ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at: www.ijmacr.com

Volume – 5, Issue – 2, March - April - 2022, Page No. : 220 – 234

Effects of Class III Malocclusion on TMJ Morphology - A Review

[1]Sajad Ghorbanizadeh, Assistant Professor of Oral & Maxillofacial Radiology, Department of Oral & Maxillofacial Radiology, School of Dentistry, Lorestan University of Medical Science, Khorramabad, Iran.

[2]Atiyeh Tavasol, Dental Student, School of Dentistry, Lorestan University of Medical Science, Khorramabad, Iran.

[3]Hamid Badrian, Assistant Professor of Operative Dentistry, Department of Operative Dentistry, School of Dentistry, Lorestan University of Medical Science, Khorramabad, Iran.

Corresponding Author: Hamid Badrian, Assistant Professor of Operative Dentistry, Department of Operative Dentistry, School of Dentistry, Lorestan University of Medical Science, Khoramabad, Iran.

How to citation this article: Sajad Ghorbanizadeh, Atiyeh Tavasol, Hamid Badrian, "Effects of Class III Malocclusion on TMJ Morphology - A Review", IJMACR- March - April - 2022, Vol – 5, Issue - 2, P. No. 220 – 234.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

The present study aimed to examine potential changes in TMJ complex made by class III malocclusion compared to normal posture. For this purpose, two independent authors reviewed articles in various languages in PubMed, Scopus, Cochrane, Embase, and Google Scholar databases being available from 2010 to 2021. Articles on TMJ morphology, glenoid fossa, articular eminence, condyle in people with class III malocclusion were reviewed, and their references were identified and reviewed, too. About 78 primary studies were identified of which 15 were selected according to inclusion-exclusion criteria. Class III occlusion can have impacts on the TMJ complex. Some of these impacts are increasing condyle size as well as decreasing articular eminence inclination, which was confirmed in the reviewed studies. However, impacts like changes in glenoid fossa and condyle position remain controversial. In sum, the effects of occlusion on TMJ require more research.

Keywords: TMJ, Morphology, Radiography

Introduction

TMJ is a complex joint for its anatomical, histological and biomechanical features. TMJ morphology varies among different people; even, left condyle and right condyle have differences in one person [1].

The condyle is an important area of growth in the face that is capable of remodeling in response to stimuli even when normal growth of the body stops. TMJ developmental changes are dependent on age and gender to some extent. Because TMJ can influence the long-term impacts of orthodontic treatment, much attention is paid to morphology and position of the condyle in orthodontics [2, 3].

Radiography is a valuable way of assessing TMJ structure. 2D radiography techniques have been widely

used to examine condyle morphology. These days, CBCT 3D radiography techniques, with lower exposure dose compared to common 3D CT techniques, allow a full confident analysis of TMJ and condyle [4].

Regarding angle classification that is the most common method used in Orthodontics, people are divided into classes I, II, and III [1]. Some studies reported a significant relationship among types of occlusion, and the shape of mandibular fossa and the condyle.

Various studies are available on the effects of occlusion on the temporomandibular joint (TMJ). The bulk of the studies has addressed potential changes caused by class III in TMJ. However, there are some problems: 1) inconsistencies among the studies are observable; 2) settings and samples are varied, and 3) aspects and components of joint structure and the definitions for them are different.

Therefore, a proper conclusion for researchers is of great importance for this issue. Regarding the abovementioned, as well as the lack of a review in this field, the present study was conducted.

Objectives of the study are as follows:

1. Drawing conclusions of class III malocclusion effects on TMJ
2. Giving recommendations for a unified procedure and unification of structural components in addressing TMJ change

Methodology

Research Strategy: Searches in PubMed, Scopus, Cochrane, Embase, and Google Scholar databases for studies from 2010 to 2020 in all languages was done with the following keyword and Mesh term was incorporated, too: temporomandibular joint, TMJ, cone beam computed tomography, CLASS I, CLASS III, orthodontic angle class I, orthodontic angle class III

