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Pilot study of the Osseous Morphological Changes in the Temporomandibular Joint in Subjects with Bilateral Missing Lower Posterior Teeth

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Abstract - We evaluated osseous morphological changes in the temporomandibular joints (TMJ) in subjects with bilateral missing lower posterior teeth. We selected 13 men with class I dental occlusion who fulfilled the study criteria. They were assigned to control group comprising 8 subjects with complete set of teeth, and test group comprising 5 subjects with bilateral missing lower posterior teeth. Two cephalometric radiographs were taken for each subject, one as base line and the other after 7 months for linear measurements of the mandibular condyle. The test group showed an increase in glenoid fossa depth (base line and after 7 months, and a slight decrease in the anterior-posterior dimension of the. The control group showed an increase in glenoid fossa depth and an increase in the anterior-posterior dimension of the condyle Our findings do not support the hypothesis that loss of occlusal support causes osseous changes in the TMJ in men. However, this could be due to the small sample size and shorter study duration. We suggest that these changes be studied using a larger sample size to achieve stronger conclusions.

Key words: temporomandibular joint_ partial edentulism _ cephalograms _ osseous morphology _ occlusal support

1 Introduction

The temporomandibular joint (TMJ) is composed of two compartments: the lower compartment contains the head of the mandibular condyle and the upper compartment The TMJ is a highly specialized articulation. It differs from the other synovial joints in that its articular surfaces are composed of dense fibrous tissue that functions as cartilage 1.It is also an arthrodial joint permitting gliding motion 2-3. Temporomandibular disorders (TMDs) are the most common chronic orofacial pain condition 4. A constellation of signs and symptoms including joint tenderness and pain on function and headache may also be features 5, 6. Three main groups of etiological factors are involved in the development of TMDs: anatomical factors including occlusion, neuromuscular factors and psychogenic factors 7. Functional natural dentition with more than 20 teeth is required for acceptable oral health and may important for maintaining a healthy body mass index into old age 8. Adequate occlusal support enables efficient chewing and may indirectly prevent TMDs 9. Reportedly, osseous contains the glenoid fossa and the articular eminence. The articular disc separates the compartments each of which has a synovial sac for nutrition and lubrication. changes in the articular components of the TMJ and variations in the osseous components of the TMJ correlate with occlusal disharmony 10. For example, unilateral or bilateral absence of all posterior teeth increases the risk of pain and joint sounds 11. Further, condylar positioning during clenching is related to the posterior occlusal support 12, and loss of such support leads to noticeable condylar movements 13.

Therefore, the osseous morphology of the TMJ in subjects with bilateral missing lower posterior teeth should be significantly different from that in subjects with a complete dentition. To validate this hypothesis, changes in the osseous morphology of the TMJ with bilateral missing lower posterior teeth and those with a complete dentition were evaluated by linear cephalometric measurements.

2 Subjects and Methods

The duration of this study was 12 months. In the first three months, 13 subjects were selected from the out-patient list of a dental clinic for enrolment. They included 8 subjects with a complete dentition and 5 subjects with bilateral missing lower posterior teeth. This study was approved by the University Sains Malaysia Research and Ethics Committee (Approval no [218.4. (2.1)]). All subjects gave written informed consent for participation.

The inclusion criteria were as follows: male gender 14, 15, class I occlusion, age between 35 and 70 years, absence of systemic diseases causing bone resorption. Subjects were excluded if they had abnormal occlusion (class II or class III), oro-facial muscular problems, and symptoms of TMDs,

history of an accident involving the TMJ or medication affecting bone resorption. Further, staff members, subjects with any other conditions considered unsuitable for the study by the investigators and those withdrew from the study were excluded.

For each subject cephalograms were obtained at the baseline and 7 months of follow up. The following linear measurements were carried out 16:

Glenoid depth, the distance from the deepest point of the glenoid fossa to the plane joins the vertex of the postglenoid process to the top of the convexity of the articular tubercle. Anteroposterior condyle dimension, the distance between the most prominent points on the anterior and posterior surfaces of the condoyle perpendicular to the mediolateral axis.

