TURKISH JOURNAL of ORTHODONTICS

DOI: 10.5152/TurkJOrthod.2020.19108

Original Article

Evaluation of the Effect of Fixed Anterior Biteplane Treatment on Temporomandibular Joint in Patients with Deep Bite

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Cite this article as: Akarsu Güven B, Ciğer S. Evaluation of the Effect of Fixed Anterior Biteplane Treatment on Temporomandibular Joint in Patients with Deep Bite. Turk J Orthod 2020; 33(1): 8-12.

ABSTRACT

Objective: To investigate the effects of fixed anterior biteplane treatment on temporomandibular joint in deep bite patients.

Methods: The sample comprised 17 Class II patients with deep bite and decreased lower anterior facial height. The average patient age was 9.9±0.9 years. Transcranial temporomandibular joint radiographs were obtained from the subjects before (T0) and after fixed anterior biteplane treatment (T1). Anterior joint space, posterior joint space, superior joint space, anteroposterior thickness of the condylar head, vertical height of the articular fossa, and the articular fossa slope were measured on temporomandibular joint radiographs to evaluate the position of the mandibular condyles in the glenoid fossa.

Results: The average treatment duration was 8.5±2.1 months. Slope of the articular fossa, vertical height of the articular fossa, anteroposterior thickness of the condyle, posterior joint space, superior joint space, and anterior joint space showed no statistically significant difference between T0 and T1 ($p>0.05$).

Conclusion: Fixed anterior biteplane appliance treatment did not change the condyle fossa relationship in Class II deep bite patients at the time of appliance removal.

Keywords: Angle Class II, deep bite, temporomandibular joint

INTRODUCTION

The influence of abnormal occlusal characteristics on the temporomandibular joint positions have been a focus of interest in various studies (1-3). Condylar retroposition with a tendency toward smaller posterior joint spaces and larger anterior joint spaces have been reported in patients with various occlusal interferences, such as Class II malocclusion and deep bite (4-7). However, conflicting results have also been reported (8-10). Authors have suggested that these conflicting results may be due to the large age variations in the samples and the differences in the analyzing methods.

Functional appliances are commonly used in the treatment of patients at the age of 8-13 years with Class II malocclusion. Functional appliance treatment has a displacement effect on the condyle in the glenoid fossa and results in growth at the condylar cartilage and joint adaptation (11). Fixed anterior biteplane appliance is a fixed functional appliance that can be used to correct Class II malocclusion and deep bite (12). The treatment outcomes were as follows: increased lower facial height, increased total facial height, downward, and anterior movement of the mandible, labial inclination of the mandibular incisors, and extrusion of the mandibular posterior teeth (12).

Thus far, many studies on the condylar positional changes caused by functional treatment have been performed (11, 13-16). However, to our knowledge, there is no consensus regarding the influence of functional treatment on the temporomandibular joint position in Class II deep bite patients.

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Received: December 20, 2019
Accepted: February 17, 2020

Therefore, this study aimed to analyze the condylar positional changes in patients treated with a fixed anterior biteplane appliance. The null hypothesis was that fixed anterior biteplane treatment does not change the condyle position.

METHODS

The investigation was approved by the Ethics Committee of Medical, Surgical and Drug Research of Hacettepe University (LUT 04/30). Transcranial temporomandibular joint radiographs of 17 patients (mean age: 9.9±0.9 years, Table 1) were included as per the following inclusion criteria: 1) absence of any systemic disease that may adversely affect growth and development and no craniofacial deformity, 2) Class II malocclusion, 3) deep bite ≥4 mm, 4) lower anterior facial height <43°, 5) horizontal growth pattern, and 6) mixed or early permanent dentition. No subjects had undergone orthodontic treatment previously.

All the patients were treated with a fixed anterior biteplane appliance to correct Class II malocclusion and deep bite as shown in Figure 1. Details about the preparation and application of the appliance were explained in an earlier study (12). Hawley appliances for lower and upper dental arches were used for retention after the fixed anterior biteplane treatment in 9 patients. Fixed edgewise treatment was continued after removal of the biteplane in 8 patients to correct dental irregularities, such as rotation and diastema.

In order to assess the temporomandibular joint position changes resulting from treatment, transcranial temporomandibular joint radiographs were taken before (T0) and after fixed anterior biteplane treatment (T1) in each patient. Initial radiography examinations were performed when the patients registered for orthodontic treatment (T0). The final radiograph was taken after achieving Class I molar relationship with decreased over bite (T1). The average treatment time was 8.5±2.1 months (Table 1).