Inclusion criteria

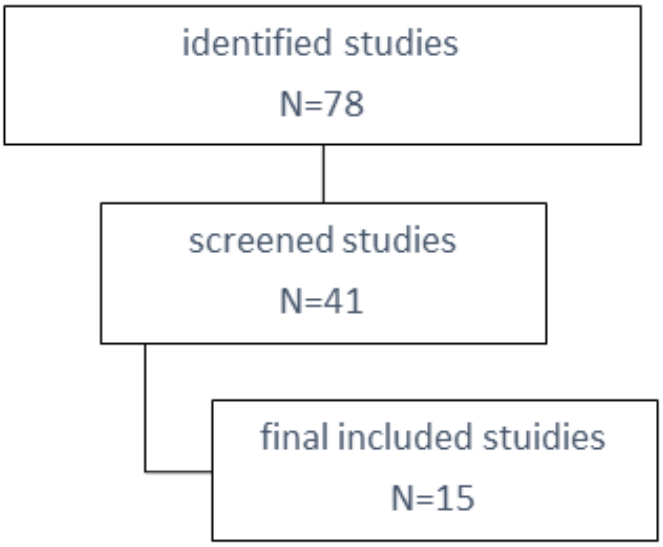
All of the cross-sectional or retrospective and case-control studies were selected for the review. Letter to editor and thesis studies were excluded. In the present review, the selected studies included all cases with class III and class I malocclusion without any joint pathology.

All cases of condyle size, condyle volume, articular eminence inclination, mandible condyle and glenoid fossa morphology, condyle position, joint space, which were examined by the 3D CBCT radiography in the reviewed studies, were included in the present studies.

To exclude the problematic cases, studies with under-treatment subjects and the ones with subjects suffering from asymmetry or disorders of joints were excluded.

Selection Process

The summary of the studies was fully reviewed by two authors to assess inclusion-exclusion criteria; the qualified studies were selected and any inconsistencies were resolved by the two.



Data Collection

Table 1:

Author	Type of Study	Sample Size	Type of Radiography	Addressed Characteristics
Hasebea et al.(5)	retrospective study	166 subjects (61 men, mean age: 27.2 6 7.6 years; 105 women, mean age: 27.4 6 9.2 years).	CBCT	condylar length, height, and width
Jyotirmay et al.(6)	retrospective study	266 study participants 112 males and 144 femalesthe age group 18–26 years	CBCT	length, width, and height of the condyle
Khademi et al(7).	retrospective study	64 patients	CBCT	Depth, width, and angle of the glenoid fossa
Mostafavi et al.(8)	retrospective study	198 patients within the age range of 15–64 years, including 68 males and 130 females	CBCT	size of the condyle, area of the condyle, and morphology index
Yamashita et al.(9)	retrospective and observational study	233 asymptomatic patients18 to 65 years (mean 37.52 ± 12.96 years)	CBCT	the volume of the mandibular condyle (MC) and the coronoid process (CP)
Arrieta-Miranda et al.(10)	retrospective study	45 subjects 18 and 35 years old	CBCT	condyle position(Upper distance Posterior distance Anterior distance Angle of eminence Height of eminence)
chae et al.(11)	Retrospective study	120 adolescent patients (10 to ,20 years old)	CBCT	Temporomandibular joint space (TMJS: AS, anterior space; SS, superior space; PS, posterior space; MS, medial space; LS, lateral space), width and depth of the condyle (MLT, mediolateral thickness; APT, anteroposterior thickness), articular slope (ArS) vertical height of the fossa (VHF)
ganesh et al.(12)	retrospective study	45 patients with Skeletal Class I (group-1), Class II Division I (group-2) and Class III malocclusions (group-3), 15 subjects each ranging in age from 15 to 40 years	CBCT	the sagittal slice were evaluated for concentric position of condyle in the fossa and also to assess the depth of the mandibular fossa the symmetry between the positions of condylemandibular fossa was assessed on the axial slice.

lobo et al.(13)	Retrospective study	180 asymptomatic patients age (<40 years, n¼90; _40 years, n¼90) sex (male, n¼90; female, n¼90).	CBCT	Right- and left-sided TMJ spaces, articular eminence inclination (AEI) and height (AEH) ,thickness of the roof of the glenoid fossa (TRGF) the anteroposterior position of the condyle in glenoid fossa
Loiola et al.(14)	Retrospective study	55 patients 21 were male and 34 female aged between 19 and 59 years	CBCT	condylar volume and surface
Mishra et al.(15)	Retrospective study	20 patients in the age range of 7-14 years	CBCT	Condylar position (antero-posterior, vertical, laterolateral position of condyle, axial condylar angle and coronal condylar angles which were measured in axial, coronal and sagittal sections
Paknahad et al. (16)	Retrospective study	20 patients presenting with a Class I skeletal pattern, 20 with a Class II skeletal pattern, and 20 with a Class III skeletal pattern	CBCT	Condylar position
Saccucci et al.(3)	Retrospective study	200 Caucasian patients (15–30 years old, 95 male and 105 females) class I (65 patients), skeletal class II (70 patients) and skeletal class III (65 patients).	CBCT	Condylar volume condylar area morphological index (MI)
Santander et al.(2)	cross-sectional study	111 adult patients (mean age = 27.0 ± 10.2 years)	CBCT	condylar morphology: linearly by the condylar width ,height and depth; angularly by the antero-posterior and medio-lateral condylar inclination; volumetrically by the ratio of the condylar volume/ mandibular volume (C/Mand).
Song et al.(1)	Retrospective study	123 Chinese patients (13–36 years old, 60 males, and 63 females) skeletal class I (31 patients), skeletal class II division 1 (30 patients), skeletal class II division 2 (30 patients), and skeletal class III (32 patients).	CBCT	position of condyle (analyzed according to Pullinger.) glenoid fossa morphology condylar morphology Joint spaces

