

Effects of early bilateral mandibular first molar extraction on condylar and ramal vertical asymmetry

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Abstract

Objectives This study aims to investigate the mandibular vertical asymmetry in a group of adult patients who had early bilateral mandibular first molar extractions.

Methods Mandibular asymmetry index measurements (condylar, ramal, and condylar plus ramal) were made on the panoramic radiographs of a study group including 30 subjects (mean age, 18.22 ± 1.30 years) and a control group of 25 subjects (mean age, 18.24 ± 1.17 years). Group I comprised the control group patients with no extractions and had excellent class I relationships, no missing teeth, and slight or

moderate anterior crowding. Group II included patients with a bilateral mandibular first molar teeth extracted before the age of 12 years. Student's *t* test was used for the comparison of asymmetry index values between the groups. A paired *t* test was used to determine possible statistically significant differences between the sides for condylar, ramal, and condylar plus ramal height measurements.

Results No group showed statistically significant side-specific differences for posterior vertical height measurements. Condylar asymmetry index (CAI), ramal asymmetry index, and condylar plus ramal asymmetry index measurements were not statistically different between the groups ($p > 0.05$).

Conclusions CAI values were significantly high when compared with the 3 % threshold value in the both groups, but comparisons between the groups were not statistically significant.

Clinical relevance This article investigates the effects of early bilateral mandibular molar teeth extraction that has never been investigated in the literature. The present study showed that the lengths of the condylar, ramal, and condylar plus ramal height were less in the study group than in a well-matched control group of without extraction.

Keywords Condylar asymmetry · Mandibular asymmetry · Facial asymmetry · First molar extraction

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Introduction

Craniofacial symmetry is the similarity and equality in shape, volume, and appearance of the right and left sides of the face with respect to the median sagittal plane [1]. However, excellent bilateral face symmetry is largely a theoretical concept that seldom exists in living organisms [2]. In support of this issue, Chebib and Chamma [3] reported that the left sight of face was larger than the right sight.

Facial complex consists of a great number of component parts, and the harmony among these parts determines the overall symmetry. Clinically, symmetry means balance, while significant asymmetry means imbalance [4]. Teeth and occlusion play an important role in the formation of this symmetry and balance [5]. The permanent first molars in a balanced occlusion are important as emphasized by Andrews [6]. However, more than 50 % of children over the age of 11 years have the experiences of caries in these teeth [7–9]. Unfortunately, the first molars are the most common early extracted teeth due to caries [9, 10]. Telli and Aytan [9] stressed that early extraction of maxillary and mandibular first molars are widely observed in Turkish population.

Although studies about condylar asymmetry have increased in the past years, till date, no study has been carried out to compare the effects of early loss of a mandibular first molar on condylar asymmetry. Therefore, this study aimed to investigate the effects of early loss of a bilateral mandibular permanent first molar on condylar and ramal heights and to determine whether subjects with early loss of a mandibular first molar had asymmetrical condyles, using the method described by Habets et al. [11].

Materials and methods

The sample consisted of an experimental group including 30 subjects (10 females, 20 males; mean age, 18.22 ± 1.30 year) and a control group of 25 subjects (16 females, 9 males; mean age, 18.24 ± 1.17 years). Ethical approval from the local ethics committee and informed consent from the parents of the children were obtained (in our university as a usual protocol, all patients or the parents already signed an informed consent form recording their agreement).

Group I was the control group with no extractions and had excellent class I relationships, no missing teeth, and slight or moderate anterior crowding. Group II included patients with bilateral mandibular first molars extracted before the age of 12. The additional criteria, also suggested and practiced by Caglaroglu et al. [1] for both the study and control groups, were the followings: (1) postpubertal period; (2) skeletal class I relationship determined by ANB angle and Wits appraisal; (3) no developmental or acquired craniofacial or neuromuscular deformities; (4) no presence of unilateral or bilateral posterior crossbite (maxillary teeth were placed on the buccal side of the mandibular teeth); (5) no previous orthodontic treatment; (6) no signs or symptoms of temporomandibular dysfunction; (7) no lateral mandibular shift during closure as determined by clinical examination; and (8) no carious lesions, extensive restorations, or pathologic periodontal status. The patients were randomly selected from the archives of the Izzet Baysal, Karadeniz Technical, and Erciyes Universities including the

clinical and radiological examination data of the patients seeking orthodontic treatment.

