Original Article

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Temporomandibular dysfunction and cervical posture and occlusion in adolescents

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Abstract

Aim: To evaluate the effect to the degree of temporomandibular dysfunctions (TMD) in adolescents and occlusal classes in the cervical posture. **Methods**: A cross-section, observational study was carried out, in which 296 adolescents took part. For the evaluation, the patients were divided into groups according to the presence and severity of the TMD, using the Helkimo questionnaire and occlusal Angle classification. The posture analysis was carried out using photogrammetry and the software Alcimage® to measure the predefined angle based on the protuberances of the Spinous Process of the 7th cervical vertebra (C7), manubrium of the sternum and mentum vertex**. Results:** 48% (n= 142) of the 296 adolescents evaluated presented no dysfunction, while 52% (n= 154) presented some degree of TMD. Of the different degrees of TMD, the highest average cervical angulation observed in the group with moderate dysfunction was 97.59º ±7.40, followed by a mild degree, of 96.32º± 9.36, and the lowest average was 93.01º±10.08 in the patients with a severe degree in the different occlusal classes. In relation to occlusal class, higher values for this angulation were observed in class II (96.77º± 8.79), compared with class I (90.64º±8.80) and class III (94.67º± 10.70), a difference which was statistically significant. **Conclusions:** The subjects with TMD presented a greater alteration in head posture, compared with those without TMD. In particular, the Class II Angle was correlated with TMD and alterations in cervical posture.

Keywords: temporomandibular disorders, head posture, adolescents, cervical column.

Introduction

The characteristic symptoms of temporomandibular dysfunctions (TMD) are: muscular and/or joint pain on touch, *mandibular function* impairment, and joint noises, the overall prevalence of these symptoms affecting over 75% of the population and this condition is not limited to adults[1]. Epidemiological studies such as those conducted by Egermark et al.[2] and Thilander et al.[3] have shown that signs and symptoms of TMD can be found in all age groups. However, its prevalence in children is considered low, increasing with age in adolescents and young adults.

The masticatory system is a regulatory or perturbing element of the postural system. Therefore, a disequilibrium induced by a temporomandibular joint (TMJ) disorder can lead to postural decompensation, just as disequilibrium of the postural system alters the masticatory system[4].

The association between head posture, cervical posture, mandibular posture and equilibrium of the *stomatognathic* system has been studied and discussed for years, and has been a source of divergent opinions[5]. Authors affirm that patients with TMD present more alterations in head positioning than patients with no

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dysfunction[5-11]. The ideal head position in the space depends on three planes: the optical plane, the transverse occlusal (masticatory) plane and the *auriculo-nasal plane*. These three planes together maintain a horizontal and parallel relationship which ensures cranial postural stability. This position is assured by the mechanoreceptors of the upper part of the cervical column[8,10-11]. In an ideal head posture, its highest volume is found slightly anterior to the cervical column[12].

Numerous aspects of stomatognathic system conditions have been found to be associated with head posture alterations. Among these aspects are: mandible position, dental or skeletal malocclusion, and TMD[12-13].

Correct dental occlusion is important for maintaining the equilibrium of the muscles which form part of the mandible[10]. With this occlusion, it is possible to verify the vertical dimension of occlusion, which corresponds to the vertical dimension of the face. If an alteration to this dimension occurs, the growth of the muscles inserted in and passing through the cranium, via the hyoid *bone* and shoulders, is altered. Therefore, alterations in head position could influence the cervical column and stomatognathic system, altering the distribution of occlusal stress and affecting the craniofacial morphology[8,11-12]. Patients with malocclusion or TMJ disorders habitually report dysfunction and pain in their neck muscles[14].

The cervical muscles are directly related to the TMJ by an interconnected neuromuscular system. Changes in the cervical column TMD and the opposite is also correct. Since head and cervical muscles are closely related to the stomatognathic system, studies have been carried out to confirm that postural changes of the head and the body could have an adverse biomechanical effect on the TMJ and lead to TMD[12-13].

