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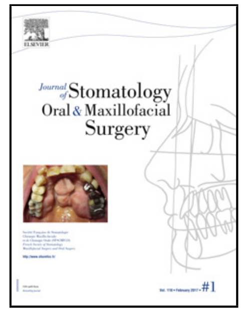

The Study of Facial Morphology in Patient with Vertical Growth Pattern (Hyperdivergent) Lacking or Showing TMD Symptoms

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The Study of Facial Morphology in Patients with Vertical Growth Pattern (Hyperdivergent) Lacking or Showing Temporomandibular disorders Symptoms

Abstract

Aim : According to the large number of studies, there seems to be a significant relation between hyperdivergence growth pattern and temporomandibular disorders. However, it is not clearly scrutinized which morphological factors can contribute to the development of temporomandibular disorders.The aim of this study was to investigate the relation between some skeletal and facial morphologic features of hyperdivergent facial growth pattern patients and temporomandibular disorders.

Materials and Methods : This case-control study was performed on a population of 50 patients including 25 patients with temporomandibular disorder and 25 non- temporomandibular disorder individuals aged between 15-30 years with hyperdivergent growth pattern (Frankfurt Mandibualr plane angle between 28 and 35 degree).Two groups of symptomatic and asymptomatic patients (case and control) were matched for age and gender. In order to evaluate the skeletal and dental variables, lateral cephalometries was taken and traced after obtaining written consent from the patients. The measured variables were A point to Nasion to B point ,Frankfurt plane to Nasion to Pogonion, Nasion to A point to Pogonion, Sella to Gnathion to Frankfurt plan, Articular point to Gonion-Menton, Sella to Articular point to Gonion, Palatal plane to Mandibular plane, and Articular point to Gonion angles. the intervals of Basion to Nasion, Sella to Basion, Gonion to Menton, and amounts of Anterior facial height meas, Upper Anterior facial height ratio to Lower Anterior facial height, posterior facial height, overjet, and overbite Data were analyzed by Chi-square test , t-test, and multivariate test.

Results : According to the descriptive statistics, the age of the control and case groups averaged 21.12 ± 1.99 and 21.63 ± 1.58 years respectively . Among the people referred to the dental school, the frequency of males and females in the control and case groups were 6, 7 and 19, 18 respectively. The results of t-test and multivariate tests indicated significant differences between the two variables of overbite and mandibular length.

Conclusion : The present study revealed increased overbite (dental feature) and mandibular length (skeletal feature) is more likely to be associated with a higher risk of temporomandibular disorders joint disease in patients with hyperdivergent facial growth pattern.

Clinical significance: Treatment of the deep bite condition can be helpful in improving temporomandibular disorder.

KeyWords : Hyperdivergence ; Temporomandibular disorders ; Lateral Cephalometry

Introduction

Temporomandibular disorders (TMD) include conditions that affect the masticatory muscles, temporomandibular joint (TMJ) and the related structures. Following the common treatments for oral and dental disease, functional disorders of masticatory muscles are one of the most commonly reported complaints of patients which include painful masticatory muscles, headache and inappropriate muscle function that appear as restricted range of mandibular movements. Functional disorders of TMJ are classified in three categories: derangements of the condyle-disc complex, structural incompatibility of articular surfaces and joint inflammatory disorders.

The main symptoms of the joint functional problems include pain at any part of the articular structure, called arthralgia and inappropriate joint function that manifests itself as a loss of normal kinetic-disk movement leading to joint sounds.(1) Such disturbances develop owing to a series of parameters and risk factors such as psychological factors, trauma, hyperactivity (parafunction habits), etc. (2)

Although there was a controversy over the years about the role of occlusal features as the causative agent or the risk factor of TMJ disorders, there is now a consensus on a weak link between mandibular and dental occlusion interrelations.(3) Various studies have shown that there is a relation between Class II skeletal growth pattern and hyperdivergence with TMD problems .(3-5) Manfredini et al. demonstrated a relation between the skeletal Class II profile and the hyperdivergence facial growth pattern (HPG) with increased TMJ displacement and degenerative joint disease in a systematic evaluation .(3) Correlations have been also shown between a group of morphological characteristics such as low ramus height, a significant increase in ANS-Me angle with the midsagittal plane, palatal tilt of maxillary incisors and TMJ disease in literature .(4-6)

