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Centric Relation in Asymptomatic Hypodivergent and Hyperdivergent Skeletal Pattern

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Abstract

Introduction: Orthodontists have always believed in the appropriate positioning of mandibular condyle in relation to the temporal fossa when teeth are in maximum intercuspation. In addition, studies focusing on the relation between facial configuration and temporomandibular disorders (TMD) indicate an association of hyperdivergency with TMD.

Objective: The main objective of this study was to evaluate and compare the centric relation and centric occlusion in asymptomatic subjects with hyperdivergent and hypodivergent facial skeletal type. The hypothesis of this study was that condylar displacement was greater and more frequent in the hyperdivergent facial type.

Materials and Methods: Two groups of 35 subjects, each representing the extremes in facial type, were randomly selected and matched for age. Mounted casts and the mandibular position indicator instrumentation were used to measure and compare the amount of condylar distraction between the 2 groups in the horizontal and vertical planes. The total amount of change between the 2 groups was examined using a statistical *t*-test.

Result: Condyles in the hyperdivergent group, on average, were deflected backward 3.6 times greater than hypodivergent group.

Conclusion: The findings of this study demonstrated significantly greater condylar displacement for hyperdivergent group in the horizontal dimension.

Keywords: Centric relation, Hyperdivergent face type, Hypodivergent face type, Mandibular position indicator

INTRODUCTION

Orthodontists have always believed in the appropriate positioning of mandibular condyle in relation to the temporal fossa when teeth are in maximum intercuspation (MI). The condyle has to be positioned superiorly and anteriorly against the articular eminence, with the articular disc interposed between the two. This position is called centric relation. It is at this centric relation position of the condyle that the teeth should have MI (centric occlusion). Therefore, ideally, centric relation should coincide with centric occlusion.[1]

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The aim of all orthodontic treatment should be to match centric relation and centric occlusion, which is difficult to achieve with orthodontics. Since CR is the most consistent and reproducible positional reference, accurate studies of dental and maxilo-mandibular relationship are dependent on CR assessment.[2] Previous studies have shown that posterior mandibular displacement leads to temporomandibular disorders (TMD)[3] and morphological changes.[4] In addition, studies focusing on the relation between facial configuration and TMD indicate an association of hyperdivergency with TMD.[5,6] Several studies have been done to establish relationship between facial morphology and condylar position.[7-11]

Since the condyle position can be widely influenced by occlusion, it is of paramount importance to determine its displacement in three-dimensional.[12-14] Conventional radiograph does not provide accurate information in this regard. Mandibular position indicator (MPI) and similar

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tools have been introduced to allow quantification of the three-dimensional displacement of the condyle.[15-17]

The significance and clinical relevance of identifying and integrating condylar displacement in orthodontic diagnosis and treatment planning, when it surpasses a threshold of 2 mm in the horizontal or vertical axis has been established. Accurate diagnosis requires the assessment of occlusal interferences and skeletal relationships, without the influence of the neuromuscular system. Despite reasonable evidence of facial configurations being more prone to articular instability, data related to the subject is scarce and conflicting.

Stringent and worms studied the relationship between skeletal pattern and internal derangement. They found a greater incidence of internal derangement in the dolichofacial skeletal pattern.[18]

Girardot reported a more significant condylar displacement in hyperdivergent facial morphologies, whereas Burke *et al.* found diminished upper articular joint spaces in the same facial type.[7,11] Gidarakou found there was an increase in the mandibular plane angle (GoGn to SN) and an increase in the gonial angle of the mandible (Ar-Go-Me) to be associated with increased temporomandibular joints (TMJ) internal derangement.[8] In contrast, Hidaka *et al.* found no relationship between facial type and condylar position.[19]

Therefore, the aim of this observational study was to clarify the above mentioned conflicting findings and throw more light on the relationship between facial type and condylar position.

The main objective of this study was to evaluate and compare the condylar position between CR and CO in asymptomatic subjects with hyperdivergent and hypodivergent facial skeletal type. The hypothesis of this study was that condylar displacement was greater and more frequent in the hyperdivergent facial type.

