

# EVALUATION OF THE ASSOCIATION BETWEEN TEMPOROMANDIBULAR DISORDER AND VERTICAL DIMENSION OF OCCLUSION IN CHILDREN AND ADOLESCENTS AGED SEVEN TO 12 YEARS

## *Avaliação da relação entre disfunção temporomandibular e dimensão vertical de oclusão em crianças de 7 a 12 anos*

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### ABSTRACT

**Purpose:** to establish the relationship between the presence of temporomandibular disorders and variability of vertical dimension of occlusion aged between 7 and 12 years. **Methods:** it was analyzed 96 children and adolescents of Rogacionista Institute in Sao Paulo, Brazil. The diagnostic investigation of temporomandibular disorders was through Helkimo index and subsequent clinical examination. To measure the data on the vertical dimension were employed distances labial - corner of his eye and nose base - ment. To compare the mean values of anthropometric measurements between genders and the groups with and without TMD, we used analysis of variance (ANOVA) complemented by least significance difference test. **Results:** the vertical dimension of occlusion showed distinct measures in children and adolescents in all age groups studied, significant changes were observed for this measure at ages 10 and 12 years of both genders. **Conclusion:** we can conclude that in this sample there was a direct relationship between TMD and DVO, positive correlation between the measures lip commissure – corner of eye and nasium - mentum in females and significant changes in the vertical dimension of occlusion at the ages of 10 and 12 years for both sexes.

**KEYWORDS:** Temporomandibular Joint; Temporomandibular Joint Disorders; Vertical Dimension; Dental Occlusion; Child

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### ■ INTRODUCTION

Centric occlusion is characterized by maximum intercuspation. When within the pattern of normality, the entire stomatognathic system responds adequately, with muscles, bones and joints functioning correctly<sup>1</sup>. When the proper balance occurs between the positioning of the teeth and the forces of elevation, contraction and resting of the muscles, the temporomandibular joint (TMJ) performs optimally<sup>2,3</sup>.

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The vertical dimension of occlusion (VDO) is the main determinant in the establishment of occlusal and facial balance. A number of studies have demonstrated that any change in VDO can compromise the activity of the hyoid and digastric muscles, predisposing individuals to temporomandibular disorder (TMD)<sup>4-6</sup>. The analysis of VDO is all the more important in the pediatric population, as young patients are in the growth phase, with all joint structures, bone bases and apical bases undergoing development. However, few papers offer clinical protocols or standard measures of VDO for children and adolescents in specific age groups<sup>7-9</sup>.

Geerts<sup>9</sup> measured VDO in children and adolescents using a digital caliper. The author states that this fast, noninvasive, low-cost method offers good reliability and no risk to the patient and is therefore considered the gold standard for this type of measure.

A change in VDO is accompanied by the most varied types of changes in one's bite. Such changes can cause pathogenic muscle and joint development indicative of TMD<sup>4,10,11</sup>. TMD is a term applied to functional abnormalities in the temporomandibular joint and associated structures<sup>1,12,13</sup>. The signs of this disorder are joint noises and limited range of motion or deviation during mandibular function, whereas the symptoms include pain in the pre-auricular region, temporomandibular joint and/or muscles of mastication<sup>5,6,14-16</sup>.

Signs and symptoms of TMD are found in all age groups. However, the prevalence of this disorder is considered low among children and increases with age in adolescence and early adulthood<sup>17,18</sup>. Since the temporomandibular joint undergoes remodeling in adolescence, there is a need for the direct, accurate evaluation of dental conditions, the temporomandibular joint and associated neuromuscular apparatus in this period of life<sup>17</sup>. As TMD can arise at the onset of craniofacial growth, a high percentage of adolescents exhibit signs and symptoms of this disorder<sup>18,19</sup>.

Epidemiological studies have reported an increase in signs and symptoms of TMD in children beginning at six years of age through to adolescence, when the prevalence of this disorder is similar to that found in adults<sup>8,9</sup>. Moreover, characteristics of malocclusion are believed to predispose individuals to signs and symptoms of TMD and are also related to a reduction in VDO<sup>9</sup>.

Considering the numerous factors that may affect the temporomandibular joint, the aim of the present study was to determine a possible association between TMD and variability in VDO among children and adolescents aged seven to 12 years.

## METHODS

The present observational, cross-sectional study was carried out in compliance with the guidelines of Resolution 196/96 of the Brazilian National Board of Health and received approval from the Human Research Ethics Committee of the Universidade Nove de Julho (Brazil) under process number 249781/2009. The parents/guardians of the participants were duly informed regarding the objectives and procedures of the study and agreed to the participation of their child or adolescent by signing a statement of informed consent.

