CONCLUSÃO GERAL

De acordo com os resultados do presente trabalho, concluiu-se que:

1º- os sinais e sintomas de disfunção temporomandibular estão presentes em adolescentes. De acordo com o *Craniomandibular Index* (CMI), a sensibilidade muscular e os ruídos articulares foram os sinais clínicos mais prevalentes. Com relação aos sintomas subjetivos, o ruído articular e a dor de cabeça foram os sintomas mais reportados. Diferenças na presença de sinais e sintomas de disfunção temporomandibular entre os gêneros só foram observadas com a sensibilidade à palpação do músculo pterigóideo lateral.

2º- Houve forte correlação entre CMI, PI, especialmente para sensibilidade muscular e ansiedade (HADSa), mostrando que, na amostra estudada, sujeitos com maior valor do CMI e PI tendem a ter níveis mais elevados do HADSa. No entanto, isto não ocorreu com a depressão (HADSd). O número de sintomas de DTM se associou com os escores HADSa e HADSd, mostrando que sujeitos que apresentaram maior número de sintomas tendem a ter algum nível de ansiedade e depressão.

3º- A magnitude da força de mordida foi estatisticamente superior para as meninas do grupo I em relação ao grupo II, não ocorrendo tal diferença com os meninos, sendo que estes mostraram valores significativamente maiores que as meninas do grupo II. A força de mordida se correlacionou negativamente com CMI e PI mas não se correlacionou com as variáveis corporais e etárias, mostrando que, na amostra estudada, tais variáveis não interferiram no valor final da força máxima. Portanto, sinais e sintomas de DTM tiveram influência na magnitude da força de mordida, principalmente no gênero feminino.

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* De acordo com a norma da UNICAMP/FOP, baseada no modelo Vancouver. Abreviatura dos periódicos em conformidade com o Medline.

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ANEXOS

Anexo 1

Questionário:

1. Você tem alguma dor ou sensibilidade na mandíbula ou na face durante a mastigação dos alimentos?
( ) sim ( ) não

2. Você tem algum problema em abrir sua boca?
( ) sim ( ) não

3. Quando abre ou fecha a boca, você ouve algum barulho perto do ouvido?
( ) sim ( ) não

4. Você já percebeu ou alguém já te disse que você aperta ou range os dentes durante o dia ou a noite?
( ) sim ( ) não

5.Você tem dor de cabeça freqüente (1 vez por semana)?
( ) sim ( ) não

Já foi ao médico para saber sobre tal problema:
Origem conhecida:

Anexo 2

ÍNDICE DE DISFUNÇÃO

EXAME CMI

Paciente: **Data:**
Examinador:

Incisivo Superior usado.....11.....21

( ) Dor em abertura máxima confortável.....mm
( ) Abertura máxima ativa (≥ 40).....mm
( ) Abertura máxima passiva (≥ 42).....mm
( ) Protrusão (≥ 7).....mm
( ) Lateralidade direita máxima (≥ 7).....mm
( ) Lateralidade esquerda máxima (≥ 7).....mm
( ) Sobressaliência (Overjet).....mm
( ) Sobremordida (Overbite).....mm
( ) Desvio de linha média.....mm D(1) E(2)

Qualidade do Movimento:
( ) Reto.....sim(1) não(0)
( ) Restrito.....não(0) sim(1)
( ) Movimento abrupto (jerky)..... não(0) sim(1)
( ) Desvio em S (≥ 2mm)..... não(0) D(1) E(2)
( ) Desvio lateral (≥ 2mm)..... não(0) D(1) E(2)
( ) Está ou pode travar aberta..... não(0) D(1) E(2)
( ) Está ou pode travar fechada..... não(0) D(1) E(2) Ambos (3)
( ) Rigidez da mandíbula..... não(0) D(1) E(2) Ambos (3)
( ) Velocidade ..... normal(0) lento(1)
( ) Outros.....