Despite all information obtained from the studies that confirmed associations between a specific pattern of skeletal development and the joint disorders, the results of some studies indicate no significant relation between a variety of malocclusions and such disorders .(7,8) Mohlin et al., for instance, reviewed related literature published from 1966 to 2003 and concluded that most studies failed to demonstrate a clear relation between a particular type of malocclusion and TMD.(7) Khademi et al. examined a population of 265 people aged 15-62 years in terms of TMD symptoms and various types of malocclusion. They concluded that there were no significant relationship between the above variables and TMD. (8)

Finally, according to the large number of such studies, there seems to be a significant relation between hyperdivergence and TMD. (3-5) However, it is not clearly scrutinized which morphological factors can contribute to the development of TMD.

Therefore, the aim of this study was to find some risk factors for the development of TMD in hyperdivergent people.

Materials and methods

This cross-sectional, case-control study was approved by the Ethics Committee of Hamedan University of Medical Sciences with an ethics code of IR.UMSHA.REC.1395. A sample size of 50 people (25 in the control group and 25 in the TMD group) was estimated with 95% power. The study group aged between 15 and 30 years old and it was characterized by having hyperdivergence facial growth pattern (HPG). The HPG benchmark was FMA (the angle between the Frankfurt plane and the lower jaw plane) ranging between 28-35 degrees. (9) The inclusion criteria were people with TMD referred to the dental school showing the following clinical symptoms:

- Pain in the masticatory muscles and the TMJ during function or touch.
- Reduced range of mandibular movement (maximum mouth opening < 40 mm)

Subjects in the control group (without TMD) were selected from the patients with HPG referred to the orthodontic department.

Exclusion criteria were individuals with syndromic asymmetry, any history of jaw and facial injuries, degenerative diseases widely involving multiple joints, congenital conditions associated with TMD joint and other systemic diseases.

The two groups of symptomatic and asymptomatic patients (case and control) were matched for age and gender.
To evaluate the skeletal and dental variables, lateral cephalometries were taken from all patients after obtaining written satisfaction. lateral cephalometries was traced to determine the variables listed in Table 1. All measured variables divided into three groups include: horizontal relationship, vertical relationship and dental relationship.
All statistical operations were carried out using SPSS 16 software considering TypeI error of 0.05. Descriptive reports were prepared by means of statistical tables and charts according to the type, scale, and processing by comparison of independent groups based on independent t-test. Multivariate tests were used to compare the vector of average multi-variable responses in both the asymptomatic and symptomatic patients. If the results of multivariate tests indicated a significant difference between the mean vectors in the two groups, independent t-test with two samples was employed to determine the variable(s) causing differences in the two groups.

Results

In this study, chi-square and t-test were used to match confounding variables such as age and gender. The individuals who showed the sign of temporomandibular disorder, considered as a case group and those who did not as a control. The mean ages of patients in the control and case groups were 21.12 ± 1.99 and 21.63 ± 1.58 years respectively with no significant differences between the two groups of symptomatic and asymptomatic patients. Also, gender distribution (male and female) showed no significant relation in the two groups (Table2).
Based on the results of descriptive statistics, both the case and control groups had Class II skeletal growth pattern (ANB case=5.06± 2.68, ANB control=5.35±2.77). Mean of all variables were measured on lateral cephalometries shows in table 3.
The results of multivariate analysis showed that the overbite variable caused a significant difference in the vector of means. In general, the vector of means for overbite variable according to overjet variable was statistically different in both symptomatic and asymptomatic patients. The results of multivariate analysis indicated that the two groups were significantly different in terms of vector of horizontal relationship variables resulting from the presence of mandibular length variable and, to some extent, due to the variable of Y-axis. The results of multivariate test showed no significant differences in the vector of vertical relationship variables in both the TMD and asymptomatic patients (Table 4).
T-test results also confirmed the results of previous analyses showing that, among all the parameters examined, there were significant differences between the case and control groups in two variables of overbite (p-value = 0.0007) and mandibular length (p-value = 0.046).Figure 1

Discussion

The present study was conducted based on an organized review research on temporomandibular disorder and skeletal structure.[3] Various studies have shown that several factors affect the facial structure of patients, namely congenital malformations, uncontrollable hormonal levels, arthritis, insufficient condyle growth, destructive respiratory habits, traumas, infection, pressure and other factors changing the adaptive capacity during the growth period resulting in facial restructuring.[10-19]