As panoramic radiographs (PRs) are routinely used as a diagnosis procedure in our clinics, all the subjects had PR available for evaluation. The subjects were positioned with the lips in rest position and the head oriented by adjusting the Frankfort plane parallel to the horizontal plane as suggested by Azevedo et al. [12] and all radiographs were taken in a standard position by experienced radiology technicians on panoramic systems. PRs were taken from the patients at least 5 years (between 5 and 9 years) after the molars were extracted.

All films were traced and measured by the same author. On both the left and right sides, the most lateral points of the condyle and ramus were marked as *X* and *Y*, respectively. On each side, a line was drawn passing through points *X* and *Y*, and termed as the A-line. Another line was drawn from the most superior points of the condylar images perpendicular to the A-line and termed as the B-line. The intersection of the A- and B-line was named point *Z*. The distances between points *X* and *Z* were measured and recorded as condylar height (CH). Similarly, the distances between points *X* and *Y*, and that between points *Z* and *Y* were measured and recorded as ramus height (RH) and condylar plus ramus heights (CH+RH), respectively (Fig. 1). The asymmetry indices of the condyle, ramus, and condylar plus ramus were computed using the following formula developed by Habets et al. [11] To measure the condylar, ramal, and condylar-plus-ramal asymmetry, the following formula was used:

$$\text{Asymmetry index} : \frac{\text{right-left}}{\text{right+left}} \times 100$$

Statistical analysis

All statistical analyses were performed by using the SPSS software package for Windows (version 13.0, SPSS, Chicago, IL, USA). The sample size for the present study was calculated based on a significance level of 0.05 and a

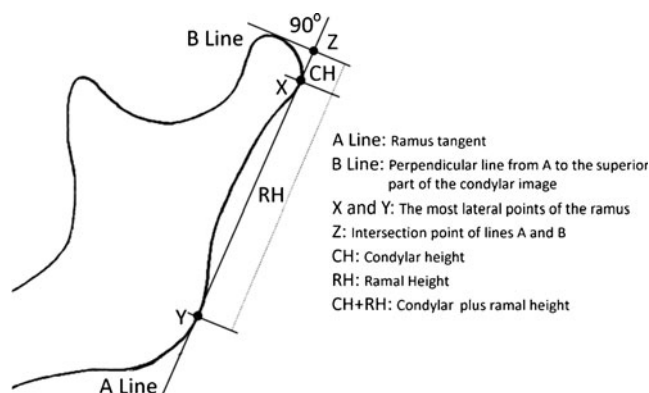


Fig. 1 Measuring method according to Habets et al.

power of 80 % to detect a meaningful difference of 0.70 % (± 0.61 %) for condylar asymmetry. Power analysis showed that 25 patients were required.

Descriptive statistics data were computed. A value of $p < 0.05$ was considered as statistically significant. The normality test of Shapiro–Wilks and Levene’s variance homogeneity test were applied to the data, and all data were found normally distributed. Thus, the comparisons between the groups were analyzed with parametric tests. Student’s t test was used for the comparison of asymmetry index values between the groups and the genders. Since no gender difference was observed, the sample was pooled. The paired t test was used to determine possible statistically significant differences between the sides for condylar, ramal, and condylar plus ramal height measurements.

Four weeks after the first measurements, 20 randomly selected PRs were retraced and remeasured by the same author. The method error was calculated by using Dahlberg’s formula [13]. The Dahlberg’s method error values were within acceptable limits and the difference between the first and second measurements of these radiograms was insignificant. In addition, the difference between the two tracings was tested for significance with paired t test and no significant difference was found ($p > 0.05$), confirming the reliability of the measurements.

Results

The mean ages of the subjects included to the study and control groups were 18.24 ± 1.17 and 18.22 ± 1.30 years, respectively. All patients included to the study were aged between 17 and 20 years. Comparison of the mean ages between the groups showed that there were no statistically significant differences in the distribution of the chronological ages between the study and control groups ($p > 0.984$). In addition, no statistically significant difference was observed between the genders in both study and control groups ($p > 0.05$).