Clinical studies showed influences of head and body posture on the mandibular rest position, range of functional movements and the jaw and neck muscles work together during rhythmic movements[12].

The relationship between TMD and cervical posture involves the relationship between TMJ, painful cervical symptoms, and posture alterations of the cervical column and the head. The position of the cervical column could be the initial cause of some occlusal discrepancies and alterations in neuromuscular harmony. The position of the head and neck lead to modifications in the mandibular trajectory, with future impairment of the TMJ, consequently affecting the entire posture[9,11-12].

Due to the possibility of dysfunctions of the TMJ originating at the beginning of craniofacial growth, a high percentage of adolescents present signs and symptoms associated with TMD[13].

The study of TMD in adolescents is important for determining, at an early stage, the problems that may predispose to abnormalities of craniofacial growth, pain or muscular dysfunction in the adult phase[14].

The aim if this study was to evaluate the effect to the degree of TMD in adolescents and occlusal classes in the cervical posture.

Material and methods

This study was approved by the *Human Research Ethics* Committee, under no. 82622/08, and those responsible for the participants signed an informed consent form, authorizing their participation in the study. This is an observational, cross-sectional study for the evaluation of the students of a municipal school in the countryside of the State of São Paulo (Brazil).

A total of 454 adolescents were evaluated. As criteria for inclusion, age group and the presence of first permanent molars were used for evaluation of the occlusal class. Individuals undergoing orthodontic treatment, those with absent first molars, and cases where it was impossible to clinically evaluate the occlusion were excluded.

Of the 454 students, 301 were in this age group, 3 used braces and 2 had lost their first permanent molars, therefore a total 296 adolescents took part in the study. The participants were divided into groups according to the degree of TMD and occlusal Angle classification.

The evaluation of signs and symptoms of TMD was obtained from the Helkimo Questionnaire[15], which includes information regarding difficulties on opening the mouth and movement of the mandible, pains in the head, nape of the neck, neck or joint regions, noise in the TMD, and the habit of clenching or grinding the teeth. A large number of indices are found in the international literature for the classification of patients with TMD, such as the widely used Helkimo Index[15], which is a pioneering questionnaire aimed at measuring the severity of TMD. In an epidemiological study, an index subdivided into anamnestic, clinical disorder and occlusal disorder was developed to assess the prevalence and degree of severity of TMD in patients with severe mandibular pain both on the individual level and in the general population[16,17].

In an attempt to define diagnostic criteria for the classification of patients with TMD, Dworkin and Le Resche[17] developed a detailed questionnaire. However, as this assessment tool is long and complex, it may not be applicable to adolescents. Moreover, the questionnaire was validated for a different culture and therefore requires validation in the Portuguese language for possible administration in Brazilian studies. Fonseca evaluated the index for the assessment of TMD adapted to the Brazilian population that would be easy to understand and administer and could be more successfully applied to the younger population. Studies have found a strong positive correlation ($r = 0.95$) between the Fonseca translation and the Helkimo Index[18].

The questionnaire is comprised of 10 questions with possible answers of **yes** (10 points), **sometimes** (5 points) and **no** (0 points). For each question, only one answer can be checked. The total score is used to classify the severity of the TMD as **severe** (70 to 100 points), **moderate** (45 to 65), **mild** (20 to 40) and **no dysfunction** (0 to 15).

In order to correlate the data for TMD and occlusal class, the students were divided into subgroups, according to the occlusal Angle classification obtained from the analysis

Table 1. Distribution of the participants by sex and the presence of TMD

		Sex		
		M	F	Total
No TMD	N	97	45	142
	%	68.3%	31.7%	100.0%
With TMD	N	46	108	154
	%	29.9%	70.1%	100.0%
Total	N	143	153	296
	%	48.3%	51.7%	100.0%

Table 2. Distribution of the participants by age and the presence of TMD.

	age											Total
	10	11	12	13	14	15	16	17	18	19	20	
NO TMD	5	28	42	22	11	4	9	1	14	3	3	142
With TMD	0	23	52	31	32	13	3	0	0	0	0	154
Total	5	51	94	53	43	17	12	1	14	3	3	296

relating to the first permanent molars.

