COMPARISON OF CONDYLAR TRANSLATION IN HYPERDIVERGENT AND HYPODIVERGENT PATIENTS: A PILOT STUDY

ABSTRACT

INTRODUCTION: the present pilot study aims to compare the condylar translation between patients with hyperdivergent and hypodivergent facial pattern. **METHODS:** after analysis of photographs and cephalometric data, sample obtained was divided into two groups: hyperdivergent (n = 12) and hypodivergent (n = 12). For evaluation of condylar translation, temporomandibular joint planigraphys with maximum mouth opening and maximum intercuspal were performed. Subsequently, the tracing of maximum mouth opening in the articulation of each planigraphy was carried out. Metric values were obtained from the measurement of the distance between the point in the lower region of the articular eminence and the point in the most anterior superior mandibular condyle. **RESULTS:** no statistically significant differences were found between the groups compared. However, the values obtained for horizontal translation performed by the right mandibular condyle were 6.00 mm for the hyperdivergent group, and 3.25 mm in the hypodivergent group. For condyle on the opposite side the horizontal translation averages were 5.66 mm for the hyperdivergent group, and of 4.50 mm for the hypodivergent group. **CONCLUSIONS:** the divergence between the means suggests that hyperdivergent patients show higher condylar translation in both condyles when compared with hypodivergent patients. Further studies should be conducted aiming to elucidate the relationship among facial pattern, cortical thickness condylar and condylar translation.

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KEYWORDS

Mandibular Condyle. Temporomandibular Joint. Maxillofacial Development.

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INTRODUCTION

The biomechanics of temporomandibular joint (TMJ) is the key for the functions of stomatognathic system. The TMJ has to work well for the opening, closing, retrusion, protusion and lateral mandibular movements. However, the mandibular condyle may be hypermobile during excursion and take a position beyond the limit of the articular eminence (condylar hypertranslation). This may weaken intra- and extracapsular tissues due to the mechanical overload applied to the temporomandibular joint.[1,2]

Clinically, TMJ hypermobility is a forward sudden movement in the condyle during the last stage of maximum opening, leaving a depression behind. As the condyle moves beyond the crest of the articular eminence, it apparently jumps forward to a position in greater opening. The side pole can be observed during this movement[3]. Although non pathological condition, condylar hypermobility may be associated with muscle and joint diseases of TMJ and may play an important role in the etiology of temporomandibular disorders (TMD), usually associated with generalized articular hypermobility.[4,5]

The morphological analysis of the face is the main diagnostic resource to determine facial pattern.[6] Hypodivergent and hyperdivergent patterns are vertical discrepancies that correspond to the extrapolation of normal variation on the frontal view of face.[7] In the 1970s, earlier studies were conducted about the association between the height of articular eminence and facial morphology. Ingervall,[8] in 1974, found that patients, both children and adults with horizontal facial growth pattern (hypodivergent), presented higher articular eminence, in contrast with individuals with vertical facial growth pattern (hyperdivergent), who has shorter articular eminence.

According to a logical analysis, the short articular eminence as a result of anatomic factors may favor condylar hypermobility. Following this reasoning, hyperdivergent individuals should also be more hypermobile.

According to current studies in the literature, the influence of facial growth pattern on the translation of mandibular condyle remains obscure. The elucidation of such mechanism could contribute to understand the etiology of joint hypermobility and associated conditions. Considering these aspects, the present pilot study aims to compare the condylar translation among patients with facial pattern and hyperdivergent hypodivergent.

MATERIAL AND METHODS

This study was approved by the Ethics Committee for Research with Human Beings of Unicesumar, under the number 190/2011. All the patients participated voluntarily in the study. First, all the participants received information about the study purposes and then signed an informed consent term. Then the files of 400 patients were evaluated.

