Flattening of the posterior slope of the articular eminence of completely edentulous patients compared to patients with maintained occlusion in relation to age using computed tomography

Luma abdul-Rada abdul-Nabi, B.D.S., D.D.S. [(1)]
Lamia H. Al-Nakib, B.D.S., M.Sc. [(2)]

ABSTRACT

Background: The posterior slope of the articular eminence of completely edentulous patients compared to patients with maintained occlusion shows significant flattening. This study aimed to correlate between the flattening of the posterior slope of the articular eminence, with dental status, age, genders, on both sides using computed tomography.

Materials and Methods: The sample of the present study was a total of 117 Iraqi subjects, who admitted to the maxillofacial department at Al-Sadr Teaching Hospital in Al-Najaf city. The examination was performed on CT scanner; the eminence inclination was measured in two methods using sagittal section.

Results: Clinically, the inclination of articular eminence was higher in edentulous subjects than in dentate subjects. While no statistically significant differences were found in the eminence inclination between the age groups. No statistically significant differences were found between the right and left side measurements or between female and male subjects.

Conclusion: There were no statistically significant differences in eminence inclination according to sex, age and between right and left side. The flattening of the articular eminence was significantly higher in completely edentulous patients than in patients with maintained occlusion.

Keyword: Elderly, complete edentulousness, condyle of the mandible, articular eminence, condylar inclination. (J Bagh Coll Dentistry 2015; 27(2):66-71).

INTRODUCTION

TMJ is a complex articular system which is located between the mandible and the temporal bone [(1)]. The osseus parts of TMJ, in addition to other factors, exert important influence upon the magnitude of the lower jaw movement.

Particularly, the slope of the posterior wall of the articular eminence [(2)], which is that part of the temporal fossa over which the condyle-disk complex, slides during the various mandibular movements. The articular eminence inclination is defined as the angle formed by the articular eminence and the Frankfort horizontal (FH) plane or any other horizontal plane, such as the occlusal or palatal plane.[(3)]

Flattening of the articular eminence might occur via Disuse or lesser masticatory activity in edentulous patients and changes in the consistency of their diets seem to generate it. Another possible cause can be observed such as partial edentulism, orthopedic aparotology and orthodontic strengths, Angle's class II and III malocclusions, over closure, the presence of TMJ disorders. [(4-14)]

Alterations from erosion, osteophyte formation, anterior disc displacement with reduction or anterior disc displacement without reduction.

(1) Master Student, Department of Oral Diagnosis, College of Dentistry, University of Baghdad.
(2) Assistant Professor, Department of Oral Diagnosis, College of Dentistry, University of Baghdad.

These transformations appear to represent an adaptation of the condyle, articular disc and the articular eminence to changes in loading. [(15)] Some authors have found a connection between the loss of teeth and the articular eminence inclination [(16,17)]. Such changes are significant when individuals have been edentulous for periods lasting more than three years [(18).]

There are several methods to determine the angulation of the posterior slope of the articular eminence. Some authors took anthropological measurements carried out on dry skulls, while others utilized medical imaging techniques (conventional radiography and tomography, MRI and CT [(19)]. The application of conventional CT in imaging the TMJ has been most significant for the evaluation of hard tissue or bony changes of the joint. Multidetector CT (MDCT) demonstrated the highest accuracy, with 93% sensitivity and 100% specificity [(20)].

MATERIALS AND METHODS

The study sample consists of 117 Iraqi subjects (60 male and 57 female) with age ranged from (20-80) years, attending to the maxillofacial department at Al-Sadr Teaching Hospital in Al-Najaf city.

The sample was divided into three groups:-

1- Group I: 20- 30 years with maintained occlusion (males: 20, females: 21)

2- Group II: over 50 years with maintained occlusion (males: 19, females: 19)
3- Group III: edentulous subjects over 50 years at least for three years (males: 21, females: 17)
The three groups were compared according to dentalstatus, age, sex and side. Patients with degenerative disorders of TMJ like interal derangement, arthritis, bruxism and history of orthodontic treatment were excluded from the study.