The results of Student’s t tests showed no statistically significant differences between the mean values of the male and female subjects ($p > 0.05$). Therefore, the data for both the genders were pooled for further statistical analyses. The descriptive mandibular asymmetry indices for both groups were shown in Table 1. No statistically significant difference was found for the condylar asymmetry index (CAI), ramal asymmetry index (RAI), and condylar plus ramal asymmetry index (CRAI) measurements between the groups ($p > 0.05$). However, CAI values were over 7 % for both groups.

Means, standard deviations, and statistical results of paired t test comparing the in condylar, ramal, and condylar plus ramal height measurements of the right and left sides in the both groups are given in Table 2. There was no

Table 1 Descriptive statistics and comparisons of asymmetry index values between the study and control groups

Asymmetry index	Group	<i>N</i>	Mean (%)	SD	<i>P</i>
CAI	Study	25	7.37	6.14	0.850
	Control	30	7.04	6.79	
RAI	Study	25	2.76	1.79	0.893
	Control	30	2.70	1.70	
CRAI	Study	25	2.42	1.48	0.730
	Control	30	2.29	1.49	

CAI condylar asymmetry index, RAI ramal asymmetry index, CRAI condylar plus ramal asymmetry index, SD standard deviation, *P* results of Student’s t test

statistically significant difference observed between the right and left sides in condylar, ramal, and condylar plus ramal height measurements between the groups ($p > 0.05$).

Discussion

Medical imaging is part of assessment of facial asymmetry. Generally, asymmetry of the craniofacial skeleton is most readily diagnosed from the frontal view rather than other sides. A method to determine asymmetries between the mandibular condyles and the rami was introduced by Habets et al. [11] using PRs. This method compares the vertical heights of the mandibular right and left condyles and rami, and uses those observations to determine condylar asymmetry in class II [14] and class III [15] malocclusions, cleft lip and palate [16], and temporomandibular disorder patients [11], and bilateral [17, 18] and unilateral [18, 19] crossbite.

Nevertheless, no study has been carried out to evaluate the effects of early mandibular first molar extraction on condylar asymmetry. The present study was the first to investigate vertical condylar and ramal asymmetry using the method of Habets et al. [11] in patients with bilateral early loss of permanent mandibular first molars.

O’Byrne et al. [20] evaluated mandibular asymmetry in adults with unilateral crossbite. They found no mandibular skeletal asymmetry. Similarly, Letzer and Kronman [21] also found no relationship between asymmetry and malocclusion. However, Alavi et al. [22] showed that a class II malocclusion might cause real mandibular asymmetry in growing subjects because of the adaptive condylar changes. Recently, Wang et al. [23] reported that asymmetry of occlusion and condyles were associated. Therefore, in the present study, patients were without skeletal malocclusion, such as classes II or III, and unilateral or bilateral crossbite to eliminate the effects of those malocclusions on the asymmetry indices.

Computed tomography is the gold standard for determination of condylar asymmetries, [24] although radiation

Table 2 Statistical side comparisons of the study and control groups

	Variable	Study group			Control group		
		Right side Mean and SD	Left side Mean and SD	<i>P</i>	Right side Mean and SD	Left side Mean and SD	<i>P</i>
<i>CH</i> condylar height, <i>RH</i> ramal height, <i>CH+RH</i> condylar plus ramal height, <i>SD</i> standard deviation, <i>P</i> results of paired <i>t</i> test	CH	4.44±0.86	4.52±0.89	0.074	4.53±0.69	4.48±0.86	0.125
	RH	43.07±2.41	42.09±3.41	0.640	44.79±2.18	44.00±3.26	0.752
	CH+RH	47.61±2.56	46.57±3.35	0.150	49.23±2.32	48.52±3.11	0.069

exposure could be an issue. PRs may be utilized for a routine dental examination. However, we observed that PRs were often used by investigators who performed mandibular [25, 26] and condylar [5, 14–19, 27] asymmetry studies. Therefore, PRs were used to determine the condylar asymmetry, together with other dental reasons because of associated costs, ethical considerations, and exposure of subjects to relatively low doses of radiation. Nevertheless, the reproducibility of vertical and angular measurements on PRs is acceptable if the patient's head is positioned in the equipment. In the present study, all radiographs were taken by experienced radiology technicians on panoramic systems and had been much attention to this situation. In addition, the statistical analyses (paired *t* test and Dahlberg's formula) to assess the reliability of the measurements confirmed the reliability of the measurements.