For classification and evaluation according to facial patterns, first frontal and profile photographs were analyzed subjectively according to facial characteristics by an examiner, an experienced orthodontist and following the standards described by Capelloza Filho[6]. Patients were classified as hyperdivergent when they presented the following criteria: (1) lower third of the face larger than the mid third; (2) short chin-neck line and acute chin-neck angle; (3) no passive lip sealing; and (4) excessive maxillary incisor exposure with lips at rest; hypodivergent patients presented the following criteria: (1) lower third of the face smaller than expected for mid third; (2) long chin-neck line and obtuse chin-neck angle; (3) passive lip sealing; and (4) little maxillary incisor exposure at rest and when smiling.

After subjective evaluations, a cephalometric analysis was carried out by the same examiner using lateral radiographs found in orthodontic files of each patient. Considering the literature, the FMA angle was used to divide patients into two groups: patients were classified as hyperdivergent when the angle as greater than 29 degrees, and hypodivergent when the values were below 21 degrees. These angles corresponded to higher values than ±1 SD of the norm established by Tweed.[9]

Exclusion criteria were: temporomandibular joint or muscle disorder, neuropathic orofacial pain, orthognathic surgery and third molar extraction less than six months earlier.

After subjective and cephalometric analysis, a sample of 24 patients was divided into two groups:

- Group I: 12 hyperdivergent patients.
- Group II: 12 hypodivergent patients.

In order to evaluate condylar translation according to the position taken by the condyle in relation to the articular eminence during maximal mouth opening, plain radiographs of TMJ at maximal mouth opening and maximal intercuspation were obtained (Fig. 1). Radiographs were taken by the same operator using a Siemens Orthophos XG plus unit.

Then, a second calibrated examiner, who had access only to the plain radiographs and did not know the facial pattern of patients, traced the images of the right and left joints at maximal mouth opening on each planigraphy, using a lead pencil (Tecnosis, 0.5 mm) and 40-micron thick, 60-g/m^2 A4 paper (Canson) in the form of planigraphys, and fixed on them using three 5-cm pieces of adhesive tape, one vertically placed in the left region and two horizontally placed in the superior region.

Tracings were performed according to the parameters described by Obwegeser et al.[10] for transcranial radiographs, which define two points using a vertical line that crosses the most superior point of glenoid fossa (point C) and another point in the most inferior region of the articular eminence (point A), and by tracing a horizontal line parallel to the Frankfurt plane. In addition, the examiner also included the mandibular condyle outline and its most upper superior point (point B) (Fig. 2). This last point was obtained by geometric devices, the result of intersection bisector between an imaginary vertical line in the most anterior point and an imaginary horizontal line at the top level of the mandibular condyle.

Values were defined by measuring the distance from the point B to the point A using a digital caliper rule and an X-ray light box, what demonstrates the horizontal translation of the mandibular condyle in relation to the articular eminence (Fig. 3).

The comparison between the two groups, on both sides, was performed by the one-way test ANOVA, carried out using 95% simultaneous level of confidence. The horizontal translation performed by the right mandibular condyle of each group were represented by R-H (mm) in millimeters, and L-H (mm) a horizontal translation performed by the left mandibular condyle in both groups, also in millimeters.

RESULTS

In hyperdivergent group of patients (group I), 58% were male and 42% female, and the mean age was 25.42 years; the mean FMA angle was 36.33 degrees. In hypodivergent group of patients (group II), 50% were male and 50% were female, and the mean age was 25.17 years. In this group, the mean FMA angle was 17.08 degrees.

The mean values of R-H(mm) were 6.00 mm in group I and 3.25 mm in group II (Table 1). However, this comparison between groups did not reveal any statistically significant difference ($p > 0.05$) (Table 2).

On the opposite side, the average amounts measured translational L-H (mm) were 5.66 mm for group I and 4.50 mm in group II (Table 3). There were no statistically significant differences in this comparison ($p > 0.05$) (Table 4).

Figure 1. Planigraphy Temporomandibular joint.