Author	Condylar dimension	Condylar Volume	glenoid fossa dimension	Articular eminence inclination	condyle-to-fossa joint spaces	position of condyle
Hasebea et al.(5)	In the anteroposterior skeletal patterns, the basic statistics of Class III as the largest average value.					
Jyotirmay et al.(6)	significant difference in length of the condyle in class I, class II, and class III conditions with $p \geq 0.05$. The width and height of the condyle were greatest in class III condition while they were lowest in class I condition. The width and height of the condyle in class II condition were more than that of class I but less than that of class III condition. The difference was statistically significant with $p \leq 0.05$.					
Khademi et al.(17)			The glenoid fossa in class I patients was wider than class III patients.			

		There were no statistically significant differences in the angle and depth of glenoid fossa in patients with a different sagittal skeletal pattern.		
Mostafavi . et al.(8)	The mean condylar volume and surface, as well as the mor-phological index, were higher in class III patients, compared with classes I and II patients			
Yamashita et al.(9)	The Dunn test showed that there were statistically higher values in the condylar volume of Class III patients when compared to Class II ($p < 0.05$).			
Arieta-Miranda et al.(10)			For the articular eminence angle, there	The upper distance of the condyle to the glenoid fossa

		was a statistically significant ($p < 0.001$) difference between the three groups, and it was further observed that the class III group showed a smaller angle of eminence than the class II group. Also, both class II and III groups had smaller angles than the class I group.	was smaller in the class II and class III compared with the class I group. The anterior distance of the condyle to the articular eminence showed significant differences when comparing the class I with the class II and class III groups. No statistically significant difference was noted in the posterior condylar distance between the groups.
chae et al.(11)			Most measurements in the sagittal view showed that SS was the greatest, and the mean ratio of AS to SS to PS was 1.00 to 1.27 to 1.19, respectively. The mean values of

			coronal MS and LS were not significantly different. the mean value showed no statical differences according to age and skeletal pattern.	
ganesh et al.(12)	The ANOVA test between the three groups on the right side revealed a statistically significant difference (P=0.031) in the depth of the mandibular fossa between the Class I (7.8±1.0mm) and Class III (8.9±1.4mm) malocclusion with mean difference of 1.05mm, indicating an increased fossa height in Class III than Class I malocclusion.		Based on the comparison between the 3 groups no statistically significant difference was observed.	The mean distance from the geometric centre of the right condylar processes to the mid-sagittal plane in ClassI is 46.6mm; ClassII is 47.7mm; ClassIII is 47.9mm with the overall P value=0.296.The mean distance from the geometric centre of the left condylar processes to the mid-sagittal plane in ClassI is 47.7mm; ClassII is 48.2mm; ClassIII IS 48.1MM with the overall P value=0.852 respectively. No statistically significant was observed.
lobo et al.(13)		The AEI and AEH were	When the variables were	

		significant lower in classes III and I patients presented the lowest values for TRGF.	related to the facial patterns, there was a statistically significant difference for all measurements, except for AS.	
Loiola et al.(14)	The groups were compared to each other, and no statistically significant difference was found between the three skeletal patterns (p = 0.588).			
Mishra et al.(15)				Independent t-test and Mann-Whitney U test showed no significant difference between position of condyle in Class I and Class III subjects.
Paknahad et al. (16)				No significant differences in condylar position between Class I and Class III subjects were detected.
Saccucci et al.(3)	subjects in skeletal class III showed a significantly higher condylar			

		volume, respect to class I and class II subjects ($p < 0.05$).		
Santander et al.(2)	Participants with skeletal Class III demonstrated smaller condylar depth compared to Class I participants. The ratio C/Mand and condylar height were higher in Class III than in Class I or II cases.			
Song et al.(1)	Compared with class II1, II2, and III subjects, the height and diameter of condyle in class I was significantly larger ($p < 0.05$).	The width of joint fossa was significantly larger in Angle class III than in Angle class I, II1, and II2, while the depth was significantly smaller	There were significant differences between class III subjects and class I, II1, II2 in the superior joint space	The condyle position in class III subjects was more anteriorly displaced compared with that in class I subjects.