Stegenga reported that degenerative changes of articular cartilage alter its physical properties and increased friction between the articular surfaces and it is related to some of the common sign and symptoms of craniomandibular dysfunction such as clicking, locking, pain and tenderness. [11] Septic arthritis of the TMJ may lead to complications such as post infectious bony changes and fibrous or bony ankylosis of the TMJ. [17]

Evaluation of lateral cephalometries of the number of males and females shows an association between internal derangement and craniofacial morphology, for example there was a positive association between SN/Go-Me and the dependent variables, this indicates an increase in the mandibular plane angle with increased severity of internal derangement. [18-19]

The findings of this study showed that TMD was related to horizontal (mandibular length) and dental (overbite) relationships.

Based on the findings of the present study, among the population referred to the dental school for examination and treatment, the frequencies of males in the case group were seven individuals, and those of females 18 individuals. This finding can confirm that the prevalence of TMD is greater in females than in males, which is consistent with the results of other studies. [28]

Various studies examined facial structures in patients with TMD using lateral cephalogram technique, including Brand et al. [20], Nebbe et al. [10, 21-22], Simmons et al. [23], Sonnesen and Svensson [24], Ciancaglini et al. [25], Dibbets and van der Weele [26], and Sonnesen et al. [27]. The majority of them focused on the association of TMD and Class II patients. For instance, Almasan and Manfredini [3,28] confirmed a significant association for these two parameters. Similarly, the findings of this study showed that TMD was related to horizontal and dental relationships. The participants in the present study had Class II mandibular relation which can be explained by the lack of anterior guidance due to increased overjet in subjects with Class II skeletal growth pattern and exerting a high pressure on the TMD joint area.

Also, there are number of studies with different results such as Alamoudi's.He studied the relationship between occlusal factors and TMD disorders and found significant associations between Class III cuspid relation with TMD. [37] In a study by Gidarakou et al., symptomatic TMD patients had larger facial plane and convex angles that indicated a retarded mandibular position. Their results indicated a probable relation between skeletal structure and irreversible reciprocal displacement of the disk. [38-39] In the study of Bastos et al. the mean values of SNA and SNB angle decreased in the case group and the axis angle (SN.Gn) increased compared to the control group, which were statistically significant. [35] Bakke stated that despite a lot of discussion about the role of occlusion in the development of TMD, there are no definite results concerning the nature of dependent variables impacts on musculoskeletal function. [36]

Several studies have shown correlations between TMD and facial growth pattern in adults, children, and adolescents.[10,21-22,29-32] Thus, it is important to understand the underlying causes and the type of facial structure before applying any treatment on the patients.

Overall, our results indicated that overbite variable was significantly different between the two groups of symptomatic and asymptomatic patients. Almăşan [28] and Thilander [34] demonstrated associations between TMJ disorders and increased and/or decreased levels of overbite in their studies. Thilander showed that TMD was significantly associated with posterior cross bite, anterior open bite, angle Class III malocclusion, and extreme maxillary overjet [34] and Alamoudi found significant associations between posterior crossbite, interstitial, tip-to-tip occlusion and anterior

crossbite relation with TMD. [37] Gidarakou et al found that smaller SNB angle, higher overjet, steeper mandibular plane, more vertical Y-axis (S-GntoFH), shorter ramus height and increased angle between the mandibular and palatal planes were observed in the symptomatic group. [38-39]
The effect of increased overbite on TMD development can be due to the excessive locking of the incisors in one another, mandibular movement and consequently backward condyle displacement resulting in pressure on the bilaminar zone, which is an area full of vessels and nerves. The pressure on this part results in pain, discomfort and joint problems. Also, the presence of a large incisor guide leads to faster detachment of the posterior teeth during jaw movements. In this case, the lower jaw acts like a Type III lever, the anterior teeth play as the resilient arm, the muscles act as moving arm, and the condyle behaves as a bolster which exert destructive forces on the condyle.
The results of multivariate tests showed no significant differences in horizontal relation variables in both symptomatic and asymptomatic TMD patients. In addition, the two groups had statistically significant differences in terms of vertical skeletal correlation variables based on the multivariate analysis. This difference was due to the presence of mandibular length variable and partially because of the Y-axis variable, which is consistent with the results of Bastos et al. [35] The high mandibular length in the case group might have exerted more leverage on the condyle, which along with the vertical pattern of the mandibular plane, increased the probability of TMD development.