Among the 105 children enrolled at the Rogationist Institute in the city of Sao Paulo (Brazil), 48 fulfilled the eligibility criteria and participated in the study. The inclusion criterion was the presence of four erupted permanent first molars without carious lesions. The exclusion criteria were neurological problems and past or current history of orthodontic or orthopedic treatment of the jaws.

The investigation of TMD was performed using the Helkimo Index, followed by a clinical exam involving an extraoral and intraoral inspection of the teeth and bite, palpation of the trapezius, sternocleidomastoid, temporal, masseter, digastric and medial pterygoid muscles, palpation of the temporomandibular joints and an analysis of mandibular movement with the aid of a digital caliper for measures of maximum mouth opening and lateral movements.

A clinical examination was performed for the measurement of data referring to VDO. For such, the child remained seated under natural light, with the head aligned with the body and gaze fixed on a predetermined point. The following measures were performed during centric occlusion using a digital caliper (Mytutoyo):<sup>20</sup>

- 1 – distance from lip commissure to outer corner of eye (LC – CE);
- 2 – distance from base of nose (nasium) to chin (mentum) (Na – Me).

The data were tabulated and submitted to statistical tests. Descriptive statistics (mean and standard deviation) were used for the characterization of the sample. Analysis of variance (ANOVA) complemented by the least significant difference (LSD) test was used for the comparison of mean anthropometric measures between genders and groups with and without TMD. The level of significance was set to 5%.

## RESULTS

Among the 48 children and adolescents evaluated, 15 (31%) were male and 33 (69%) were female. Mean age was  $9.8 \pm 1.56$  years. The

diagnostic exams revealed what 35 (72.9%) of the participants exhibited TMD and 13 (27.2%) did not have the disorder. Considering all ages, mean LC-CE distance was  $59.30 \pm 4.52$  mm and mean

Na-Me distance was  $61.39 \pm 4.48$  mm. Table 1 displays the descriptive statistics for LC-CE and Na-Me at all ages analyzed.

**Table 1 - Correlation between LC-CE and Na-Me for all ages**

Variable	Mean $\pm$ SD	Minimum	Maximum	Median
Cl - Co	$59.30 \pm 4.52$	47.70	70.20	59.10
Na- Me	$61.39 \pm 4.48$	52.30	70.60	61.30

Analysis of correlation between lip commissure to corner of eye (LC-CE) and nasium to mentum (Na-Me) through Pearson's correlation test (0.47)

Descriptive statistics of LC-CE and Na-Me considering all ages

Stratifying the data by age, the minimum LC-CE distance was 52.30 mm at nine years of age and maximum LC-CE was 70.20 mm at 12 years of age. Minimum Na-Me distance was 56.70 mm at seven

years of age and maximum Na-Me was 68.70 mm at 11 years of age (Table 2). Pearson's correlation was significant (0.47) for the correlation between the LC-CE and Na-Me measures.

**Table 2 - LC-CE and Na-Me measures according to age**

Age	Variable	Mean $\pm$ SD	Minimum	Maximum	Median
7 years	LC-CE	$56.93 \pm 4.28$	56.70	61.40	58.60
	Na-Me	$58.90 \pm 2.36$	56.70	61.40	58.60
8 years	LC-CE	$58.45 \pm 2.64$	56.20	63.50	57.75
	Na-Me	$59.50 \pm 2.98$	56.10	63.50	59.45
9 years	LC-CE	$57.59 \pm 4.83$	47.40	65.20	58.60
	Na-Me	$57.28 \pm 3.64$	52.30	64.70	56.70
10 years	LC-CE	$57.17 \pm 3.94$	49.10	62.70	57.10
	Na-Me	$60.80 \pm 3.79$	54.50	66.30	61.30
11 years	LC-CE	$63.03 \pm 3.74$	56.10	67.00	63.10
	Na-Me	$61.90 \pm 3.56$	57.80	68.70	61.30
12 years	LC-CE	$61.37 \pm 4.54$	52.50	70.20	62.05
	Na-Me	$64.71 \pm 2.40$	59.80	67.60	65.40

Descriptive statistics of measures stratified by age

LC-CE: lip commissure to corner of eye; Na-Me: nasium to mentum

Table 3 displays the results of the comparison of measures using the paired t-test for all ages together and separately. A statistically significant difference between LC-CE and Na-Me was found at 10 years of age. Moreover, the p-value was precisely 0.05 at 12 years of age, which can also be considered statistically significant. No significant differences were found for the other ages.