Table 2

Discussion

1. Condylar size

According to Hasebea [5] and Jyoti may]6], in clients with class III occlusion, condyle dimensions (length, width, height) were significantly bigger compared to class I occlusion. In the study by Santander [2], the height and length of condyle were larger in class III. Song [1] reported a considerably larger condyle diameter in class I compared to class III. Regarding Condylar volume, Mostafavi [8] and Saccucci [3] reported a larger volume in class III occlusion compared to class I. However, Yamashita [9] and Loiola [14] reported no significant difference in condyle volume. Although the related literature, especially studies with bigger sample sizes, reported a bigger condyle size in class III, no certain conclusions can be drawn.

2. Glenoid fossa dimensions

Khadami [17] reported significant relationship in fossa width but length had no difference in class I and class III, but Song [1] reported bigger width of fossa in class

III. Ganesh [12] showed that fossa length was larger in class III while Song [1] reported a much smaller fossa length in class III. According to the studies, a small sample size and inconsistent conclusions allow no certain conclusions on the effect of class III occlusion on glenoid fossa dimensions.

3. Articular eminence inclination

Studies by Arieta-Miranda [10] and Lobo [13], a shower that articular eminence inclination was significantly smaller in Class III than in class I.

4. Condyle to fossa joint spaces

In studies by Chae [11], Ganech [12], Mishra [15] and Paknahad [16], no significant differences between condyle position and condyle to fossa joint spaces were reported. Arieta-Miranda [10], Lobo [13], and Song [1] showed that superior joint space of condyle in class III was lower compared to class I.

Limitations

In sum, in the conclusion of reviewing studies on TMJ changes caused by class III malocclusion the very first issue was the number of anatomic and structural components used to describe the same features. In the final studies reviewed for the present study (N=15), 17 parameters were identified[1] that refer to 4 major characteristics of TMJ.

Recommendations

The importance of descriptive studies in epidemiology and etiologic investigations implies designing studies that allow drawing conclusions and proper presentation of the collected data. Hence, the following recommendations are given for future studies on class III malocclusion

1. Condylar length, height, and width
2. Depth, width, and angle of glenoid fossa
3. Size of condyle
4. Area of condyle
5. Morphology index
6. Volume of the mandibular condyle (MC)
7. Condyle position
8. Temporomandibular joint space
9. Articular slope (ArS)
10. Articular eminence inclination (AEI)
11. Articular eminence height (AEH)
12. Thickness of the roof of the glenoid fossa (TRGF)
13. Morphological index (MI)
14. Angularly by the antero-posterior and medio-lateral condylar inclination
15. Mandibular volume (C/M and)
16. Glenoid fossa morphology
17. Condylar morphology

1. Determination of major indices of TMJ changes as well as quantitative definitions for major parameters for investigations
2. Definition of inclusion/ exclusion criteria so that problematic factors do not influence the results

In the present review, because of under-treatment subjects or subjects with asymmetry or disorders comorbid with class III, influences on the main results were probable and so these individuals were excluded from the review. Therefore, the following is recommended:

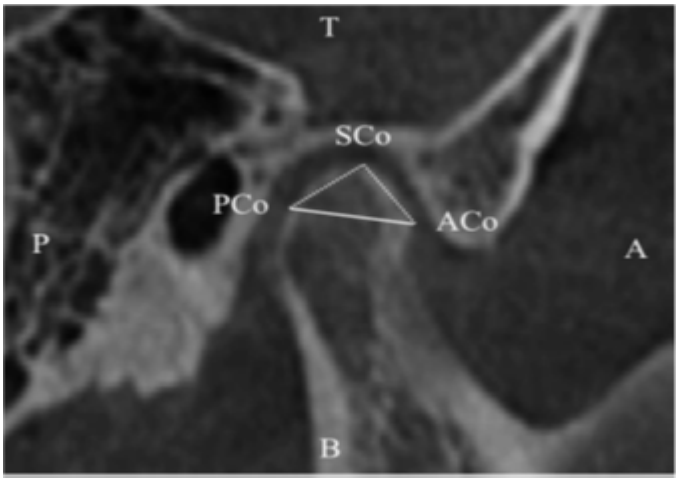
A) Assessed characteristics

1.)Condyle size: examining condyle dimensions (maximum length, width, and height/depth)