Conclusion

The result of this study reveals that increased overbite and longer mandibular length are possibly associated with a higher risk of TMJ disease in patients with vertical and Class II growth patterns. Such patients, therefore, should be examined with a specific sensitivity in terms of TMD problem.

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Tables

Table 1. Measured variables in two groups and their definition

	Row	Variable	Definition
1	horizontal relationship	ANB angle	Obtained from the difference between the angles of SNA and SNB showing the difference between the jaws with each other.
2		Na-A-Pog angle	An angle of convexity (convection angle) is obtained from the connection of the nazion-A-pogonion points.
3		SGn-FH angle (Y axis)	The angle between SGn and Frankfort plane; high values indicate vertical growth pattern and low values show horizontal growth pattern.
4		Go-Me	The distance between the gonion-menton joint showing the mandibular length
5		FH-NaPog Angle	The face angle is the internal angle of the face plane (N-Pog) and the Frankfort plane (FH) indicating the posterior or anterior mandible.
6	vertical relationship	Mp-FH angle	The angle between the Frankfort plane and mandibular plane, the mean normodivergent of which is 28 according to the Tweed analysis.
7		Ar-Go-Me angle	Formed by articular-gonion and menton connection. High values indicate upward and backward rotations of the mandible and low values represent upward and forward mandibular rotations.
8		S-Ar-Go angle	The articular angle is created by the connection between articular and gonional points indicating the position of mandible.
9		PP-Mp angle	The angle between the maxillary plane and mandibular representing HPG with a normal value of 25.
10		Ar-Go	Articular-GO joint representing ramus length.

11		Ba-Na	The distance between the N-Ba joint denoting the total length of the skull base.
12		S-Ba	The distance between S-Ba joint indicating the length of the posterior skull base.
13		AFH	Anterior facial height measured from N to Me points.
14		PFH	The posterior facial elevation obtained from connecting the Ar-Go points
15		UAFH/LAFH	This is obtained by dividing the above values by a normal value of about 65%. The higher values represent vertical growth pattern and the lower values indicate horizontal growth pattern of the face.
16	dental relationship	Overjet	Clinical examination; the horizontal overlap of the upper and lower central incisors with a normal value of 2 mm.
17		Overbite	Vertical overlap of upper and lower central incisors with normal values of 1-2 mm.

Table 2: Comparison of gender distribution in two groups with chi square test

Variable		Case group		Control		P-value
		Frequency	**%**	**Frequency**	**%**	
Gender	Male	7	28	6	24	0.747
	Female	18	72	19	76	
	Total	25	100	25	100	

Table 3. descriptive statistics of lateral cephalometric measurements in the case and control groups (Compared with T – test).

Variable	Mean (control group)	Mean (case group)	P – value
ANB.angle	5.35±2.77	5.06± 2.68	0.707
Facial Angle	3.95±82.28	82.70±3.66	0.676
Na.A.Pog.angle	11.74±7.44	8.63±3.76	0.119
Mandibular Plan	31.47 ± 3.21	31.86±2.75	0.693
Y axis	61.82±4.49	81.63± 2.75	0.064
Gonial Angle	130.25 ± 7.21	128.17± 4.38	0.244
Articular Angle	137.42±8.49	139.70±5.14	0.256
PP.Mp.angle	32.05±3.89	31.56±4.77	0.689
Ramus Height	48.28±4.74	45.86±5.51	0.103
Cranial Base	100.53±7.1	99.99 ± 6.7	
post. Cranial Base	32.53±2.9	32.51 ± 3.28	
Mandibular Length	67.44±4.02	70.12±5.2	0.046
AFH	115.3±7.79	117.93±7.52	0.229
UAFHlLAFH	0.78±0.08	0.76 ± 0.1	0.607
PFH	75.26±5.78	75.54±8555.85	0.869
Overjet	5±1.63	4.64± 1.74	0.454
Overbite	1.75±1.96	3.16±1.57	0.007

Table 4. Multivariate test for dental, horizontal and vertical relationships (tests of between-subject effects)