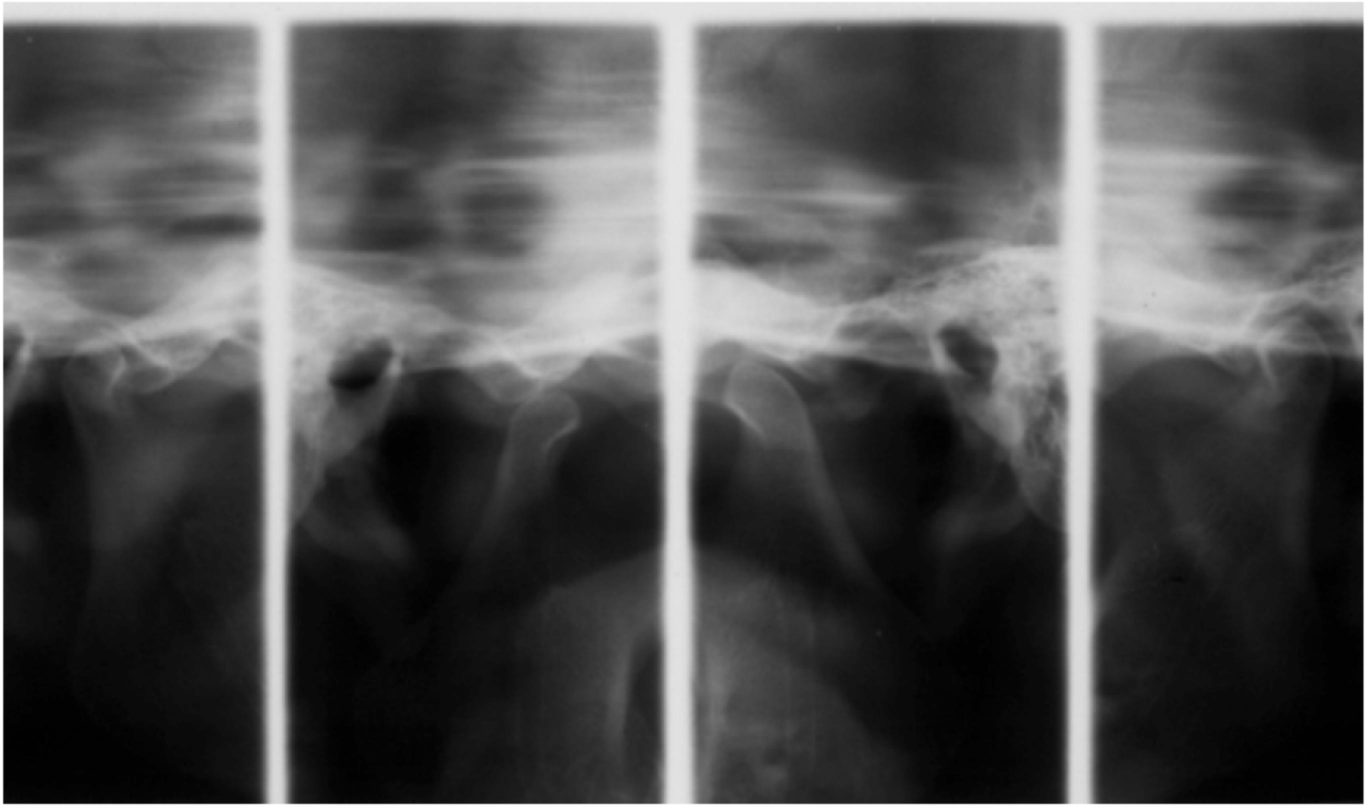


Figure 2. Tracing.