MATERIALS AND METHODS

The research protocol was reviewed and approved by the Ethical Committee of the Institute. Condylar position was studied in two groups of 35 subjects each representing the extremes in facial type. The subjects were patients who reported to our institution. Based on the study criteria, we included individuals, who were between 16 and 30 years of age and facial skeleton characteristics as measured cephalometrically. Age was a criterion for selection since the intention was to study young adult subjects having completed growth. Facial skeleton type was determined by the Jarabak rotation index. Subjects were considered to be hyperdivergent if the posterior-anterior face height ratio (sella-gonion/nasion-menton) was 59% or less and mean mandibular plane angle was 34° or more. Subjects were considered to be hypodivergent if the posterior-anterior face height ratio (sella-gonion/nasion-menton) was 65% or more and mean mandibular plane angle was 16° or less.

Patients were excluded if they had missing permanent teeth except third molars, grossly carious teeth, restorative treatment, mobile teeth due to advanced periodontitis, crossbite or open bite, functional mandibular deviation due to occlusal interference, previous orthodontic treatment, history, clinical signs and symptoms of TMDs as determined by patient's clinical history and clinical examination, previous TMD treatment, evident dental or facial asymmetry, congenital skeletal deformity such as cleft lip and palate, and history of trauma or surgery to the TMJ. In addition, patients were excluded if they had Class III malocclusion and Class II div2 malocclusion. It was felt these factors could significantly affect condylar length and/or the occlusion, which could, in turn, distort data gathered for the study.

The records utilized included clinical history to evaluate TMJ dysfunction, clinical examination, lateral cephalometric radiograph in centric occlusion, and orthopantomogram, articulator mounted study casts in centric relation. Cephalometric measurements made were the mandibular plane angle (GoGn-SN), anterior facial height, posterior facial height, PFH × 100/AFH (Jarabak's ratio).

Irreversible hydrocolloid material was used to make the impression. The impressions were poured in white dental stone. The cast was trimmed without allowing water to splash onto its tooth surfaces, which could partially dissolve them.

A single operator was involved in all the clinical and laboratory experiments. A single arbitrary face bow and SAM® 2P articulator were used for mounting the stone casts (Velmix; Kerr® Manufacturing Co., Romulus, MI, USA) with the CR wax records (DeLar Bite Registration Wax; DeLar® Corporation, Lake Oswego, OR, USA). Horizontal and vertical CD was evaluated using a single MPI and MI wax records (Moyco® Industries Inc., Philadelphia, PA, USA).

Maxillary cast was mounted in the articulator using the arbitrary face bow. The mandibular casts were mounted to the maxillary using a modified Roth power centric bite registration record. The MI records were obtained before CR registration, by asking the patient to bite firmly with the teeth in MI. After being chilled in ice water, record accuracy was checked in the mouth. For CR registration, Roth's power centric technique was performed immediately after neuromuscular deprograming with the patient relaxed and reclined at 45°. Two cotton rolls were interposed between the dental arches for a minimum of 10 min. CR bite registration was performed in two stages. With the softened wax, the anterior section was obtained by guiding the mandible during closure to avoid protrusion. The cusps responsible for premature inter-arch contact were maintained 2 mm apart. Next, the anterior wax was hardened in ice water and then interposed between the arches simultaneously with the posterior softened wax section to accomplish the registration. The mandible was guided during the closure, and when the anterior teeth fit into the corresponding anterior wax indentations, the patient was asked to bite firmly. With this technique, as the posterior wax section was softened, muscular strength helped to adjust the vertical intra-articular condylar position.[20,21]

Each MPI recording was measured 3 times. The average of the 2 of 3 closest measurements was recorded.

Statistical Analysis

A statistical report was created from MPI measurements to compare the magnitude and direction of the condylar axis movement from CR to CO in hypodivergent (Group 1) and hyperdivergent (Group 2) groups. A Student's *t*-test was performed for comparison of the magnitude of MPI measurements.

RESULTS

X indicates the horizontal displacement of condyles. Positive values indicate protrusive movement of condyles, and negative values indicate retrusive condylar movement.

Z indicates the vertical displacement of condyles. Positive values indicate the superior displacement of condyles and Slavicek terms it as compression. Negative values indicate the inferior displacement of condyles, Slavicek terms it as a distraction.

Y indicates transverse condylar movement. Positive values indicate left the condylar movement, and negative values indicate condylar movement to the right side.

Table 1 summarizes the comparison between the 2 groups in X, Z, and Y coordinates.