The clinical assessment of head posture was conducted using a postural grid. Each subject was asked to remain in his/her normal posture, in a standing position. The self-balance position was used to standardize the posture of each subject, asking him/her to look straight ahead, parallel to the floor, keeping the gaze horizontal[19]. To study the posture, three different points were marked with painted semi-spheres (1.5 cm), which were attached to the volunteer's skin with double-sided adhesive tape. The spinous process of the seventh cervical vertebra, the manubrium of the sternum, and the mentum vertex, were chosen for this evaluation based on Rocabado's[20] description. The subject's posture was also photographed (right side) using a digital camera (Kodak™ Z740 7.1). The camera was placed on a height-adjustable tripod with a standard distance of 1.5 m between the camera and the subjects. All the clinical examinations and the pictures were carried out by the same person, who was blind to which group the subjects were in.

The measurements in the photographs were performed using a computer software (Alcimage®) to quantify the posture, using angular calculus. The angle was calculated automatically by the software, so the examiner was unaware of the angle value until the end of the analysis. In this study, three reference points were established for the head posture analysis: the spinous process of the seventh cervical vertebra, manubrium of the sternum and mentum vertex. The average of the three measurements, for each volunteer, was used to obtain greater reliability of the angles collected.

According to the classification, the volunteers were compared in terms of degree of TMD and posture (mean angles). The data obtained were tabulated and submitted to chi-squared statistical calculations for the qualitative variables, Shapiro-Wilk W normality test ($p > 0.05$) and analysis of variance for the quantitative variables. A level of significance of 0.05 was considered in all the analyses, using the SPSS12.0 for windows statistical software (SPSS Inc., Chicago, IL, USA) .

Results

Of the 296 adolescents evaluated, 143 (48.3%) were male and 153 (51.7%) female. The mean age was 13 years (± 2.02).

In relation to the presence of TMD, it was observed that 48% (n= 142) presented no dysfunction, while 52% (n= 154) presented some degree of TMD. Of the 142 patients that did not have any TMD, 68.3% (n=97) were male while 31.7% (n= 45) were female. Of the group of individuals classified as having TMD, a higher frequency of females, 70.1% (n=108) was observed, compared with 29.9% (n=46) males (Table 1). Evaluating the relationship between sex and the presence of TMD statistically, the association between the female sex and the presence of the dysfunction was significant ($p < 0.001$).

In relation to age and the presence of TMD, a higher frequency was observed in the 11 to 13 year age group, but in this age group, the number of participants was larger (Table 2) and when evaluated statistically, there was no significant difference.

In relation to the cervical angle, higher mean values were found for the group of adolescents with TMD: 96.37° ±9.01, while the group with no TMD presented mean values of 91.80 ± 9.37.

The distribution of the adolescents by degree of TMD shows a more frequent occurrence of the mild degree (36.5%) among the patients with TMD. Within the different degrees of TMD, a greater cervical angulation for the group with moderate dysfunction (97.59º ±7.40), and the mild degree (96.32º± 9.36) were observed compared with the values obtained for the group with no TMD (91.80 ± 9.37), these differences being statistically significant. The group with severe dysfunction presented values of 93.01º±10.08, with no statistically significant difference between it and the other groups (Table 3).

Table 4 shows the distribution of the participants in relation to the occlusal angle classification. In relation to

Table 3. Significance between the differences in means for cervical angles in the different groups.

TMD	TMD	Mean Difference	Standard Error	Sig.
No TMD	Mild	-4.51774(*)	1.17326	p<0.001
	Moderate	-5.78504(*)	1.73416	0.001
	Severe	-1.20673	2.87599	0.675
Mild	Moderate	-1.26730	1.78733	0.479
	Severe	3.31101	2.90835	0.256
Moderate	Severe	4.57831	3.17636	0.151

Table 4. Classification of occlusal angle for the different degrees of TMD.