The eminence inclination was measured in two methods using sagittal section which were:-
1-**Best-fit line method:-** The best-fit plane of the articular eminence posterior surface was drown, in sagittal section. Frankfort horizontal plane was drawn. The angle that formed between two planes in sagittal section was measured (eminence inclination), (Figure 1). This method was done for the right &left sides.

Figure 1: Angle between two planes in sagittal section represented the eminence inclination.

2- Top-roof line method

Which is the angle between the plane passing through the points (the deepest point of articular eminence & the highest point of the fossa) and Frankfort horizontal plane, in sagittal section. The plane which joined the two points was drawn (highest point of the mandibular fossa & the deepest point of the articular eminence). Frankfort horizontal plane was drown. Angle that formed between two planes in sagittal section (which represent the articular eminence inclination), was measured (Figure 2). This was done for right &left sides.

Figure 2: Angle between two planes in sagittal section (which represent the articular eminence inclination).

Statistical analyses were done using SPSS version 21 Frequency distribution for selected variables was done first. The primary outcome quantitative variable (slope measurement) for the present study was shown to be normally distributed. Such quantitative variables are described by mean, SD, SE. The independent samples t-test was used to assess the statistical significance of difference in mean between 2 groups. ANOVA trend model was used to test the statistical significance of difference in mean of a quantitative normally distributed variable with age group.

RESULTS

The mean of PSAEI angle was significantly higher among dentate group compared to edentulous group. The difference in mean (-6.6^{o}, -14.5^{o}). While the effect of being edentulous was strong (Cohen's d = -1.73, -2.14). Table 1 and Figure 3.

Table 1: The differences in mean measurement of PSAEI angle between dentate and edentulous group.

	Being edentulous for 50+ years only		Diff. in mean	Cohen's d	P
	Dentate	Edentulous			
Mean of left and right side (top roof line method)					
Range	(36.1 to 46)	(24 to 42)	-6.6	-1.73	**<0.001**
Mean	41	34.4			
SD	2.8	4.7			
SE	0.63	1.15			
N	19	17			
Mean of left and right side (best fit line method)					
Range	(52 to 72.5)	(32 to 61.5)	-14.5	-2.14	**<0.001**
Mean	62	47.5			
SD	6.1	7.5			
SE	1.39	1.83			
N	19	17			

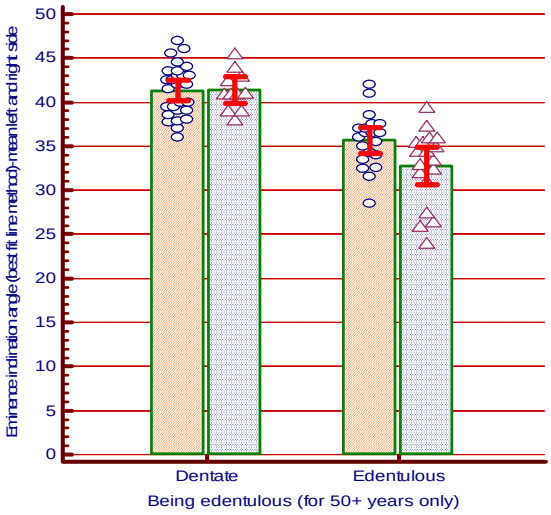

Figure 3: Dot diagram with error bars showing the mean measurements of PSAEI angle(top-roof method) by age and dentition status(with its 95%CI).