Anteroposterior Dimension

Figure 1 shows mean condylar shift in X axis for Group 2 was 1.13 mm, which was 1.7 times greater than corresponding 0.65 mm for hypodivergent group, which was significant statistically.

Table 1 shows the comparison between the two groups. The mean forward movement of condyle was 0.95 mm and 0.63 mm for Groups 1 and 2, respectively, which was not significant statistically.

Figure 2 shows mean backward movement of condyle was –0.44 mm for Group 1 and –1.59 mm for Group 2 which was statistically significant ($P < 0.0001$). Thus, condyles in

Table 1: Mean values for the condylar deflection in three-dimensional for hypodivergent and hyperdivergent facial type

CD	Mean±SD		*T* value, df	*P* value
	Group 1	Group 2		
X (-)	0.44±0.38	1.53±0.95	6.762, 78	0.0001
X (+)	0.95±0.91	0.63±0.84	1.407, 58	0.1649
Z (-)	1.25±0.61	1.59±0.80	2.461, 108	0.0154
Z (+)	0.37±0.46	0.66±1.06	1.062, 28	0.2975
(X)	0.65±0.70	1.13±1.00	3.287, 138	0.0013
(Y)	0.39±0.41	0.38±0.19	0.1291, 68	0.8976
(Z)	0.99±0.70	1.46±0.89	3.386, 138	0.0009

SD: Standard deviation, CD: Condylar displacement

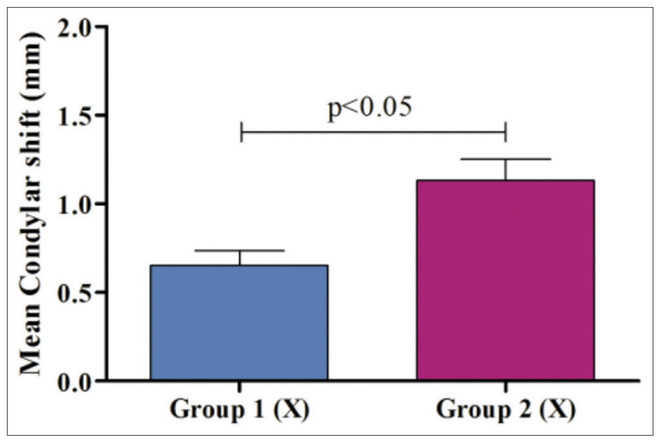

Figure 1: A comparison of total horizontal condylar displacement for the 2 groups

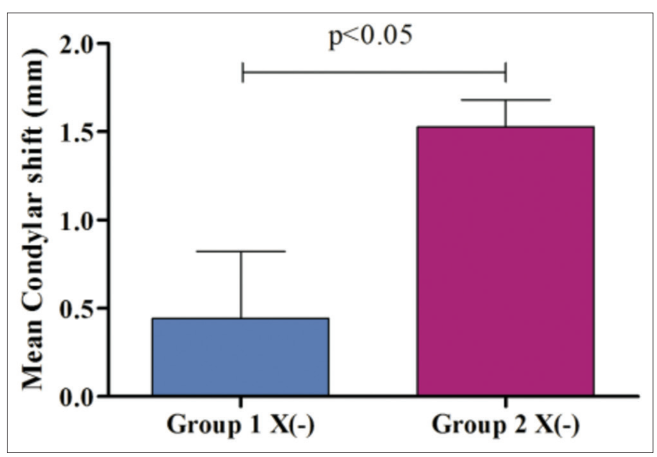

Figure 2: A comparison of backward condylar displacement for the 2 groups

hyperdivergent group, on average, were deflected backward 3.6 times greater than hypodivergent group.

Vertical Dimension

Figure 3 shows mean vertical displacement (Z axis) for Group 2 was 1.46 mm, which was 1.3 times greater than corresponding 0.99 mm for Group 1, the difference was significant statistically (Table 1).

Figure 4 shows mean distraction for Group 1 was –1.25 mm as compared to corresponding −1.59 mm for Group 2, which was significant statistically.

The mean compression was 0.37 mm for Group 1 as compared to 0.66 mm for Group 2, which was not statistically significant.