	Source of variation		F	p_value
Dental Relationship	Constant	Overjet	408.422	
		Overbite	95.694	
	Group	Overjet	0.570	0.454
		Overbite	7.952	0.007
Vertical relationship	Constant	Mandibular Plan	4108.351	
		PP.Mp.angle	2669.719	
		Gonial Angle	23495.196	
		Articular Angle	19458.472	
		Ramus Height	4149.033	
		AFH	11601.344	
		PFH	8398.501	
		UAFHlLAFH	19458.051	
	Group	Mandibular Plan	0.157	0.693
		PP.Mp.angle	0.162	0.689
		Gonial Angle	1.516	0.244
		Articular Angle	1.322	0.256
		Ramus Height	2.762	0.103
		AFH	1.482	0.229
		PFH	0.030	0.869
		UAFHlLAFH	0.267	0.607
Horizontl relationship	Constant	ANB.angle	181.746	
		Na.A.Pog.angle	107.916	
		Facial Angle	27272.460	
		Mandibular Length	10946.622	

		Y axis	14240.304	
	Group	ANB.angle	0.143	0.707
		Na.A.Pog.angle	2.519	0.119
		Facial Angle	0.177	0.676
		Mandibular Length	4.180	0.046
		Y axis	3.581	0.064

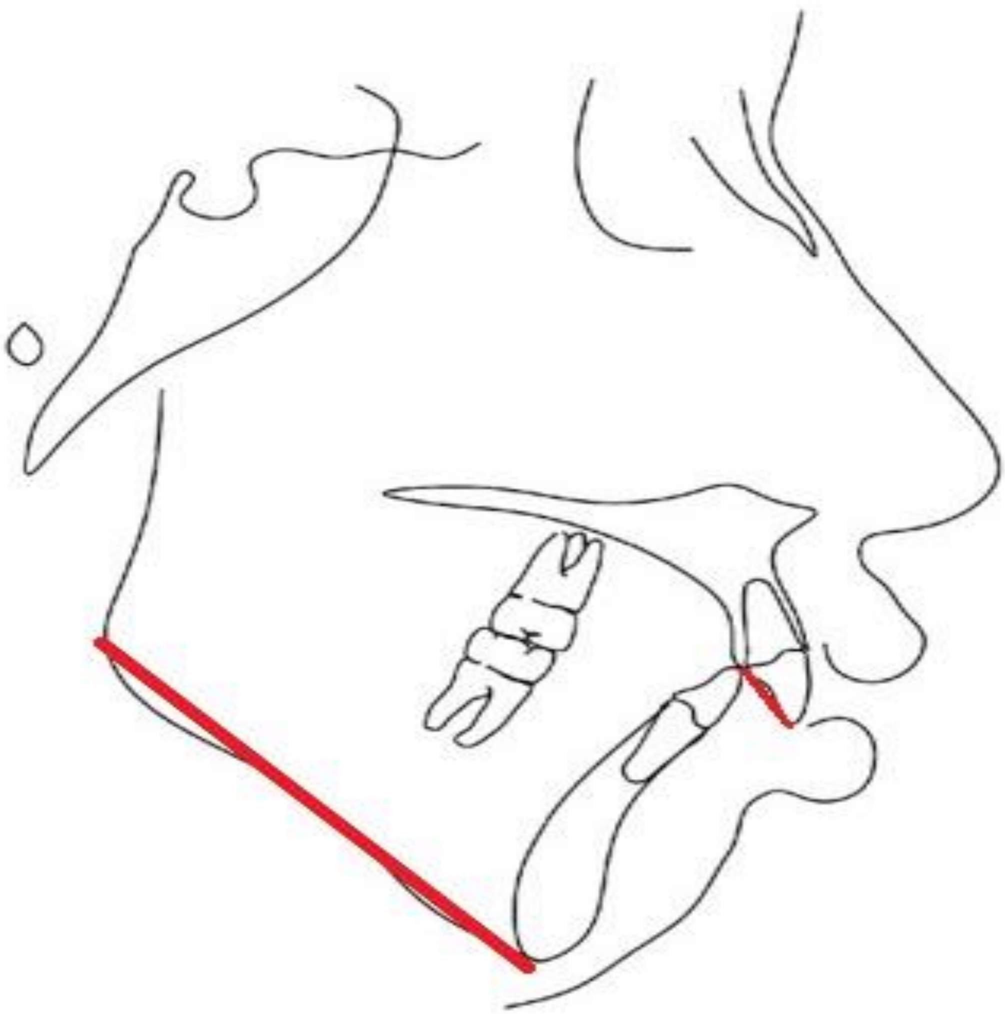

Figure 1 - Schematic view of variables with significant association with TMD