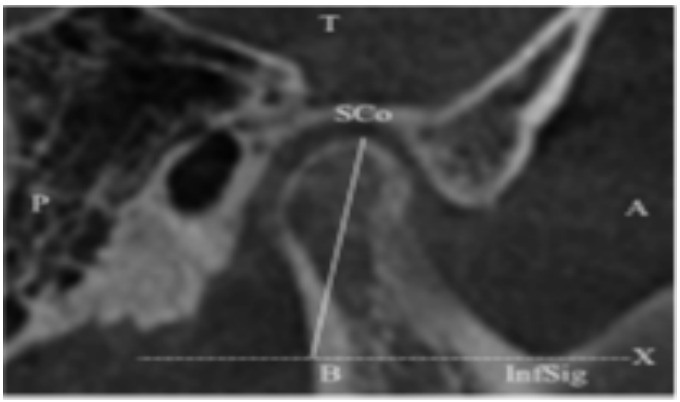
Condylar Width, Distance from Most lateral point of the condyle to Most medial point of the condyle

Condylar length, Most anterior point of the condyle to Most posterior point of the condyle

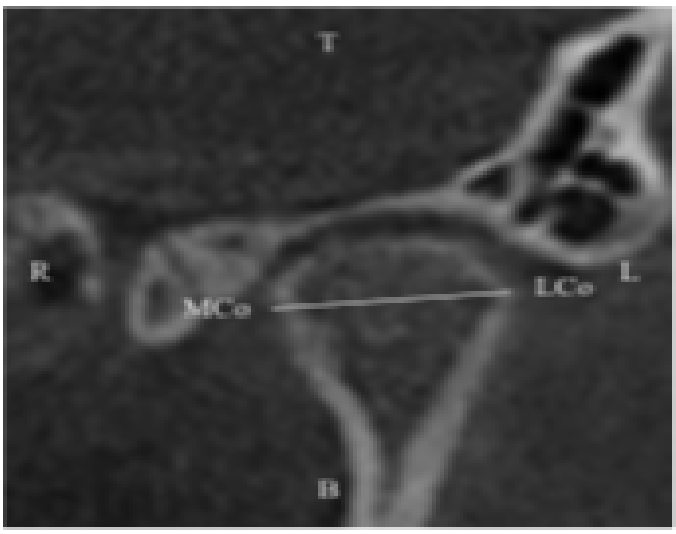
Condylar Height, Distance from SCo perpendicular to Line perpendicular to R-tan tanging the deepest point of the mandibular incisura.