Morphometric findings, including the changes over the study period, are summarized in Table 1. Subjects with a complete dentition showed increased glenoid depth. However, these subjects had an increase in anterior-posterior condylar dimension and slight decrease in anterior facial height at 7 months compared with the baseline (Figures 1A, 1B).

Anterior facial height, the distance from the sub-nasal septum to the menton.

An Orthoralix 9200 panoramic system (Gendex Dental Systems, Des Plaines, IL, USA)was used for cephalograms with the following specifications 17:

magnification 1.1, default kV factor 70 kV for 0.8 s in small –size subjects, 74 kV for 0.8 s in medium –size subjects and 78 kV for 0.8 s in large-size subjects, peak voltage 60-84 kV, tube current 3-15 mA, exposure time 0.16-2.50 s.

Data were collected and entered into SPSS version 18. Due to the small sample size, we could not use P values; therefore, median and interquartile range (IQR) was used to describe the numerical variables.

3 Results:

The subjects with bilateral missing lower posterior teeth had increased glenoid depth, a slightly decreased anterior posterior condylar dimension and slightly increased anterior facial height at 7 months compared with the baseline (Figure 2A).

Table 1: Show Median and Interquartile Range base line and after 7 months

Variable	Median (IQR)	Difference
Ant. Posterior Condyle-1 Base	1.1500 (0.305)	Increase by 0.020
Ant. Posterior Condyle-1 After	1.1700 (0.180)	
Ant. Posterior Condyle-2 Base	1.1300 (0.575)	Decrease by 0.008
Ant. Posterior Condyle-2 After	1.1100 (0.505)	
Glenoid depth-1 Base	.8650 (0.353)	Increase by 0.085
Glenoid depth-1 After	1.0550 (0.215)	
Glenoid depth-2 Base	.8600 (0.210)	Increase by 0.002
Glenoid depth-2 After	.7500 (0.310)	
Ant. Face-1 Base	7.2850 (0.478)	Decrease by 0.135
Ant. Face-1 After	7.1200 (0.713)	
Ant. Face-2 Base	7.1700 (0.735)	Increase by 0.168
Ant. Face-2 After	7.2100 (0.545)	

Table 2: above shows the mean for the base line measurement and after 7 months of measurement.

Descriptive Statistics

		N	Mean	Std. Deviation	Minimum	Maximum
Group 1	Ant. Posterior Condyle-1 Base	8	1.1975	0.20714	0.98	1.6
	Ant. Posterior Condyle-1 After	8	1.2175	0.11548	1.09	1.43
	Ant. Posterior Condyle-2 Base	5	1.16	0.34095	0.84	1.71
	Ant. Posterior Condyle-2 After	5	1.152	0.2835	0.84	1.58
	Glenoid depth-1 Base	8	0.9513	0.19867	0.73	1.26
	Glenoid depth-1 After	8	1.0362	0.12603	0.83	1.17
	Glenoid depth-2 Base	5	0.832	0.11189	0.69	0.97
	Glenoid depth-2 After	5	0.834	0.16257	0.68	1.01
	Ant. Face-1 Base	8	7.32	0.53926	6.39	8.31
	Ant. Face-1 After	8	7.185	0.43681	6.65	7.96
	Ant. Face-2 Base	5	7.068	0.40388	6.64	7.63
	Ant. Face-2 After	5	7.236	0.3115	6.78	7.61

Ranks

		N	Mean Rank	Sum of Ranks
Ant. Posterior Condyle-1 After - Ant. Posterior Condyle-1 Base	Negative Ranks	1[a]	8.00	8.00
	Positive Ranks	7[b]	4.00	28.00
	Ties	0[c]		
	Total	8		

a. Ant. Posterior Condyle-1 < Ant. Posterior Condyle-1

b. Ant. Posterior Condyle-1 > Ant. Posterior Condyle-1

Ranks

		N	Mean Rank	Sum of Ranks
Ant. Posterior Condyle-1 After - Ant. Posterior Condyle-1 Base	Negative Ranks	1[a]	8.00	8.00
	Positive Ranks	7[b]	4.00	28.00
	Ties	0[c]		
	Total	8		

a. Ant. Posterior Condyle-1 < Ant. Posterior Condyle-1

b. Ant. Posterior Condyle-1 > Ant. Posterior Condyle-1

c. Ant. Posterior Condyle-1 = Ant. Posterior Condyle-1

From the table's legend that 1 subject had a higher Ant. Posterior condyle before treatment than after their treatment. However, 7 subjects had a higher Ant. Posterior condyle after treatment and 0 subject saw no change in their Ant. Posterior condyle.