		TMD			
		Mild	Moderate	Severe	Total
I	N	38	10	3	51
		(35.2%)	(28.6%)	(27.3%)	(33.1%)
II	N				
		56	17	3	76
III	N	(51.9%)	(48.6%)	(27.3%)	(49.4%)
Total	N	14	8	5	27
		(13.0%)	(22.9%)	(45.5%)	(17.5%)
		108	35	11	154
		(100%)	(100%)	(100%)	(100%)

occlusal class, higher values were seen for this angle in class II in comparison to class I and class III, this difference was statistically significant ($p<0.005$) for a confidence interval of 95% (Table 5).

Discussion

In the present study, alterations in cervical posture in adolescents with TMD and malocclusion were observed.

In the evaluation between TMD and cervical posture among the adolescents, a greater cervical angle was observed in those with TMD. This cervical alteration is related to the forward leaning positioning of the head in patients with TMD, and has been discussed in various studies[5,21-24]. This finding agrees with other authors, such as Armijo-Olivo et al.[9], who state that the forward position of the head results in mandible function and positioning disturbances. This outcome would increase the tension in the masticatory muscles and, consequently, cause TMD[10].

Sonnesen et al.[25] observed that TMJ disorder was associated with a marked forward inclination of the upper cervical spine and increased craniocervical angulation. However, this relationship is investigated mainly in adults[26,27,28] and the number of works with children and adolescents is scrace[29-31].

In the detailed analysis of the relationship between degree of TMD and cervical posture, a greater cervical angulation was observed in this study, i.e. a greater *forward leaning* posture of the head in patients with mild and moderate TMD, compared with adolescents with severe TMD. This result could be because in this study, the severe TMD group had a proportionally larger number of individuals with Class III malocclusion, which commonly presents the head and neck in a more backward leaning posture to compensate for the forward protruding mandible[4,32].

The relationship between malocclusions and head posture has been described between features of skeletal class II malocclusions, retruded mandibular position and reduced mandibular length on the sagittal plane and increased cervical lordosis. The head and neck angulation variation in patients with and without TMD problems was associated with malocclusion in the literature[32,33], which was observed in this research, in which the greatest average cervical angulation was observed in the Class II malocclusion group.

There was no difference in posture between the Class I and Class III patients. This data is in accordance with aspects described in the literature, which affirm that patients with Class I occlusion maintain the position of the head in equilibrium while Class II patients alter the position of the head and the shoulders, leaning forward to compensate for the retracted mandibular position, and those with Class III malocclusion position the head backwards or adjust the cervical column[4,7,12,31,34].

The hypothesis of the relationship between malocclusion and cervical posture is that the position of the mandible may influence the muscles, causing the change of the neck and spinal column position.

The postural evaluation in many studies is carried out in the form of a clinical examination[6] and at other times, a cephalometric x-ray is used[27]. This work used photogrammetry, which is a non-invasive method that can quantify the postural alterations without the inconvenience of radiation. The use of software for quantitative evaluation of cervical posture prevents examiner subjectivity.

Thus, it was demonstrated that the study of TMD in adolescents is important for determining, at an early stage, the problems that predispose to abnormalities of craniofacial growth, pain or muscular dysfunction in the adult phase[23]. Bearing in mind the close relationship established by the dental occlusion, oral functions, and head and body posture,

Table 5. Significance between the means for cervical angles in the different occlusal classes.

Occlusal class	Occlusal class	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
I	II	-6.12947(*)	1.12968	p<0.001	-8.7906	-3.4683
	III	-4.02632	1.74929	0.057	-8.1471	.0945
II	III	2.10314	1.69967	0.432	-1.9007	6.1070

* The mean difference is significant at a level of 0.05.

the need arises for establishing a new standard for the evaluation and treatment of patients[21] on the basis of a multidisciplinary approach. Based on the results obtained from the analysis in this study, it can be concluded that there is a relationship among TMD, cervical posture and occlusal class in adolescents, this effect being evident in the participants with Angle Class II.