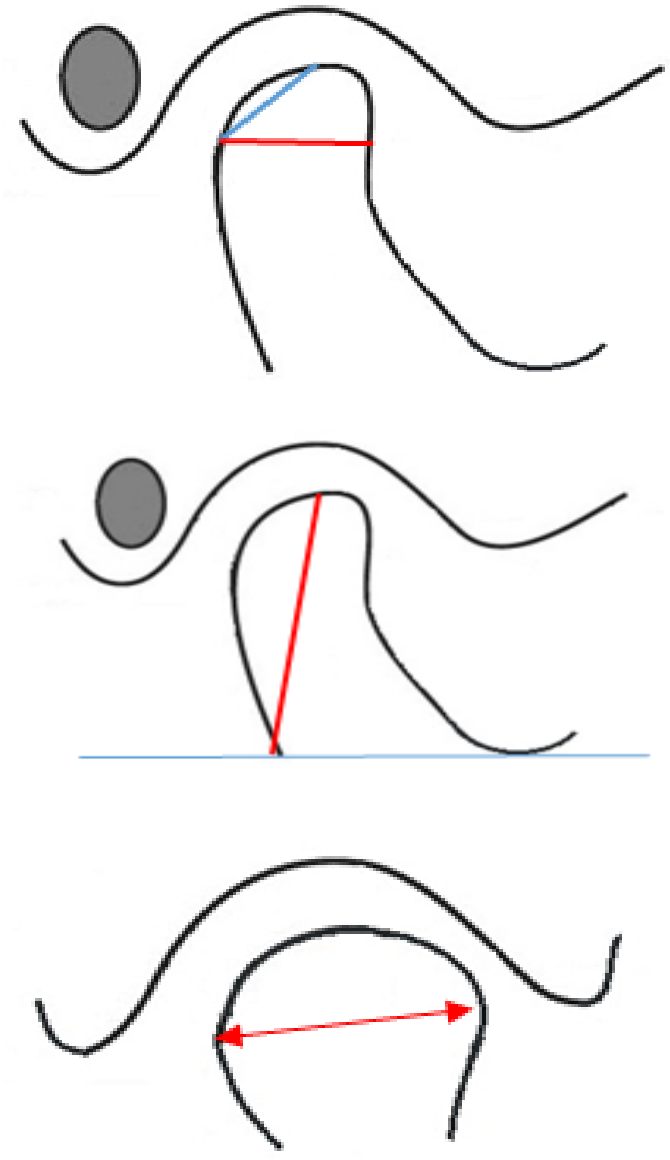
Condylar length



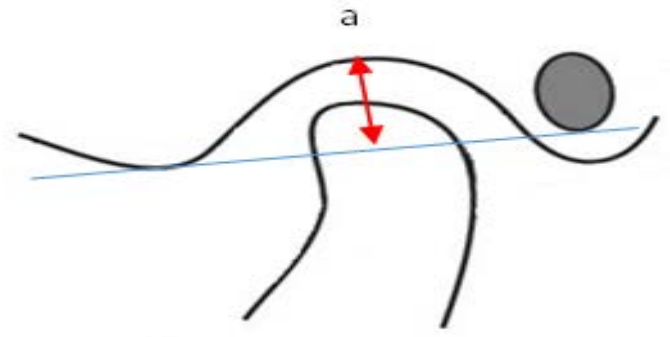
Condylar Height



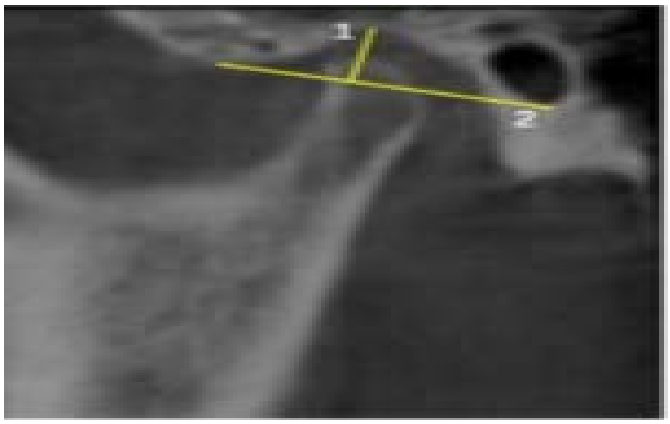
Condylar Width



1. Glenoid fossa size: condyle dimensions (maximum length, width, height)

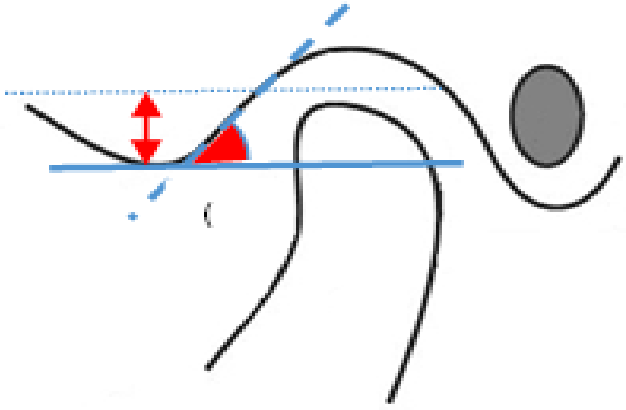


a) Depth of glenoid fossa

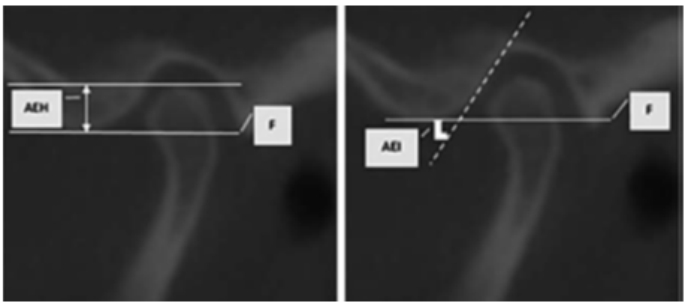


2. Articular eminence size (height): Dimensions of articular eminence (height)

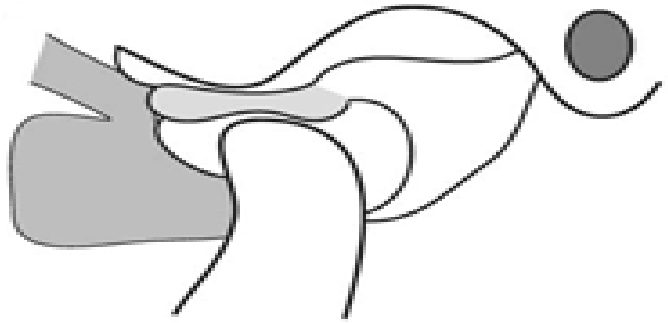
3. Articular eminence inclination: slope or angle between eminence apex and its side.