Table 1. Demographic and clinical characteristics of the study population

n	Male subjects	Female subjects	Age (T0) years	Treatment time months
			mean (SD)	mean (SD)
17	8	9	9.9 (0.9)	8.5 (2.1)

SD: standard deviation

Figure 1. Intraoral photograph of the fixed anterior biteplane appliance

Transcranial temporomandibular joint radiographs were obtained under standard conditions using the same millimetric and angular values (coronal, sagittal, and vertical) for radiographs taken at T0 and T1 periods on a periapical radiography device (Planmeca Prostyle Intra, Helsinki, Finland) using the "Denar Accurad 200" head orientation device.

The position of the mandibular condyles in the glenoid fossa; anterior, posterior, and superior joint space widths; anteroposterior thickness of the condylar head; vertical height of the articular fossa; and the slope of the articular fossa were examined on the transcranial joint radiographs according to the method of Cohlmia et al. (8). Points and planes are shown in Figure 2. Measurements are shown in Figure 3.

Statistical Analyses

Statistical calculations were performed with Statistical Package for Social Sciences software, version 11.5 (SPSS Inc.; Chicago, IL, USA). Shapiro-Wilk test was used to test the normality of distribution for continuous variables. The parameters that were normally distributed were analyzed using paired-t test. The statistical significance was established at $p<0.05$.

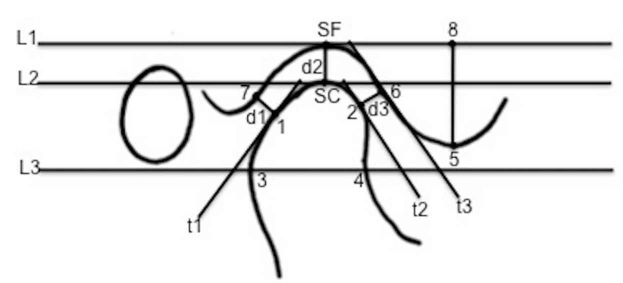

Figure 2. Landmarks and planes: L1, line tangent to the most superior point of the glenoid fossa (SF) and parallel to the superior border of the radiograph; L2, line parallel to L1 to locate the superior aspect of the condyle (SC); L3, line parallel to L2 through the most convex point of the anterior aspect of the condylar head; t1, tangent to the posterior aspect of the condyle from SF; t2, tangent to the anterior aspect of the condyle from SF; t3, line best fit to the anterior slope of the glenoid fossa; d1, line drawn perpendicular to t1 through the posterior condyle point; d2, line drawn perpendicular to L2 through the superior fossa point: d3, line drawn perpendicular to t2 through the anterior condyle point; d4, line drawn perpendicular to L1 through the most inferior point of articular eminence; SF, the most superior point of the glenoid fossa; SC, the superior aspect of the condyle; 1, posterior condyle point; 2, anterior condyle point; 3, the most posterior point of condylar head; 4, anterior head of the condyle; 5, the most inferior point of the articular eminence; 6, point intersected the glenoid fossa perpendicular to t2 from anterior condyle point; 7, point intersected the glenoid fossa perpendicular to t1 from posterior condyle point; 8, intersection of d4 and L1

In order to evaluate the measurement error, the measurements were repeated by the same investigator for all the patients after two weeks. Intraclass coefficient correlation was >0.940.

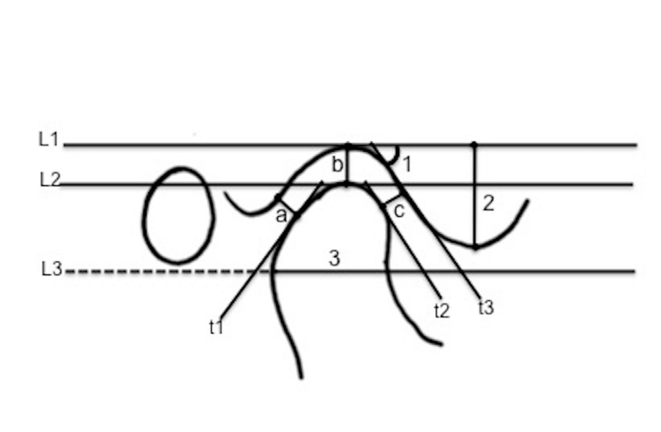

Figure 3. Measurements: 1, Slope of the articular fossa; 2, Vertical height of the articular fossa; 3, Thickness of the condylar head; a, Posterior joint space; b, Superior joint space; c, Anterior joint space

RESULTS

Slope of the articular fossa, vertical height of the articular fossa, thickness of the condylar head, posterior joint space, superior joint space, and anterior joint space showed no significant difference between T0 and T1 (p>0.05, Table 2, 3). The slope of the articular fossa and the vertical height of the articular fossa showed a tendency to be more symmetric on the left and right sides from T0 to T1; however, the changes were not statistically significant.