References

1. Hirsch C, Hoffmann J, Türp JC. Are temporomandibular disorder symptoms and diagnoses associated with pubertal development in adolescents? An epidemiological study J Orofac Orthop. 2012; 73: 6-18.
2. Egermark-Eriksson I, Carlsson GE, Magnusson T. A 20-year longitudinal study of subjective symptoms of temporomandibular disorders from childhood to adulthood. Acta Odontol Scand. 2001; 59: 40-8.
3. Thilander B, Rubio G, Pena L, de Mayorga C. Prevalence of temporomandibular dysfunction and its association with malocclusion in children and adolescents: an epidemiologic study related to specified stages of dental development. Angle Orthod. 2002; 72: 146-54.
4. Ghessa G, Capobianco S, Lai V. Stabilometria e disturbicranio-cervico-mandibolari. Minerva Stomatol. 2002; 51: 167-71.
5. Armijo-Olivo S, Rappoport K, Fuentes J, Gadotti IC, Major PW, Warren S, et al. Head and cervical posture in patients with temporomandibular disorders. J Orofac Pain. 2011, 25: 199-209.
6. Arntsen T, Sonnesen L. Cervical vertebral column morphology related to craniofacial morphology and head posture in preorthodontic children with Class II malocclusion and horizontal maxillary overjet. Am J Orthod Dentofacial Orthop. 2011; 140: 1-7.
7. D'atitilio M, Caputi S, Epifania E, Festa F, Tecco S. Evaluation of cervical posture in skeletal class I, II and III. Cranio. 2005, 23: 219-28.
8. Ferraz-Junior AML, Guimarães JP, Rodrigues MF, Lima RHM. Evaluation of postural changes prevalence in patients with temporomandibular disorders: a therapeutic proposal. Rev Serviço ATM. 2004, 4: 24-32.
9. Armijo-Olivo S, Warren S, Fuentes J, Magee DJ. Clinical relevance vs. statistical significance: Using neck outcomes in patients with temporomandibular disorders as an example. Man Ther. 2011; 16: 563-72.
10. Armijo-Olivo S, Silvestre RA, Fuentes JP, da Costa BR, Major PW, Warren S, et al. Patients with temporomandibular disorders have increased fatigability of the cervical extensor muscles. Clin J Pain. 2012; 28: 55-64.
11. Olivo SA, Fuentes J, Major PW, Warren S, Thie NM, Magee DJ. The association between neck disability and jaw disability. J Oral Rehabil. 2010; 37: 670-9.
12. Manfredini D, Castroflorio T, Perinetti G, Guarda-Nardini L. Dental occlusion, body posture and temporomandibular disorders: where we are now and where we are heading for. J Oral Rehabil. 2012; 39: 463-71.
13. 13.Thilander B, Rubio G, Pena L, de Mayorga C. Prevalence of temporomandibular dysfunction and its association with malocclusion in children and adolescents: an epidemiologic study related to specified stages of dental development. Angle Orthod. 2002; 72: 146-54.
14. Emodi-Perlman A, Eli I, Friedman-Rubin P, Goldsmith C, Reiter S, Winocur E. Bruxism, oral parafunctions, anamnestic and clinical findings of temporomandibular disorders in children. J Oral Rehabil. 2012; 39: 126-35.
15. Helkimo M. Studies on function and dysfunction of the masticatory system III. Analysis of anamnestic and clinical recordings of dysfunction with the aid of indices. Swed Dent J. 1974; 67: 165.
16. He SS, Deng X, Wamalwa P, Chen S Correlation between centric relation; maximum intercuspation discrepancy and temporomandibular joint dysfunction. Acta Odontol Scand. 2010; 68: 368-76.
17. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord. 1992; 6: 301-55.