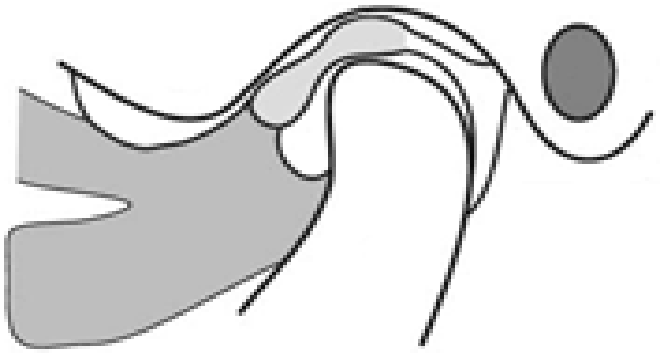


Articular eminence inclination (AEI) articular eminence height (AEH) Frankfort plan (F)

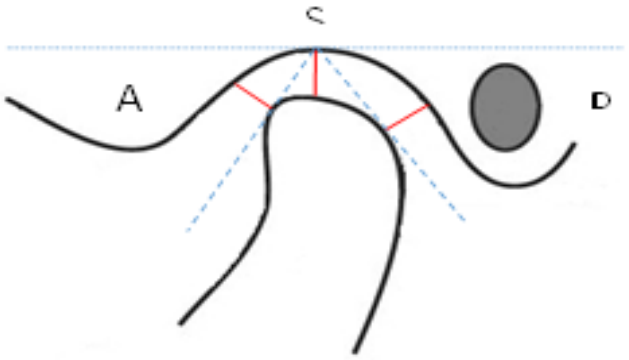


4. The relationship between articular eminence point with condyle apex with mouth open

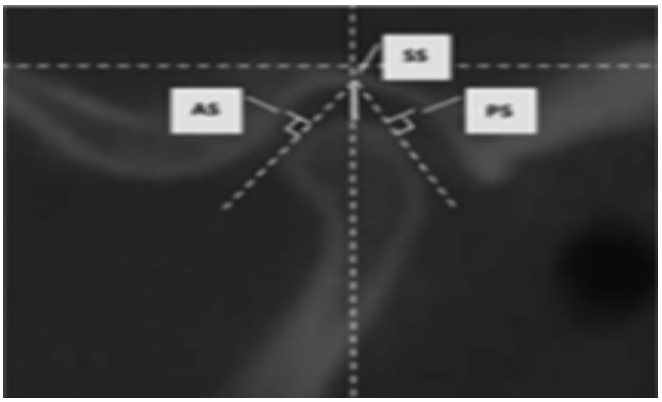




5. The position of the condyle in the glenoid fossa (measuring the distance of condyle to fossa from front, up, side)



As. Anterior space; ss, superior space; ps, posterior space;



B) Inclusion criteria

To be included in the study, the subjects must lack any: asymmetry that affects TMJ and joints like arthritis rheumatoid (juvenile arthritis rheumatoid), acute TMJ trauma, mandible fractions, TMJ involving pathologies, face surgeries, and radiotherapy of TMJ area.

A) Bigger sample sizes

Conclusions

Class III occlusion can influence the TMJ complex. Bigger condyle size, smaller articular eminence inclination is among the impacts supported by evidence. However, cases like glenoid fossa dimensions and condyle position remain controversial. Generally, occlusion impacts on TMJ still require more studies.

References

1. Song J, Cheng M, Qian Y, Chu F. Cone-beam CT evaluation of temporomandibular joint in permanent dentition according to Angle's classification. Oral Radiol. 2020 Jul;36(3):261–6.

2. Santander P, Quast A, Olbrisch C, Rose M, Moser N, Schliephake H, et al. Comprehensive 3D analysis of condylar morphology in adults with different skeletal patterns - a cross-sectional study. Head Face Med. 2020 Nov;16(1):33.

3. Saccucci M, D'Attilio M, Rodolfino D, Festa F, Polimeni A, Tecco S. Condylar volume and condylar area in class I, class II and class III young adult subjects. Head Face Med. 2012 Dec;8:34.