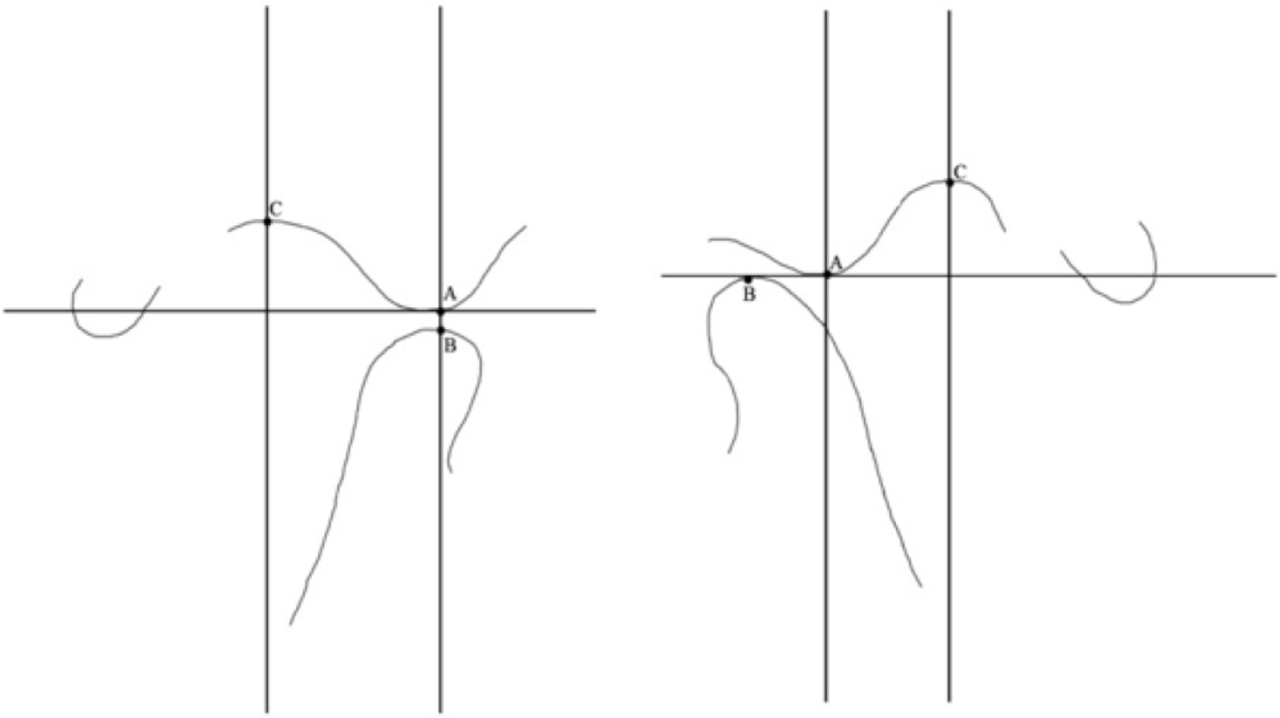
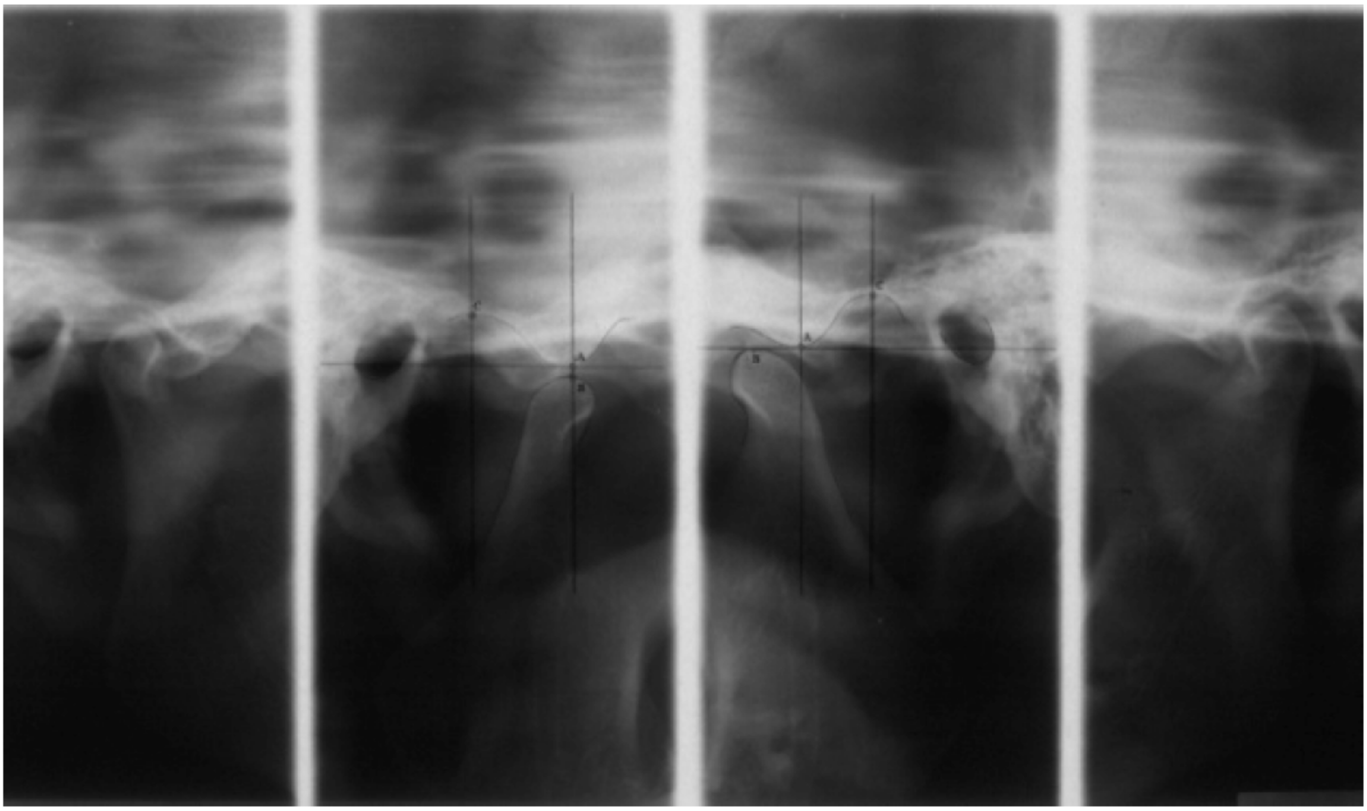