DISCUSSION

Various studies[8-11,22-24] have shown that association exists between the internal derangement and facial morphology. These studies serve to illustrate identified association between facial morphology and localized TMJ disturbances. The orthodontist should be aware that young growing individuals experiencing TMJ internal derangement may not have significant signs and symptoms at an early age; later as they grow older, they may become symptomatic.[22]

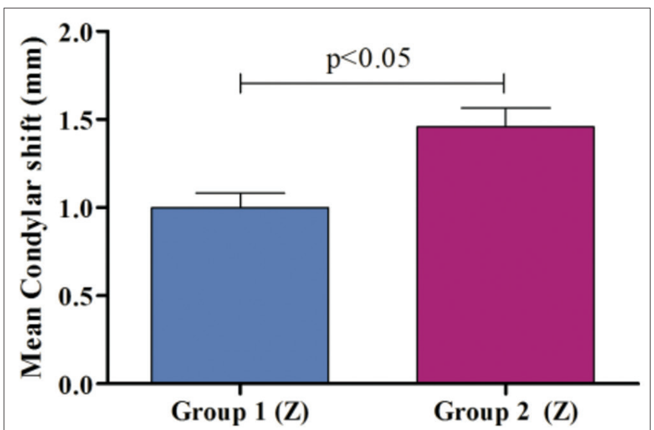

Figure 3: A comparison of total vertical condylar displacement for the 2 groups

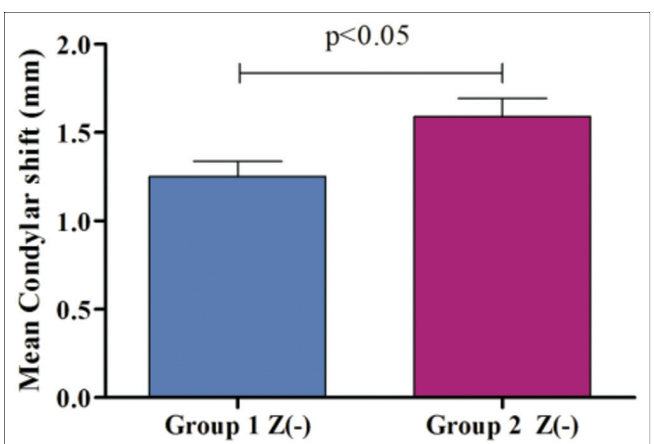

Figure 4: A comparison of condylar distraction for the 2 groups

Ideally, although CR and CO should be coincident, this is not frequently seen even in subjects with normal occlusion as they most often exhibit a small discrepancy.[1]

To overcome the drawbacks of radiographs and other imaging techniques, articulator mounted models have been advocated by many clinicians to study the relationship of the condyle to the glenoid fossa.[1,17,25-27]

Authors, such as Roth,[1,26,27] Slavicek,[17,28] Okeson,[25] Dawson,[30] Utt[29] Rosneer, and Goldberg,[31] have advocated the use of diagnostic study models mounted in CR to make a complete diagnosis and establish the goal of optimal functional occlusion. Okeson advocates the use of mounted casts since the protective reflexes of the neuromuscular system may prevent detection of interferences clinically.[25]

Instruments such as the MPI are valuable adjuncts to diagnostic casts mounted on an articulator as it provides information concerning changes between CO and CR at the level of the condyles.[28,29] The MPI is used to measure the CR-CO discrepancy as the assessment is done in three-dimensional of space.[27,28] The MPI allows for a simple and non-invasive technique for comparing clinically captured CR and CO position through the displacement of the opening and closing axis position of the patient. The MPI represents the opening and closing axis of the mandible that passes through both condyles; therefore, movement of the axis represents the movement of the condyles.

The "power centric" interocclusal registration as proposed by Roth was recorded in this study.[1] This technique makes use of the patient's own power closure muscles to seat the condyles as closely as possible to the CR with the condyles centered transversely and seated against the articular disks anteriorly and superiorly within the fossa. This method eliminates the operator error often encountered in attempts to manipulate the patient's mandible to CR. Since the patient is applying all the pressure, it is less likely to exceed the physiologic limits of the system.

Reproducibility of Roth powers centric bite registration technique was investigated by Wood and Elliott[20] and by Schmitt, Kulbersh *et al.*[32] and by Wood and Elliott.[33] The result showed that there were no statistically significant differences ($P > 0.05$) within each operator or between operators; the Roth CR bite registration with Blue Delar wax is highly reproducible.