Stratifying by gender, the correlation between LC-CE and Na-Me was non-significant for the male gender ( $p = 0.60959$ ), but significant for the female gender ( $p = 0.01126$ ) (Table 4).

A statistically significant difference in mean VDO was found between participants with and without TMD in both genders (Table 5).

**Table 3 - Difference between LC-CE and Na-Me for all ages together and separately**

Age	Variable	t	p-value
All ages	LC-CE _Na-Me	-2.60	0.0135
7 years	LC-CE _Na-Me	-0.53	0.6516
8 years	LC-CE _Na-Me	-0.69	0.4642
9 years	LC-CE _Na-Me	0.19	0.8571
10 years	LC-CE _Na-Me	-2.47	0.0390*
11 years	LC-CE _Na-Me	0.73	0.4949
12 years	LC-CE _Na-Me	-2.25	0.0509*

Paired t-test at 5% significance level

LC-CE: lip commissure to corner of eye; Na-Me: nasium to mentum

**Table 4 - Comparison of mean LC-CE and Na-Me according to gender and age**

Gender	Age	LC-CE (mm)	Na-Me (mm)
Female	7	59.2±3.2	56.7±2.0
	8	63.5±2.5	61.4±3.9
	9	57.3±5.1	56.9±3.7
	10	57.0±4.9	60.7±2.9
	11	62.6±3.9	62.3±3.7
	12	62.8±3.9	64.7±2.5
Male	7	55.8±5.4	57.5±3.2
	8	57.4±1.0	60.0±2.0
	9	60.0±2.9	59.1±3.2
	10	57.6±1.4	60.2±2.3
	11	65.8±1.0	61.0±6.0
	12	58.1±5.0	59.3±3.7

ANOVA complemented by LSD test

LC-CE: lip commissure to corner of eye; Na-Me: nasium to mentum

**Table 5 - Mean vertical dimension of occlusion in participants with and without temporomandibular disorder**

	N	Mean	Standard deviation	95% confidence interval		Minimum mm	Maximum Mm
Without TMD	13	61.623	2.7860	59.940	63.307	56.1	65.7
With TMD	35	60.854	4.5072	59.306	62.403	52.0	70.0
Total	48	61.062	4.0984	59.872	62.253	52.0	70.0

ANOVA complemented by LSD test

TMD: temporomandibular disorder

## ■ DISCUSSION

The results of the present study demonstrate different measures of VDO in all age groups analyzed (7 to 12 years). Significantly significant changes in VDO were found in both genders at 10 and 12 years of age, which is likely due to the instability in growth that occurs when the VDO increases

due to the eruption of the permanent premolars and second molars caused by active bone apposition and reposition<sup>21</sup>.

There is no consensus in the literature on the relation of VDO measures in the deciduous and mixed dentition phases<sup>21,22</sup>. In adults, however, this distance should have the same proportion as the LC-CE for facial balance and so that the muscles

can function correctly, thereby avoiding future problems with malocclusion<sup>23,24</sup>.

In the present study, the smallest LC-CE distance was 47.40 mm at nine years of age and the largest was 70.20 mm at 12 years of age, whereas the smallest Na-Me distance was 52.30 mm at seven years of age and the largest was 68.70 mm at 11 years of age. As each 3 mm in change in VDO leads to an approximate change of 0.8 mm in the central relation,<sup>20</sup> it is important to maintain the ideal VDO in accordance with age for a correct central relation, thereby avoiding problems with the occlusion and temporomandibular joint, as such problems can cause changes in the muscles and joints indicative of TMD<sup>3,11,21,22</sup>.

A previous study demonstrated that changes in the bite of more than or less than 2 mm can cause a 50% interincisal increase during intercuspation and a 40% increase in the resting position<sup>23</sup>, which can impair facial esthetics<sup>19</sup>. Deficiencies in VDO can also have a negative impact on facial attractiveness and the development of malocclusions<sup>22</sup>.

A statistically significant association between VDO and age was found in both genders and an association was found with TMD in 35 children (72.91% of the sample). Moreover, children with TMD demonstrated greater variations in VDO in comparison to those without TMD. This variation ranged from 52 to 70 mm in children and adolescents with TMD and 56.1 to 65.70 mm among those without the disorder.