Test Statistics[b]

	Ant. Posterior Condyle-1 After - Ant. Posterior Condyle-1 Base
Z	-1.404[a]
Asymp. Sig. (2-tailed)	.160

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

A Wilcoxon Signed Ranks Test showed that a Ant. Posterior condyle before and after treatment did not elicit a statistically significant change. (Z = -1.404, P = 0.160).

2. Group 2

Ranks

		N	Mean Rank	Sum of Ranks
Ant. Posterior Condyle-2 After - Ant. Posterior Condyle-2 Base	Negative Ranks	2[a]	2.50	5.00
	Positive Ranks	2[b]	2.50	5.00
	Ties	1[c]		
	Total	5		

a. Ant. Posterior Condyle-2 After < Ant. Posterior Condyle-2 Base

b. Ant. Posterior Condyle-2 After > Ant. Posterior Condyle-2 Base

c. Ant. Posterior Condyle-2 After = Ant. Posterior Condyle-2 Base

From the table's legend that 2 subject had a higher Ant. Posterior condyle before treatment than after their treatment. There were also 2 subjects had a higher Ant. Posterior condyle after treatment and only 1 subject saw no change in their Ant. Posterior condyle.

Test Statistics[b]

	Ant. Posterior Condyle-2 After - Ant. Posterior Condyle-2 Base
Z	.000[a]
Asymp. Sig. (2-tailed)	1.000

a. The sum of negative ranks equals the sum of positive ranks.

b. Wilcoxon Signed Ranks Test

A Wilcoxon Signed Ranks Test cannot be done since the sum of negative ranks equals to the sum of positive ranks.

≈ Comparing between Group 1 (p-value = 0.160) and Group 2, maybe we can say that Group 1 more significant.

3. Group 1

Ranks

		N	Mean Rank	Sum of Ranks
Glenoid depth-1 After - Glenoid depth-1 Base	Negative Ranks	2[a]	4.25	8.50
	Positive Ranks	6[b]	4.58	27.50
	Ties	0[c]		
	Total	8		

a. Glenoid depth-1 After < Glenoid depth-1 Base

b. Glenoid depth-1 After > Glenoid depth-1 Base

c. Glenoid depth-1 After = Glenoid depth-1 Base

From the table's legend that 2 subject had a higher Ant. Posterior condyle before treatment than after their treatment. However, 6 subjects had a higher Ant. Posterior condyle after treatment and again 0 subject saw no change in their Ant. Posterior condyle.

Test Statistics[b]

	Glenoid depth-1 After - Glenoid depth-1 Base
Z	-1.334[a]
Asymp. Sig. (2-tailed)	.182

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

A Wilcoxon Signed Ranks Test showed that a Ant. Posterior condyle before and after treatment did not elicit a statistically significant change. (Z = -1.334, P = 0.182).

4. Group 2

Ranks

		N	Mean Rank	Sum of Ranks
Glenoid depth-2 After - Glenoid depth-2 Base	Negative Ranks	3[a]	2.33	7.00
	Positive Ranks	2[b]	4.00	8.00
	Ties	0[c]		

	Total	5		

a. Glenoid depth-2 After < Glenoid depth-2 Base

b. Glenoid depth-2 After > Glenoid depth-2 Base

c. Glenoid depth-2 After = Glenoid depth-2 Base

However, from the table's legend above shows that 3 subject had a higher Ant. Posterior condyle before treatment than after their treatment. In contradiction, 2 subjects had a higher Ant. Posterior condyle after treatment and 0 subjects saw no change in their Ant. Posterior condyle.

Test Statistics[b]

	Glenoid depth-2 After - Glenoid depth-2 Base
Z	-.135[a]
Asymp. Sig. (2-tailed)	.893

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

A Wilcoxon Signed Ranks Test showed that a Ant. Posterior condyle before and after treatment did not elicit a statistically significant change. (Z = -0.135, P = 0.893).