The eminence inclination value of males were higher than those of females in both dentate and edentulous groups for right and left sides and by two way of measurements; however, these differences were not statistically significant (p> 0.05).Comparing the differences between the mean angle values of right and left sides of the three groups, it can be seen that the values found in the group of elderly patients with maintained occlusion were much closer to the values of the young group. No significant difference was measured between the right and left side in these groups (P> 0.05). Table 2

Table 2: Age difference in mean measurement of PSAEI angle (Dentate only)

	Age group (years)			P
	Group I<=30	Group II 50-69	Group III 70+	
PSAEI angle (top-roof method)-mean left and right side				
Range	(38 to 51.3)	(36.1 to 47)	(38 to 45.5)	
Mean	42.7	41.3	4O.7	
SD	3.1	2.9	2.3	0.18[NS]
SE	0.49	0.56	0.68	
N	41	27	11	
PSAEI angle (best-fit-line) mean left and right side				
Range	(57 to 72.2)	(52 to 69)	(54 to 70)	
Mean	63.8	60.9	60	
SD	4.1	5.1	5	0.84[NS]
SE	0.63	0.98	1.5	
N	41	27	11	

The mean of left and right side was higher in group I compare to group II, difference in mean was (-5.5^{o},-2.9 ^{o}). The effect was strong (Cohen's d = -0.85, -0.78) table 3.

There was no significant difference between right and left side in dentate and edentulous group and by two ways of measurements (Figure 4).

Table 3: Age difference in mean measurement of PSAEI angleedentulous group

	Age group(years)		Diff. in mean	Cohen's d	P
	Group 1 (50-69)	Group 2 70+			
Mean of left and right side (best-fit-line)					
Range	(41 to 61.5)	(32 to 57.5)	-5.5	-0.85	**0.013**
Mean	51	45.5			
SD	5.5	7.4			
SE	1.24	1.75			
N	20	18			
Mean of left and right side (top-roof-method)					
Range	(28.5 to 42)	(24 to 39.5)	-2.9	-0.78	**0.021**
Mean	35.7	32.8			
SD	3.1	4.3			
SE	0.7	1			
N	20	18			

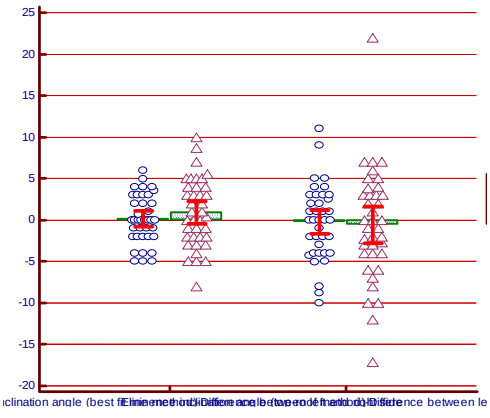

Figure 4: Dot diagram PSAEI angle-difference between right and left side

DISCUSSION

From analysis shown in Table 1 & figure 1 there was significantly increase in reduction in PSAEI in edentulous group compare to dentate group. flattness of articular eminence directly propotion with loss of teeth & this effect was strong as the cohen's > 0.8.

Whats found is in agreement with other studies who reported the same relationships [11,14,15, 21,22].Some authors concluded thata reduction in the height of the fossa was observed in individuals who had remained edentulous for three years compared to dentate subjects.[20,17,4,9,10]

This study is disagreed with other previous investigations that show the loss of teeth has no effect upon the articular eminence inclination [2,23].

In the current study showed that gender had no significant effect on PSAEI, however, the mean of eminence inclination value in males were higher than in females These marginal differences were not statistically significant. found that there were no differences in eminence inclination by gender[15]. There are few studies in the literature that found a difference in eminence inclination according to gender.[2,24,25,26]These differences may be attributed to the sample sizes used in these studies.

From Table2,the mean of left and right side of PSAEI was found to be highest in the group I (42.7°,63.8°), followed by group II (41.3°,60.9°), and lowest in the group III (40.7° , 60°).But the differences in mean not reach significant effect related to measurements of articular eminence. So the age has no or mild effect on articular eminence. Similar findings were reported by **Dilhan** [26]. Even though less adaptive capacity is recognized during an individual's advanced age, articular remodelling in such people has been proved to be constant, especially in edentulates having total prosthesis [9]**.** This study is in disagreement with previous studies by **Kurita** [27] **and Sülün** [28] who reported that morphological changes may occur in the eminence structure with advanced age and this results in the flattening of the eminence in the long term. In the present study, it was found that there was a significant difference between the mean of right and left sides of subjects in group I and group II,(35.7°, 51°) (31.1°,45.5°) respectively, differences in mean (-2.9°,-5.5°) this mean increase in reduction with age & the effect of age was moderate to strong on PSAEI (cohen's -0.78 ,-0.85)(table 3)