Wood and Korne[33] showed that recording condylar displacement with MPI device is highly reproducible.

Horizontal Condylar Displacement

The data showed that the hyperdivergent subjects had greater displacement of the condyle in the horizontal dimensions. Mean condylar shift in X-axis for the hyperdivergent group was 1.13 mm, which was 1.7 times greater than corresponding 0.65 mm for hypodivergent group which was statistically significant.

The displacement of condyle in X-axis can be subdivided into forward (+X) and backward (−X) components. The mean forward movement of condyle (+X) was 0.95 mm and 0.63 mm for Groups 1 and 2, respectively, which was not significant statistically. This was the only parameter in which greater displacement was seen in hypodivergent group. This finding is in contrast with the Girardot's[20] study where he found more forward displacement in the hyperdivergent group. The mean backward movement of condyle (−X) was −0.44 mm for Group 1 and −1.53 mm for Group 2 which was statistically significant ($P < 0.001$). Thus, condyles in the hyperdivergent group, on average, were positioned backward 3.6 times greater than hypodivergent group. Of all the dimensions totaled and compared, this one showed the greatest difference between the 2 groups. Thus, one might suspect the amount of backward condylar displacement for the hyperdivergent patient, on average, will be about thrice that of the hypodivergent patient. When the 2 groups were compared concerning anterior or posterior deflection of the condyle, it was found that the greatest movement occurred to the posterior in the hyperdivergent group.

This finding was similar to Girardot's data.[11] Girardot's study showed a similar overall and posterior displacement in the horizontal plane. In Girardot's study, backward displacement in the hyperdivergent group was 1.6 times greater than backward displacement recorded for hypodivergent group.

This supports Roth's[26] concept of a molar fulcrum and may be important since posterior displacement of the condyle away from the eminence would theoretically compromise joint stability and/or function. It has been hypothesized[24] that displacement of the condyle away from the eminence may be detrimental to joint health and/or stability since there is subsequent loss of juxtaposition between the condyle, disc, and eminence. The posterior aspect of the mandibular fossa is quite thin and apparently not meant for bearing stress. It has been demonstrated that when an occlusal condition causes a condyle to be positioned posterior to musculoskeletally stable position, the posterior border of the disc can be thinned.

Vertical Dimension

Mean vertical displacement (Z axis) for Group 2 was 1.46 mm, which was 1.5 times greater than corresponding 0.99 mm for Group 1. The difference between two groups is significant statistically, did show more displacement in the vertical plane in the hyperdivergent group than in the hypodivergent group.

Girardot's study[11] reported a similar difference between hyperdivergent and hypodivergent group, but the mean vertical displacement was higher in his study for both groups. The mean vertical condylar displacement in the hyperdivergent group was 1.7 mm and 1.2 mm in hypodivergent group. Higher mean displacement reported by Girardot can be attributed to the difference in subject selection.

Girardot did not exclude the subject if there had been a restorative treatment or orthodontic treatment or patient had Class II div2 malocclusion. Orthodontic treatment mechanics such as cervical headgear and long Class II elastics that cause extrusion of molars will make the fulcrum worse.[1,26] These factors would distort the data gathered from these subjects showing greater condylar distraction from CR to MI.

Stringert and Worms[18] found hyperdivergent facial types to have a greater frequency of internal derangement than hypodivergent facial types. They suggested this might be a consequence of degenerative changes within the TMJ or as they said, "for some reason, persons with hyperdivergent characteristics are more prone to internal derangements."

The displacement of the condyle in the vertical plane can be subdivided into compression (+) and distraction (-) components.

The mean distraction for Group 1 was –1.25 mm as compared to corresponding –1.59 mm for Group 2, this was significant statistically. The mean compression was 0.37 mm for Group 1 as compared to 0.66 mm for Group 2, which was not statistically significant.

Ideally, in the present study, it would have been better if all subjects had worn a mandibular repositioning splint for 6 months prior obtaining CR records.

Medio-Lateral Dimension

The mean displacement between two groups was almost the same. Mean transverse displacement for Group 1 was 0.39 mm and for Group 2 was 0.43 mm. Thus, displacement in both the groups was minimal and below the 0.5 value. Utt[28] in his study has indicated that values >0.5 mm in the Y plane is clinically significant. Since the subjects in the study were asymptomatic, this would explain for decreased value in Y plane.