≈ Comparing between Group 1 (p-value = 0.182) and Group 2 (p-value = 0.893), maybe we can say that Group 1 is more significant since the p-value for Group 1 is lower than Group 2.

5. Group 1

Ranks

		N	Mean Rank	Sum of Ranks
Ant. Face-1 After - Ant. Face-1 Base	Negative Ranks	6[a]	4.83	29.00
	Positive Ranks	2[b]	3.50	7.00
	Ties	0[c]		

	Total	8		

a. Ant. Face-1 After < Ant. Face-1 Base

b. Ant. Face-1 After > Ant. Face-1 Base

c. Ant. Face-1 After = Ant. Face-1 Base

Same from table before, table above also a higher by 6 subject had a higher Ant. Posterior condyle before treatment than after their treatment. Only subjects had a higher Ant. Posterior condyle after treatment and 0 subject saw no change in their Ant. Posterior condyle.

Test Statistics[b]

	Ant. Face-1 After - Ant. Face-1 Base
Z	-1.540[a]
Asymp. Sig. (2-tailed)	.123

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

A Wilcoxon Signed Ranks Test showed that a Ant. Posterior condyle before and after treatment did not elicit a statistically significant change. (Z = -1.540, P = 0.123).

6. Group 2

Ranks

		N	Mean Rank	Sum of Ranks
Ant. Face-2 After - Ant. Face-2 Base	Negative Ranks	1[a]	1.50	1.50
	Positive Ranks	4[b]	3.38	13.50
	Ties	0[c]		
	Total	5		

a. Ant. Face-2 After < Ant. Face-2 Base

b. Ant. Face-2 After > Ant. Face-2 Base

Ranks

		N	Mean Rank	Sum of Ranks
Ant. Face-2 After - Ant. Face-2 Base	Negative Ranks	1[a]	1.50	1.50
	Positive Ranks	4[b]	3.38	13.50
	Ties	0[c]		
	Total	5		

a. Ant. Face-2 After < Ant. Face-2 Base

b. Ant. Face-2 After > Ant. Face-2 Base

c. Ant. Face-2 After = Ant. Face-2 Base

From the table's legend that 1 subject had a higher Ant. Posterior condyle before treatment than after their treatment. However, 4 subjects had a higher Ant. Posterior condyle after treatment and 0 subject saw no change in their Ant. Posterior condyle.

Test Statistics[b]

	Ant. Face-2 After - Ant. Face-2 Base
Z	-1.625[a]
Asymp. Sig. (2-tailed)	.104

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

A Wilcoxon Signed Ranks Test showed that a Ant. Posterior condyle before and after treatment did not elicit a statistically significant change. (Z = -1.625, P = 0.104).

≈ Comparing between Group 1 (p-value = 0.123) and Group 2 (p-value = 0.104), maybe we can say that Group 2 is more significant since the p-value for Group 2 is lower than Group 1.

4 Discussions

An increase in the load per unit of bite force within the temporomandibular joints (TMJ) with greater use of anterior teeth has been reported 18. Several epidemiological investigations and animal studies have shown that manipulation of teeth (extraction, extirpation, and high occlusal contacts) can induce changes in the TMJ 19-22. An increase in degenerative changes in the TMJ was observed in patients with missing molars 23. Previous studies 24-26 have concluded that missing mandibular posterior teeth represents a cumulative risk factor in the presence of internal derangement of the TMJ. A previous study indicated that there was a small but significant increase in the prevalence of missing mandibular posterior teeth found in subjects with disk displacement and that the absence of these teeth may accelerate the development of degenerative joint diseases; however, no evidence that shortened dental arches causes overloading of the joints and teeth was provided, which indicates that neuromuscular regulatory systems are controlling maximum clenching strength under various occlusal conditions 27. Further, the studies performed by Kayseri/Nijmegen et al. have shown that shortened dental arches comprising anterior and premolar teeth in general fulfill the requirements of a functional dentition 28. In this study, only male subjects were enrolled to avoid female subjects with post-menopausal osteoporosis that might increase the rate of bone resorption and affect the results. The limited sample size is attributable to the Ethical Committee guideline that the number of subjects must not exceed 16. All equipments were calibrated and safe for use. Further, the radiographic parameters were standard because the supplier of the panoramic system adjusts and calibrates the equipment to the accepted standards. Wedel et al16 reported the use of linear measurements of the condyle to asses TMJ morphology. An increase in glenoid depth observed in all subjects, indicates increase rate of bone resorption of the glenoid fossa. The slight increase in anterior facial height noted in subjects with bilateral missing lower posterior teeth may be a result of occlusal disturbance due to missing teeth and the slight decrease in this parameter in the subjects with a complete dentition may be attributable to functional attrition.