It was noted that eminence inclination is dependent not only upon age but also on dental status in edentulous subjects, so it would be wrong to assess eminence inclination according to age only in edentulous subjects. This is in agreement with other sciences [15] reported the flattening of the articular eminence could be correlated with age; however, the rate of deformation is significantly higher in completely edentulous patients than in patients with a maintained occlusion. Similar findings were reported by previous studies [28-30].

Ballesteros et al [1] concluded that there was association between dental state and age as being determinant factors in reducing mandibular fossa depth.

No significant differences were observed between left and right side. This is in agreement with **Kinga et al** [15] reported no significant difference was measured between the two sides.

Zabarovil [2] concluded that the asymmetry between the left and right joint was almost a rule, and the difference reaches up to 30°.

In this study, Figure 2 showed no differences between the two methods of measurements, both angles represent the articular eminence inclination, the (best fit line–Frankfurt horizontal plane) focuses primarily on the posterior surface of the eminence, whereas the latter method (fossa roof–eminence top, Frankfurt horizontal plane) focuses on the location of the eminence crest relative to the fossa roof. It seems that ‘‘best fit line’’ method is more accurate due to the fact that the posterior slope of the articular-eminence is easy to observe (and measure the inclination), while the location of the eminence crest and the fossa roof are more subjected to individual determination (possibility of mistake) [3]**.**

REFERENCES

1. Ballesteros LE. Ramirez LM, Muñoz G. Mandibular fossa depth variations: Relation to age and dental state. Int J Morphol 2011; 29(4): 1189-94.
2. Zabarovic D, Jerolimov V, Carek V, Vojvodic D, Zabarovic K, Bukovic D Jr. The effect of tooth loss on the tm-joint articular eminence inclination. Coll Antropol 2000; (Suppl 1): 37–42.
3. Katsavrias EG. Changes in articular eminence inclination during the craniofacial growth period. Angle Orthod 2002; 72(3): 258–64.
4. Oberg T, Carlsson GE, Fajers CM. The temporomandibular joint. A morphologic study on a human autopsy material. Acta Odontol Scand 1971; 29(3): 349-84.
5. Carlsson GE, Oberg T. Remodelling of the temporomandibular joints. Oral Sci Rev 1974; 6(0): 53-86.
6. Granados J. The influence of the loss of teeth and attrition on the articular eminence. J Prosthetic Dent 1979; 42: 78–85.
7. Floridi A, Matson E. Contribution to the study of variation of the depth of the human jaw cavity, face of the total absence of the permanent teeth. Rev OdontUSP1987; 1:42-5.
8. Pirttiniemi P, Kantomaa T, Rönning O. Relation of the glenoid fossa to craniofacial morphology, studied on