18. Fonseca DM, Bonfante G, Valle AL, de Freitas SFT. Diagnosis of the craniomandibular disfunction through anamnesis. Rev Gauch de Odontol. 1994; 4:23-32.
19. Costa JR, Pereira SRA, Mitri G, Motta JC, Pignatari SSN, Weckx LLM. Relationship between dental occlusion, the head and cervical spine-position in mouth breathing children. Rev Paul Pediatr. 2005; 23: 88-93.
20. Rocabado M. Biomechanical relationship of the cranial, cervical, and hyoid regions. J Craniomandibular Pract. 1983; 1: 61-6.
21. Solow B, Sandham A. Cranio-cervical posture: a factor in the development and function of the dentofacial structures. Eur J Orthod. 2002; 24: 447-56.
22. Strini PJ, Machado NA, Gorreri MC, Ferreira Ade F, Sousa Gda C, Fernandes Neto AJ. Postural evaluation of patients with temporomandibular disorders under use of occlusal splints. J Appl Oral Sci. 2009; 17: 539-43.
23. Perinetti G, Contardo L, Biasati AS, Perdoni L, Castaldo A. Dental malocclusion and body posture in young subjects: a multiple regression study. Clinics. 2010; 65: 689-95.
24. Conti PB, Sakano E, Ribeiro MA, Schivinski CI, Ribeiro JD. Assessment of the body posture of mouth-breathing children and adolescents. J Pediatr. 2011; 87: 357-63.
25. Sonnesen Bake M, Solow B. Temporomandibiular disorder in relation to craniofacial dimensiones, head posture and bite force in children select for orthodontic treatment. Eur J Orthod. 2001, 23: 179-92.
26. Maluf SA, Moreno BG, Crivello O, Cabral CM, Bortolotti G, Marques AP. Global postural reeducation and static stretching exercises in the treatment of myogenic temporomandibular disorders: a randomized study. J Manipulative Physiol Ther. 2010; 33: 500-7.
27. Olivo SA, Bravo J, Magee DJ, Thie NMR, Flores-Mir R. The association between head and cervical posture and temporomandibular disorders: a systematic review. J.Orofacial Pain. 2006; 20: 9-23.
28. Matheus RA, Ramos-Perez FM, Menezes AV, Ambrosano GM, Haiter-Neto F, Bóscolo FN, et al. The relationship between temporomandibular dysfunction and head and cervical posture. J Appl Oral Sci. 2009; 17: 204-8.
29. Barbosa TS, Miyakoda LS, Poctztaruk RL, Rocha CP, Gavião MBD. Temporomandibular disorders and bruxism in childhood and adolescence: Review of the literature.Int J Pediatr Otorhinolaryngol. 2008, 72: 299-314.
30. Maluf SA, Moreno BG, Crivello O, Cabral CM, Bortolotti G, Marques AP. Global postural reeducation and static stretching exercises in the treatment of myogenic temporomandibular disorders: a randomized study. J Manipulative Physiol Ther. 2010; 33: 500-7.
31. Torii K, Chiwata I. Occlusal adjustment using the bite plate-induced occlusal position as a reference position for temporomandibular disorders: a pilot study. Head Face Med. 2010; 6: 5.
32. Fink M, Wähling K, Stiesch-Scholz M, Tschernitschek H.The functional relationship between the craniomandibular system, cervical spine, and the sacroiliac joint: a preliminary investigation. Cranio. 2003; 21: 202-8.
33. Yamamoto T, Nishigawa K, Bando E, Hosoki M. Effect of different head positions on the jaw closing point during tapping movements. J Oral Rehabil. 2009; 36: 32-8.
34. Chaves TC, de Andrade e Silva TS, Monteiro SA, Watanabe PC, Oliveira AS, Grossi DB. Craniocervical posture and hyoid bone position in children with mild and moderate asthma and mouth breathing. Int J Pediatr Otorhinolaryngol. 2010; 74: 1021-7.