The comparative differences in condylar shift between two facial types became even more conspicuous when measuring the number of condyles that were displaced to the extreme (2 mm or more). The number of hyperdivergent joints shifting 2 mm or more in the horizontal plane (X) numbered 15 as compared to 3 in hypodivergent. In the vertical plane (Z), 6 condyles in hypodivergent group were displaced to extreme as compared to 15 in the hyperdivergent group. Nine joints in hyperdivergent group only show 2 mm or more displacement in both horizontal and vertical plane. Since the subjects in this study comprised of asymptomatic individuals, the majority of them had MPI readings <2 mm. It was stated that subjects with 2 mm or more displacement should undergo muscle deprogramming prior to active Orthodontic treatment.[29]

For the orthodontist desiring to treat to the upward and forward or seated condylar position, this study is helpful because it shows most pretreatment patients will have a centric relation to centric occlusion discrepancy. The information gathered from mounted casts can have a profound effect on treatment planning. The data gleaned from this study is particularly valuable because it indicates the clinician can generally assume condylar distractions will be much greater in hyperdivergent facial patterns than in hypodivergent ones. Certainly each case must be evaluated separately, but the clinician is better prepared for diagnosis with this knowledge.

CONCLUSION

It was hypothesized that hyperdivergent group would exhibit greater condylar displacement than the hypodivergent group. The findings of this study demonstrated significantly greater condylar displacement for the hyperdivergent group in the horizontal dimension. In vertical dimension condylar distraction was 1.5 times greater in the hyperdivergent group. There was no significant difference between the two groups in transverse dimension.

Therefore, if condylar displacement is not considered during assessment of orthodontic cases, the risk of misdiagnosis is high, being significantly higher in patients with the hyper divergent facial pattern.