dry human skulls. Acta Odontol Scand 1990; 48(6): 359-64.
9. Taddei C, Frank RM, Cahe PM. Effects of complete denture wearing on temporomandibular joints: a histomorphometric study. J Prosthet Dent 1991; 65(5): 692-8.
10. Pirttiniemi P, Kantomaa T. Relation of glenoid fossa morphology to mandibulofacial asymmetry, studied in dry human Lapp skulls. Acta Odontol Scand 1992; 50(4): 235-43.
11. Galante G, Paesani D, Tallents RH, Hatala MA, Katzberg RW, Murphy W. Angle of the articular eminence in patients with temporomandibular joint dysfunction and asymptomatic volunteers. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1995; 80(2): 242-9.
12. Katsavrias EG, Halazonetis DJ. Condyle and fossa shape in Class II and Class III skeletal patterns: a morphometric tomographic study. Am J Orthod Dentofacial Orthop 2005; 128(3):337-46.
13. Jasinevicius TR, Pyle MA, Lalumandier JA, Nelson S, Kohrs KJ, Türp JC, Sawyer DR. Asymmetry of the articular eminence in dentate and partially edentulous populations. Cranio 2006; 24(2): 85-94.
14. Jasinevicius TR, Pyle MA, Nelson S, Lalumandier J. A, Kohrs KJ, Sawyer D. R. Relationship of degenerative changes of the temporomandibular joint (TMJ) with the angle of eminentia. J Oral Rehabil 2006; 33(9): 638-45.
15. Csado K, Marton K, Pe´ ter. Anatomical changes in the structure of the temporomandibular joint caused by complete edentulousness. The Gerodontology Society and John Wiley & Sons A/S, Gerodontology 2012; 29: 111–16.
16. Mongini F. Changes in the temporo-mandibular joint in partial edentulism. Minerva Stomatol 1968; 17(10): 850-8.
17. Mongini F. Remodelling of the mandibular condyle in the adult and its relationship to the condition of the dental arches. Acta Anat (Basel) 1972; 82(3):437-53.
18. Moffett BC, Johnson LC, Mccabe JB, Askew HC. Articular remodeling in the adult human temporomandibular joint. Am J Anat1964; 115:119-41.
19. Sümbüllü MA, Çağlayan F, Akgül HM, Yilmaz AB. Radiological examination of the articular eminance morphology using cone beam CT. March 2012; 41(3): 234–240.
20. Moffett BC, Johnson L C, Mccabe JB, Askew HC. Articular remodeling in the adult human temporomandibular joint. Am J Anat 1964; 115:119-41.
21. Raustia A. Effect of edentulousness on mandibular size and condyle fossa position. J Oral Rehabil 1998; 25:174–9.
22. Yamada K, Tsuruta A, Hanada K, Hayashi T. Morphology of the articular eminence in temporomandibular joints and condylar bone change. J Oral Rehabil 2004; 31: 438–44.
23. Kranjčić J, Vojvodić D, Žabarović D, Vodanović M, Komar D, Mehulić K. Differences in articular-eminence inclination between medieval & contemporary human populations. Arch Oral Biol 2012; 57(8):1147-52.
24. Zivko-Babic´ J, Panduric´ J, Jerolimov V, Mioc M, Pizeta L,Jakovac M. Bite force in subjects with complete dentition. Coll Antropol 2002; 26: 293–302.
25. Ejima K, Schulze D, Stippig A, Matsumoto K, Rottke D, Honda K. Relationship between the thickness of the roof of glenoid fossa, condyle morphology and remaining teeth in asymptomatic European patients based on cone beam CT data sets. Dentomaxillofacial Radiology 2013; 42(3): 90929410.
26. Elgüy D, Elgüy M, FiGekçioLlu E, DölekoLlu S, Ersan N. Articular Eminence Inclination, Height, and Condyle Morphology on Cone Beam Computed. Turkey Hindawi Publishing Corporation the Scientific World J 2014.
27. Kurita H, Ohtsuka A, Kobayashi H, Kurashina K. Flattening of the articular eminence correlates with progressive internal derangement of the temporomandibular joint. Dentomaxillofac. Radiol 2000; 29(5): 277-9.
28. Kurita H, Ohtsuka A., Kobayashi H. & Kurashina K. Flattening of the articular eminence correlates with progressive internal derangement of the temporomandibular joint. Dentomaxillofac Radiol 2000; 29(5): 277-9.
29. Touré G, Duboucher C. & Vacher C. Anatomical modifications of the temporomandibular joint during ageing. Surg Radiol Anat 2005; 27(1): 51-5.
30. Meng FW, Hu KJ, Zhou SX, Ning WD, Yang XC, Liu CK. The value of multislice helical CT in the morphological study of temporomandibular joint. J Pract Radiol 2006; 22: 1308-11.