As the temporomandibular joint undergoes constant remodeling in adolescence, high prevalence rates of signs and symptoms of TMD are found in this age group<sup>22,23</sup>. The present data are in agreement with these findings, as 72.91% of the sample exhibited signs and symptoms of TMD. The results underscore the importance of an early diagnosis to impede the progress of the disorder and limit the harm caused to the stomatognathic system. On the other hand, the fact that the temporomandibular joint undergoes constant remodeling in childhood and adolescence may imply that TMD is not related to changes in VDO. A previous longitudinal study involving children treated with orthodontics/orthopedics of the jaws (which sometimes increases the VDO) followed up for a 30-year period concluded that one cannot affirm whether the treatment had a beneficial or harmful effect on the presence of TMD<sup>24</sup>.

The current consensus is that determinant factors of functional changes in the stomatognathic system are those that have a negative impact on the balance among the bite, muscles of mastication and temporomandibular joint and that TMD

may be caused by occlusal macro-traumas and micro-traumas that affect chewing function and cause functional asymmetry of the stomatognathic system<sup>9,25,26</sup>. A number of studies have demonstrated that there is no standardized method for the detection of TMD. One should also bear in mind that individual variation is an important factor to the development of TMD. In a recent systematic review involving 37 papers, the craniomandibular index was used in one paper, the Research Diagnostic Criteria for Temporomandibular Disorders was used in nine, a clinical patient-history protocol was used in 21 papers and Helkimo disorder index was used in six papers<sup>27</sup>.

TMD is a multifactor disorder with a psychogenic influence that affects quality of life<sup>27</sup> and increases with age in adolescence and young adulthood<sup>28</sup>. In a recent study, Pereira et al.<sup>29</sup> evaluated risks for the development of TMD in adolescents and concluded that the gestational behavior of the mother, malocclusion, menarche and harmful oral habits were not associated with TMD and that gender alone was correlated with the incidence of TMD in 12-year-old patients.

Another study concluded that it is not possible to establish an association between TMD and orthodontic treatment, as occlusion may not be the main factor in the development of the disorder. In contrast, Laucis-Pinto<sup>30</sup> and Bevilacqua<sup>31</sup> state that occlusion is indeed one of the etiological agents of TMD. In the present study, 12-year-old patients exhibited a statistically significant change in the difference between LC-CE and Na-Me measures, demonstrating a positive correlation between TMD and VDO in this age group.

For an effective diagnosis of TMD, it is important to evaluate all variables capable of influencing the harmony of the stomatognathic system, including the variability in VDO, to prevent this disorder and allow craniofacial growth and development within the patterns of normality. Further studies with a larger number of individuals in each age group are needed to establish the actual mean VDO in children and adolescent during craniofacial development.

## ■ CONCLUSION

In the present study, a direct association was found between TMD and VDO, with positive correlations between the lip commissure to outer corner of eye and the nasium to mentum in the female sex as well as significant changes in the vertical dimension of occlusion at 10 and 12 years of age in both genders.

**RESUMO**

**Objetivo:** verificar se existe relação entre a presença de disfunção temporomandibular (DTM) relacionada à variabilidade da dimensão vertical de oclusão em crianças e adolescentes na faixa etária de 7 a 12 anos. **Métodos:** foram avaliadas 96 crianças e adolescentes do Instituto Rogacionista em São Paulo. A pesquisa diagnóstica da disfunção temporomandibular foi por meio do Índice de Helkimo e exame clínico posterior. Para a mensuração dos dados referentes à dimensão vertical foram empregadas as distâncias comissura labial - canto externo do olho e base do nariz – mento. A comparação dos valores médios das medidas antropométricas entre os gêneros e os grupos com e sem disfunção temporomandibular foi realizada empregando-se a análise de variância (ANOVA) complementada pelo teste least significance difference. **Resultados:** a dimensão vertical de oclusão demonstrou medidas distintas nas crianças e adolescentes em todas as faixas etárias avaliadas, foram observadas alterações significantes dessa medida nas idades de 10 e 12 anos de ambos os gêneros. **Conclusão:** pode -se concluir que na amostra estudada houve relação direta entre a presença de DTM e Dimensão vertical de oclusão (DVO), correlação positiva entre as medidas comissura labial – canto do olho externo e Násio – Mento no sexo feminino e alterações significantes na dimensão vertical de oclusão nas idades de 10 e 12 anos para ambos os sexos.

**DESCRITORES:** Articulação Temporomandibular; Transtornos da Articulação Temporomandibular ; Dimensão Vertical; Oclusão Dentária; Criança

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