Clique articular (abertura e fechamento 3 vezes)

	D		E	
( ) incômodo	não(0)	sim(1)	não(0)	sim(1)
( ) dolorido	(0) (1) (2) (3)		(0) (1) (2) (3)	
( ) dor na ATM	não(0)	sim(1)	não(0)	sim(1)

	D		E	
( ) Clique de abertura	não(0)	sim(1)	não(0)	sim(1)
( ) Medida	.....mm		.....mm	
( ) Clique em todas as aberturas	não(0)	sim(1)	não(0)	sim(1)

( ) Clique em 2 de 3	não(0)	sim(1)	não(0)	sim(1)
( ) Clique em apenas 1	não(0)	sim(1)	não(0)	sim(1)
( ) Clique de fechamento	não(0)	sim(1)	não(0)	sim(1)
( ) Medida	.....mm		.....mm	
( ) Clique em todos os fechamentos	não(0)	sim(1)	não(0)	sim(1)
( ) Clique em 2 de 3	não(0)	sim(1)	não(0)	sim(1)
( ) Clique em apenas 1	não(0)	sim(1)	não(0)	sim(1)
( ) Ruído audível (popping)	não(0)	sim(1)	não(0)	sim(1)
( ) Eliminação de clique recíproco (protruído)	não(0)	sim(1)	não(0)	sim(1)
Crepitação				
( ) incômodo	não(0)	sim(1)	não(0)	sim(1)
( ) dolorido	(0) (1) (2) (3)		(0) (1) (2) (3)	
( ) crepitação grosseira	não(0)	sim(1)	não(0)	sim(1)
( ) crepitação fina	não(0)	sim(1)	não(0)	sim(1)

Ruídos articulares em movimentos excursivos

	nenhum	clique	crepitação grosseira	crepitação fina
Lateralidade Direita	não(0)	D(1)E(2)A(3)	D(1)E(2)A(3)	D(1)E(2)A(3)
Lateralidade Esquerda	não(0)	D(1)E(2)A(3)	D(1)E(2)A(3)	D(1)E(2)A(3)
Protrusão	não(0)	D(1)E(2)A(3)	D(1)E(2)A(3)	D(1)E(2)A(3)

Palpação

Extraoral	D	E
Temporal Anterior	_____	_____
Temporal Médio	_____	_____
Temporal Posterior	_____	_____
Masseter Profundo	_____	_____
Origem do Masseter	_____	_____
Corpo do Masseter	_____	_____
Inserção do Masseter	_____	_____
Digástrico Posterior	_____	_____
Ptrigoide Medial	_____	_____
Vértex	_____	_____

Pescoço		
Esternocleidomastóide Superior	_____	_____
Esternocleidomastóide Médio	_____	_____
Esternocleidomastóide Inferior	_____	_____
Inserção do Trapézio	_____	_____
Trapézio Superior	_____	_____

Esplenius Capitis....._____....._____

ATM
Região Lateral do Côndilo....._____....._____
Região Dorsal do Côndilo....._____....._____
Região Superior da Cápsula....._____....._____

Intraoral
Pterigóide Medial....._____....._____
Pterigóide Lateral....._____....._____
Inserção do Temporal....._____....._____

Anexo 3

Nome: _____ Prontuário: _____

Leia todas as frases. Marque com "X" a resposta que melhor corresponder a como você tem se sentido na última semana. Não é preciso ficar pensando muito em cada questão. Neste questionário as respostas espontâneas têm mais valor do que aquelas em que se pensa muito. **Marque apenas uma resposta para cada pergunta.**

A	**Eu me sinto tenso ou contraído:**	
	A maior parte do tempo	3
	Boa parte do tempo	2
	De vez em quando	1
	Nunca	0
D	**Eu ainda sinto gosto pelas mesmas coisas de antes:**	
	Sim, do mesmo jeito que antes	0
	Não tanto quanto antes	1
	Só um pouco	2
	Já não sinto mais prazer em nada	3
A	**Eu sinto uma espécie de medo, como se alguma coisa ruim fosse acontecer:**	
	Sim, e de um jeito muito forte	3
	Não tanto quanto antes	2
	Um pouco, mas isso não me preocupa	1
	Não sinto nada disso	0
D	**Dou risada e me divirto quando vejo coisas engraçadas:**	
	Do mesmo jeito que antes	0
	Atualmente um pouco menos	1
	Atualmente bem menos	2
	Não consigo mais	3
A	**Estou com a cabeça cheia de preocupações:**	
	A maior parte do tempo	3
	Boa parte do tempo	2
	De vez em quando	1
	Raramente	0