REFERENCES

1. Roth RH. Functional occlusion for the orthodontist. J Clin Orthod 1981;15:32-40.
2. Shildkraut M, Wood DP, Hunter WS. The CR-CO discrepancy and its effect on cephalometric measurements. Angle Orthod 1994;64:333-42.
3. Isberg AM, Isacsson G. Tissue reactions of the temporomandibular joint following retrusive guidance of the mandible. Cranio 1986;4:143-8.
4. Desai S, Johnson DL, Howes RI, Rohrer MD. Changes in the rabbit temporomandibular joint associated with posterior displacement of the mandible. Int J Prosthodont 1996;9:46-57.
5. Ahn SJ, Baek SH, Kim TW, Nahm DS. Discrimination of internal derangement of temporomandibular joint by lateral cephalometric analysis. Am J Orthod Dentofacial Orthop 2006;130:331-9.
6. Hwang CJ, Sung SJ, Kim SJ. Lateral cephalometric characteristics of malocclusion patients with temporomandibular joint disorder symptoms. Am J Orthod Dentofacial Orthop 2006;129:497-503.
7. Burke G, Major P, Glover K, Prasad N. Correlations between condylar characteristics and facial morphology in Class II preadolescent patients. Am J Orthod Dentofacial Orthop 1998;114:328-36.
8. Gidarakou IK, Tallents RH, Kyrkanides S, Stein S, Moss M. Comparison of skeletal and dental morphology in asymptomatic volunteers and symptomatic patients with bilateral degenerative joint disease. Angle Orthod 2003;73:71-8.
9. Gidarakou IK, Tallents RH, Kyrkanides S, Stein S, Moss ME. Comparison of skeletal and dental morphology in asymptomatic volunteers and symptomatic patients with unilateral disk displacement without reduction. Angle Orthod 2003;73:121-7.
10. Gidarakou IK, Tallents RH, Stein S, Kyrkanides S, Moss ME. Comparison of skeletal and dental morphology in asymptomatic volunteers and symptomatic patients with unilateral disk displacement with reduction. Angle Orthod 2004;74:212-9.
11. Girardot RA Jr. Comparison of condylar position in hyperdivergent and hypodivergent facial skeletal types. Angle Orthod 2001;71:240-6.
12. Vitral RW, Telles Cde S, Fraga MR, de Oliveira RS, Tanaka OM. Computed tomography evaluation of temporomandibular joint alterations in patients with Class II Division 1 subdivision malocclusions: Condyle-fossa relationship. Am J Orthod Dentofacial Orthop 2004;126:48-52.
13. Rodrigues AF, Fraga MR, Vitral RW. Computed tomography evaluation of the temporomandibular joint in Class I malocclusion patients: Condylar symmetry and condyle-fossa relationship. Am J Orthod Dentofacial Orthop 2009;136:192-8.
14. Hilgers ML, Scarfe WC, Scheetz JP, Farman AG. Accuracy of linear temporomandibular joint measurements with cone beam computed tomography and digital cephalometric radiography. Am J Orthod Dentofacial Orthop 2005;128:803-11.
15. Hayashi T, Ito J, Koyama J, Hinoki A, Kobayashi F, Torikai Y, *et al.* Detectability of anterior displacement of the articular disk in the temporomandibular joint on helical computed tomography: The value of open mouth position. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;88:106-11.
16. Ikeda K, Kawamura A. Assessment of optimal condylar position with limited cone-beam computed tomography. Am J Orthod Dentofacial Orthop 2009;135:495-501.
17. Slavicek R. Clinical and instrumental functional analysis and treatment planning. Part 4. Instrumental analysis of mandibular casts using the mandibular position indicator. J Clin Orthod 1988;22:566-75.
18. Stringert HG, Worms FW. Variations in skeletal and dental patterns in patients with structural and functional alterations of the temporomandibular joint: A preliminary report. Am J Orthod 1986;89:285-97.
19. Hidaka O, Adachi S, Takada K. The difference in condylar position between centric relation and centric occlusion in pretreatment Japanese orthodontic patients. Angle Orthod 2002;72:295-301.
20. Wood DP, Elliott RW. Reproducibility of the centric relation bite registration technique. Angle Orthod 1994;64:211-20.
21. Wood DP, Floreani KJ, Galil KA, Teteruck WR. The effect of incisal bite force on condylar seating. Angle Orthod 1994;64:53-61.
22. Nebbe B, Major PW, Prasad NG, Grace M, Kamelchuk LS. TMJ internal derangement and adolescent craniofacial morphology: A pilot study. Angle Orthod 1997;67:407-14.
23. Nebbe B, Major PW, Prasad NG. Female adolescent facial pattern associated with TMJ disk displacement and reduction in disk length: Part I. Am J Orthod Dentofacial Orthop 1999;116:168-76.

24. Nebbe B, Major PW, Prasad NG. Male adolescent facial pattern associated with TMJ disk displacement and reduction in disk length: Part II. Am J Orthod Dentofacial Orthop 1999;116:301-7.
25. Okeson JP. When Is Orthodontic Therapy Indicated for the Management of TMD? [Audio Tape]. Birmingham, Ala: Practical Reviews in Orthodontics, Educational Reviews; 1998.
26. Roth RH, Rolfs DA. Functional occlusion for the orthodontist. Part II. J Clin Orthod 1981;15:100-23.
27. Roth RH. Functional occlusion for the orthodontist - Part 3 finishing to gnathological principle. JCO 1981;3:174-98.
28. Slavicek R. Dr. Rudolf Slavicek on clinical and instrumental functional analysis for diagnosis and treatment planning. Part 1. Interview by Dr. Eugene L. Gottlieb. J Clin Orthod 1988;22:358-70.
29. Utt TW, Meyers CE Jr, Wierzba TF, Hondrum SO. A three-dimensional comparison of condylar position changes between centric relation and centric occlusion using the mandibular position indicator. Am J Orthod Dentofacial Orthop 1995;107:298-308.
30. Dawson PE. Temporomandibular joint pain-dysfunction problems can be solved. J Prosthet Dent 1973;29:100-12.
31. Rosner D, Goldberg GF. Condylar retruded contact position and intercuspal position correlation in dentulous patients. Part I: Three-dimensional analysis of condylar registrations. J Prosthet Dent 1986;56:230-9.
32. Schmitt ME, Kulbersh R, Freeland T. Reproducibility of the Roth power centric in determining centric relation. Semin Orthod 2003;9:102-8.
33. Wood DP, Korne PH. Estimated and true hinge axis: A comparison of condylar displacements. Angle Orthod 1992;62:167-75.

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