Figure 3. Tracings to evaluate condylar translation.



DISCUSSION

The pilot study is an effective way to validate the line of research. Besides allowing to test, revise and improve the instruments of methodology, enables to predict the results of future studies and to direct work strategies to optimize the knowledge.[11]

The literature is frequent in relating condylar hypertranslation with the signs and symptoms of TMD[12,13], besides using radiographic analyzes in which hypermobility was ordinally categorized and evaluated on nonparametric and even subjective[10, 12, 13, 14]. In the methodology employed in this study, we chose to compose the sample without the presence of TMD, and then such factors do not interfere in the search. It was also prioritized an objective and parametric measurement on the condylar excursion in order to optimize the reliability and reproducibility of test results.

In many studies correlating facial morphology and functionality of TMJ[8,15,16] lateral radiographs were used, which precluded an adequate assessment of condylar excursion. In other ones [10,12,13], transcranial radiographs was employed; however, they have large overlap of condylar portions and other anatomical structures[17], besides they show a sensitive radiographic positioning and long exposure time which can facilitate the movement of the patient during radiographic outlet. In order to overcome these points, the analysis of condylar translation in this work was performed through TMJ planigraphys because they show less overlap images regarding transcranial[17], in addition, they are practical examination, less expensive, easily standardized of radiographic technique[18] and constitute an important clinical help in diagnosis and monitoring of joint conditions when correctly interpreted.

Table 1 . Mean of mandibular condyle translation - right TMJ.

Group	N	Mean	StDev
I	12	6.00	4.93
II	12	3.25	3.16
Pooled StDev = 4.14			

I: hyperdivergent; II: hypodivergent; n: number of individuals in the sample; StDev: Standard deviation.

Table 2. Right TMJ. One-way ANOVA. Comparison between groups.

Source	df	SS	MS	F	p
Between Groups	1	45.4	45.4	2.64	0.119
Within Groups	22	378.3	17.2		
Total	23	423.6			
Pooled StDev = 4.14					

df: number of groups; SS: sum of squares; MS: variance; F: reason of variances; p: p- vaule.

Table 3. Mean of mandibular condyle translation - left TMJ.