D	**Eu me sinto alegre:**	
	Nunca	3
	Poucas vezes	2
	Muitas vezes	1
	A maior parte do tempo	0
A	**Consigo ficar sentado à vontade e me sentir relaxado:**	
	Sim, quase sempre	0
	Muitas vezes	1
	Poucas vezes	2
	Nunca	3
D	**Eu estou lento para pensar e fazer coisas:**	
	Quase sempre	3
	Muitas vezes	2
	Poucas vezes	1
	Nunca	0
A	**Eu tenho uma sensação ruim de medo, como um frio na barriga ou um aperto no estômago:**	
	Nunca	0
	De vez em quando	1
	Muitas vezes	2
	Quase sempre	3
D	**Eu perdi o interesse em cuidar da minha aparência:**	
	Completamente	3
	Não estou mais me cuidando como eu deveria	2
	Talvez não tanto quanto antes	1
	Me cuido do mesmo jeito que antes	0
A	**Eu me sinto inquieto, como se eu não pudesse ficar parado em lugar nenhum:**	
	Sim, demais	3
	Bastante	2
	Um pouco	1
	Não me sinto assim	0

D	**Fico esperando animado as coisas boas que estão por vir:**	
	Do mesmo jeito que antes	0
	Um pouco menos do que antes	1
	Bem menos que antes	2
	Quase nunca	3
A	**De repente, tenho a sensação de entrar em pânico:**	
	A quase todo momento	3
	Várias vezes	2
	De vez em quando	1
	Não sinto isso	0
D	**Consigo sentir prazer quando assisto um bom programa de televisão, de rádio, ou quando leio alguma coisa:**	
	Quase sempre	0
	Várias vezes	1
	Poucas vezes	2
	Quase nunca	3
	Total 'A' =	
	Total 'D' =	

SCORE

Total "A"= Ansiedade

Total "D" = Depressão

0 – 7 = normal

8 – 10 = leve

11 – 14 = moderado

15 – 21 = severo

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CERTIFICADO

Certificamos que o Projeto de pesquisa intitulado "Fatores associados à presença de sinais e sintomas de disfunção temporomandibular em adolescentes", sob o protocolo nº **081/2002** dos Pesquisadores ***Leonardo Rigoldi Bonjardim***, sob a responsabilidade da Profa. Dar. **Maria Beatriz Duarte Gavião**, está de acordo com a Resolução 196/96 do Conselho Nacional de Saúde/MS, de 10/10/96, tendo sido aprovado pelo Comitê de Ética em Pesquisa – FOP.

Piracicaba, 16 de agosto de 2002

We certify that the research project with title "Factors related to signs and symptoms of temporomandibular dysfunction in teenagers", protocol nº 081/2002, by Researcher ***Leonardo Rigoldi Bonjardim***, responsibility by Prof. Dr. **Maria Beatriz Duarte Gavião**, is in agreement with the Resolution 196/96 from National Committee of Health/Health Department (BR) and was approved by the Ethical Committee in Research at the Piracicaba Dentistry School/UNICAMP (State University of Campinas).

Piracicaba, SP, Brazil, August 16 2002

Fernanda Klein Marcond

Profa. Dra. Fernanda Klein Marcondes

Secretário em Exercício
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Prof. Dr. Pedro Luiz Rosalen

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Anexo 5

Maria Beatriz Gavião

De: <jor@odont.au.dk>
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Cc: <psvensson@odont.au.dk>
Enviada em: quinta-feira, 8 de julho de 2004 10:48
Assunto: Manuscript submitted - JOR-04-0246

Dear Prof. Maria Beatriz Gavião

Thank you for submitting your manuscript entitled "Signs and symptoms of temporomandibular dysfunction in a group of Brazilian adolescents " to the Journal of Oral Rehabilitation. We will contact you in due course.

Kind regards

Janet Mikkelsen
Editorial Assistant
Journal of Oral Rehabilitation

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Enviada em: terça-feira, 29 de junho de 2004 17:58
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Prof. Maria Beatriz Gavião

Thank you for resubmitting your revision of "Bite force determination in adolescents with and without temporomandibular dysfunction".
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