5 Conclusions

The results of this study indicate different changes of the osseous morphology of the TMJ between the subjects. Within the study limitations, our findings do not support the view that loss of occlusal support is a causative factor for osseous changes in the TMJ. Future studies should investigate these changes in a larger sample size to drive a stronger conclusion.

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6 Acknowledgments

The authors declare that they have no conflicts of interest.

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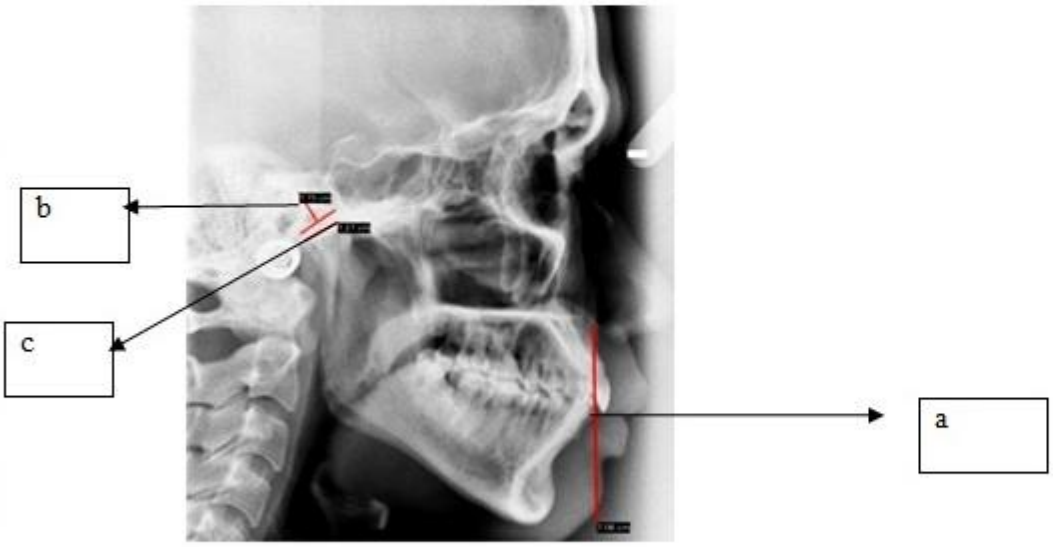

Figure 1B

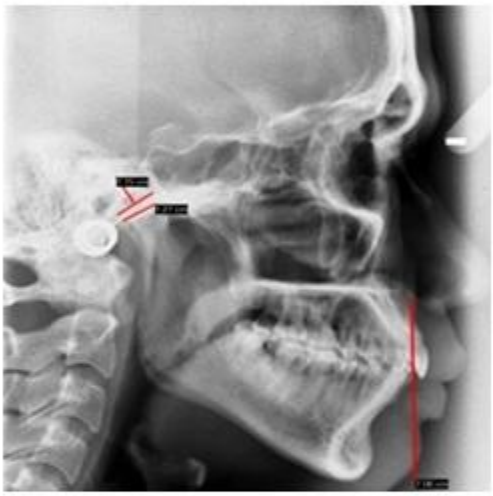

Figure 1A

Figure 2

Figure legends

Figure 1. Lateral cephalograms of a subject with a complete dentition obtained at the base line (B) and 7 months of follow-up (A).

1B: Baseline lateral cephalometric radiograph for a subject with a complete set of teeth

a - anterior face height, b - depth of glenoid, c - anterior-posterior dimension of the condyle

1A: Lateral cephalometric radiograph for a subject with a complete set of teeth after 7 months

Figure 2. Lateral cephalometric radiograph of a subject with missing lower posterior teeth after 7 months.