Group	N	Mean	StDev
1	12	5.66	4.716
2	12	4.50	4.123
Pooled StDev = 4.43			

I: hyperdivergent; II: hypodivergent; n: number of individuals in the sample; StDev: Standard deviation.

Table 4. Left TMJ. One-way ANOVA. Comparison between groups.

Source	df	SS	MS	F	p
Between Groups	1	8,2	8,2	0,42	0,526
Within Groups	22	431,7	19,6		
Total	23	439,8			

Pooled StDev = 4.43

df: number of groups; SS: sum of squares; MS: variance; F: reason of variances; p: p- vaule.

There were similar gender distribution and the mean age in the composition of groups; group I (58% male, 42% female, 25.42 years) and group II (50% male, 50% female, 25.17 years). However, these variables were not considered in this work, because Ingervall[8], in his study on the relationship between condylar inclination, the articular eminence height and facial morphology with 116 children and 58 adults in various facial patterns, found no significant differences when compared between genders and varying ages. Both men and women, children and adults had the same line of characteristics within a given facial type.

According Okeson[19] in 1992, morphological peculiarities of the condyle and the fossa may favor the broad movement of the condyle during mouth opening. The hypodivergent individuals exhibit higher articular eminence[8], higher and more voluminous mandibular condyle[20]. While hyperdivergent individuals have a lower articular eminence, a lower and less bulky mandibular condyle mandibular branch[21] present an anatomical trend for a greater condylar translation.

In this study, the horizontal translation mean performed by the right mandibular condyle was 6.00 mm for the group I, and 3.25 mm in the group II. On the contralateral side, the horizontal translation average performed by the left mandibular condyle for the group I was and 5.66mm, and 4.50 mm for the group II. Because both translation averages present themselves higher in hyperdivergent individuals, it collaborates with the literature findings about the characteristics of predisposition to higher condylar translation, relevant for this standard.

However, the statistical analysis of both sides presented no significant difference in the comparison between the groups ($p > 0.05$), possibly due to the small sample size ($n = 12$ for each group) and because it is a pilot study.

Maybe this point is a limit for results extrapolation.

Individuals who hold a condylar hypertranslation are prone to episodes of subluxation and dislocation of the TMJ[22]. Then it is prudent aware them about this situation and advice on the control of mouth opening and the practice of home exercises addressed to masticatory muscles[22, 23].

Patients with TMJ hypermobility have greater prevalence of temporomandibular dysfunctions (83%) than patients without hypermobility (41%)[24]. According to Conti et al.[25], articular hypermobility is one of the most common causes of structural changes that may lead to joint sounds.

Because of its instability, hypermobile TMJ may stimulate an articular overload and lead to degenerative changes that could result in intracapsular disturbances or inflammation[26]. In some cases, excessive pressure generated on TMJ may exceed the adaptive capacity, which may result in degeneration of fibrous tissue that covers the condyle, transferring the stress to the underlying bone and promoting bone degeneration, such as osteoarthritis[27].

Horner KA et al.[28] in 2012 measured the thickness of cortical bone dentoalveolar through pictures of cone beam computed tomography in young adults with different facial patterns. The results showed that patients with standard growth, hyperdivergent mandibular cortical bone is significantly thinner.

Hyperdivergent patients have higher condylar translation and smaller thickness of mandibular cortical bone, what become them less able to adapt to the pressure exerted by hypermobility; we suspect that hyperdivergent patients are more frequently affected by degenerative bone processes and we believe this relationship represents an important area of research to elucidate the idiopathic condylar resorption.

The results of this study suggest that patients with hyperdivergent growth pattern have greater condylar translation, both right and left condyle when compared to patients with hypodivergent growth pattern. However, due to the small sample size, caution is needed in interpreting results.

Further studies should be conducted with a larger number of participants and using cone beam CT or MRI to confirm the hypothesis.

CONCLUSION

In view of the proposition, the methodology used and the results obtained, it can be concluded that:

• Hyperdivergent patients (Group I) present higher average values for horizontal condylar translation in both condyles than hypodivergent patients (Group II). However, there was no statistically significant difference in the comparison between groups.

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