4. Veronica P de H, Luis-Alberto B, Jose V. Evaluation of the Mandibular Condylar Volume in Different Vertical Patterns with Cone Beam Computed Tomography in Young Adult Subjects. 16522721244 [Internet]. [cited 2021 Jul 15]; Available from: http://165.227.21.244/management_research/article_pdf/156482179806. COSD-RA180219-11.pdf

5. Hasebe A, Yamaguchi T, … TN-TA, 2019 undefined. Comparison of condylar size among different anteroposterior and vertical skeletal patterns using cone-beam computed tomography. meridian.allenpress.com [Internet]. [cited 2021 Jul 15]; Available from: https://meridian.allenpress.com/angle-orthodontist/article-abstract/89/2/306/9117

6. Jyotirmay S, Adarsh K, Sinha A, … AK-TJ of, 2021 undefined. Evaluation of Size of the Condyle in Vertical and Anteroposterior Skeletal Conditions with the Help of Cone-beam Computed Tomography. thejcdp.com [Internet]. 2020 [cited 2021 Jul 15]; Available from: https://www.thejcdp.com/doi/JCDP/pdf/10.5005/jp-journals-10024-3001

7. Khademi B, Karandish M, … MP-J of C, 2020 undefined. Comparison of Glenoid Fossa Morphology Between Different Sagittal Skeletal Pattern Using Cone Beam Computed Tomography. journals.lww.com [Internet]. [cited 2021 Jul 15]; Available from: https://journals.lww.com/jcraniofacialsurgery/Fulltext/2020/12000/Comparison_of_Glenoid_Fossa_Morphology_Between.81.aspx

8. Mostafavi M, Vahdat A, … LJ-J of C, 2018 undefined. Analysis of condylar volume in relation to craniofacial morphology using cone beam computed tomography. jocms.org [Internet]. [cited 2021 Jul 15];

Available,from:http://www.jocms.org/index.php/jcms/article/view/485

9. Yamashita FC, Yamashita AL, Romanichen IMM, Tolentino EDS, Chicarelli M, Iwaki LCV. Three-dimensional evaluation of mandibular condyle and coronoid process according to sex, age, and skeletal deformities. Cranio - J Craniomandib Pract. 2020;

10. Arieta-Miranda JM, Silva-Valencia M, Flores-Mir C, Paredes-Sampen NA, Arriola-Guillen LE. Spatial analysis of condyle position according to sagittal skeletal relationship, assessed by cone beam computed tomography. Prog Orthod. 2013 Oct;14:36.

11. Chae J-M, Park JH, Tai K, Mizutani K, Uzuka S, Miyashita W, et al. Evaluation of condyle-fossa relationships in adolescents with various skeletal patterns using cone-beam computed tomography. Angle Orthod. 2020 Mar;90(2):224–32.

12. Ganesh G, Maheswari DU, Vijayalakshmi D, Nagachandran D, Ponraj DRR. Evaluation And Comparison of The Relationship of Condyle And Mandibular Fossa In Patients with Class I , Class II Division I And Class III Malocclusion : A Cone Beam Computed Tomography Study. In 2017.

13. Lobo F, Tolentino E de S, Iwaki LCV, Walewski LÂ, Takeshita WM, Chicarelli M. Imaginology Tridimensional Study of Temporomandibular Joint Osseous Components According to Sagittal Skeletal Relationship, Sex, and Age. J Craniofac Surg. 2019 Jul;30(5):1462–5.

14. Loiola ME de A, Fuziy A, Higa RH, Fuziy CHF, Gandini Júnior LG, Costa ALF. In vivo three-dimensional cephalometric landmarks using CBCT for assessment of condylar volume and surface in individuals with Class I, II, and III malocclusions. Cranio. 2020 Dec;1–6.

15. Mishra R, Kharbanda OP, Balachandran R. 3D CBCT Evaluation of Condyle Position in Skeletal Class I & Class III Growing Subjects. Orthod J Nepal. 2018;7:9–14.

16. Paknahad M, Shahidi S, Abbaszade H. Correlation between condylar position and different sagittal skeletal facial types. J Orofac Orthop = Fortschritte der Kieferorthopadie Organ/official J Dtsch Gesellschaft fur Kieferorthopadie. 2016 Sep;77(5):350–6.

17. Khademi B, Karandish M, Paknahad M, Farmani S. Comparison of Glenoid Fossa Morphology Between Different Sagittal Skeletal Pattern Using Cone Beam Computed Tomography. J Craniofac Surg. 2020;31(8):e789–92.