DISCUSSION

Thus far, several studies have been conducted to determine the effects of deep bite and Class II malocclusion on the temporomandibular joint. In some studies, deep bite was associated with posterior condyle displacement, disc luxation, and pain (17-20). In other studies, no effect on condylar displacement was shown (21-24). In this study, transcranial joint radiographs taken before and after fixed anterior biteplane treatment were compared to detect the effect of biteplane on the condyle positions. According to the results, fixed anterior biteplane treatment did not

Table 2. Comparison of the temporomandibular joint position between T0 and T1 on the left side

Left TMJ measurements		Mean	SD	Minimum	Maximum	P
Posterior joint space (mm)	T0	2.5	0.93	1	3.8	0.063
	T1	3.4	1.55	2	7.5	
Superior joint space (mm)	T0	3.4	0.82	2	5	0.449
	T1	3.6	0.93	2	5	
Anterior joint space (mm)	T0	2.7	1.35	1.2	5.5	0.165
	T1	2.1	0.53	1.3	3	
Thickness of condylar head (mm)	T0	11.2	1.72	8.2	14.6	1.000
	T1	11.2	1.23	9.6	14.5	
Slope of articular fossa (°)	T0	43.5	8.17	29.8	53.3	0.137
	T1	47.6	12.63	28	68	
Vertical height of articular fossa (mm)	T0	6.6	2.03	3.5	9.5	0.158
	T1	7.4	2.34	3.2	12	

SD: standard deviation

Table 3. Comparison of the temporomandibular joint position between T0 and T1 on the right side

Right TMJ measurements		Mean	SD	Minimum	Maximum	P
Posterior joint space (mm)	T0	2.6	0.53	1.9	3.7	0.788
	T1	2.6	0.65	2	4	
Superior joint space (mm)	T0	2.9	1.04	1	4.8	0.117
	T1	3.4	0.70	1.5	4.4	
Anterior joint space (mm)	T0	2.2	1.13	1	4.8	0.966
	T1	2.2	1.15	1	4.9	
Thickness of condylar head (mm)	T0	11.3	1.29	9	14	0.378
	T1	11.0	1.82	8.3	14	
Slope of articular fossa (°)	T0	51.0	9.61	39	70	0.455
	T1	48.9	7.68	38	63.8	
Vertical height of articular fossa (mm)	T0	8.3	1.85	5.8	12	0.188
	T1	7.7	1.96	4	10.8	

SD: standard deviation

change the condyle position. The null hypothesis was accepted. This result was in accordance with the reports that showed no significant differences in the condyle position after mandibular positional change with Class II treatment (11, 16, 25). During an average treatment duration of 8.5 months, possible condylar and glenoid fossa remodeling after the mandibular positional change with fixed anterior biteplane might explain the unchanged temporomandibular condyle position.

Anterior joint space on the left side showed greater values than the right side at T0, indicating asymmetric condyle position in Class II deep bite patients. Various studies have reported that this asymmetry should not be considered as a pathology and may be associated with the normal asymmetries of the cranial base (26, 27). After the treatment of fixed anterior biteplane treatment, values of the anterior and posterior joint spaces became closer, and symmetry of the joint spaces was achieved on the left and right sides.

It was stated that the steep slope of the articular fossa may cause greater rotational movement of the disc on the condyle that may increase the risk of disc displacement disorders. Cohlmia et al. (8) showed a steeper articular fossa slope in deep bite patients. After the treatment of deep bite with fixed anterior biteplane, the slope of the articular fossa on the right side tended to decrease and became symmetric with that on the left side.

One of the limitations of the study was the use of two-dimensional radiographs that involve several unwanted factors, such as difficulty in visualizing a three-dimensional structure and superimposition of the surrounding structures. While Computed tomography/Cone-beam computed tomography may be recommended for three-dimensional evaluation of the temporomandibular joint, accounting the ALARA principles, two-dimensional imaging was preferred in order to reduce the effective radiation that the patients received (28). In addition, the clinical validity of two-dimensional tomographic tracing to measure the condylar position is questionable. The difficulty in evaluating small changes in condylar positioning, even with the use of tomography have been discussed previously (29-31).

Another limitation of the study was the lack of a control group; we did not compose a control group due to ethical reasons. However, it is noteworthy that all the patients were in the same cervical vertebral maturation stage in their pre- and post-treatment periods.

CONCLUSION

Considering the limitations of this study, we found no significant changes in the condyle fossa relationship with the use of a fixed anterior biteplane appliance.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Medical, Surgical and Drug Research of Hacettepe University (LUT 04/30).

Informed Consent: Informed consent was taken from patients at the beginning of the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - B.A.G., S.C..; Design - B.A.G., S.C.; Data Collection and/or Processing - B.A.G.; Analysis and/or Interpretation - B.A.G., S.C.; Literature Search -B.A.G.; Writing Manuscript - B.A.G.; Critical Review - B.A.G., S.C.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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