Early extraction of mandibular permanent first molars might also cause problems, such as continuing extrusion of the corresponding opposite teeth, tipping of adjacent teeth toward the extraction site, periodontal problems, and asymmetric chewing habits [28–30]. Early extraction of permanent first molars could negatively affect the balance of all occlusion [28]. The asymmetrical function and imbalanced occlusion may cause asymmetric adaptive development of the right and left sides of the mandible, which may cause modeling of the condyle [31]. In a recent paper, Caglaroglu et al. [1] investigated the effects of early loss of maxillary and mandibular first molars on skeletal asymmetry using posteroanterior radiographs and reported that skeletal asymmetries mainly occurred in the lower anterior region. In our study, we detected that no statistically significant side-specific condylar asymmetries were found between the groups. We thought that it is due to extraction of mandibular first molars, bilaterally. In agreement with Caglaroglu et al. [1], those patients with mandibular first molar extracted had mild or moderate crowding in their mandibular arches. Thus, they were orthodontically treated to solve the orthodontic problems. In addition, it has been shown that mesialization of posterior teeth in the maxillary arch in patients with first molar extraction might result in a remarkable rotational movement and those movements can cause a posterior crossbite [1]. However, early mandibular first

molar extractions did not cause any crossbite in our study samples and thus no difference in the asymmetry indices were found between the study and control groups. In support of this study, Yüksel and Tortop Üçem [32] researched the effects of unilateral and bilateral congenital second premolar agenesis on facial asymmetry using postero-anterior radiographs and informed that patients with bilateral second premolar agenesis have not mandibular skeletal asymmetry.

According to Habets et al. [33] a 3 % index ratio can result from a 1 cm change in head position while the PR is being taken, and thus, asymmetry index values (CAI, RAI, and CRAI) greater than 3 % should be considered as mandibular posterior vertical asymmetry. In the present study, patients with early bilateral loss of mandibular first molar were found to have asymmetric mandibles according to the CAI measurements, and those with no missing teeth were also observed to have asymmetry. Concordant with the present findings, Kurt et al. [16], Uysal et al. [18], and Sağlam [27] found CAI 9.95±10.42 %, 7.57±8.39 %, and of 7.96±6.73 % in the control groups with class I, respectively.

The weakness of the present study was that it was performed on PRs but not on the computed tomography by means of three-dimensional analyses. Although it is the gold standard to evaluate an asymmetry in condylar, ramal, and condylar plus ramal vertical heights by means of three-dimensional analyses, PRs have an acceptable cost-benefit ratio due to its minimal radiation exposure and routinely used for such studies in the literature. Since it is not ethic to collect computed tomographs to perform this study and there is not enough archive including those data, we performed the present study on PRs.

Conclusions

Condylar index values were significantly higher when compared with the 3 % threshold value of Habets et al. [33] in both the groups, but comparisons between the groups were not statistically significant. In addition, no statistically significant side-specific condylar asymmetries were found between the groups.

References

1. Çağlaroğlu M, Kilic N, Erdem A (2008) Effects of early unilateral first molar extraction on skeletal asymmetry. *Am J Orthod Dentofac Orthop* 134:270–275
2. Bishara SE, Burkey PS, Kharouf JG (1994) Dental and facial asymmetries: a review. *Angle Orthod* 64:89–98
3. Chebib FS, Chamma AM (1981) Indices of craniofacial asymmetry. *Angle Orthod* 51:214–226
4. Erickson GE, Waite DE (1974) Mandibular asymmetry. *Am Dent Assoc* 89:1369
5. Sezgin OS, Celenk P, Arici S (2007) Mandibular asymmetry in different occlusion patterns. *Angle Orthod* 77:803–807
6. Andrews LF (1972) The six keys to normal occlusion. *Am J Orthod* 62:296–309
7. Morita M, Kimura T, Kanegae M, Ishikawa A, Watanabe T (1994) Reasons for extraction of permanent teeth in Japan. *Community Dent Oral Epidemiol* 22:303–306
8. Todd JE, Dodd T (1983) Children's dental health in the United Kingdom. Office of Population Censuses and Surveys, London
9. Telli AE, Aytan S (1989) Changes in the dental arch due to obligatory early extraction of first permanent molars. *Turk J Orthod* 2:138–143
10. Albadri S, Zaitoun H, McDonnell ST, Davidson LE (2007) Extraction of first permanent molar teeth: results from three dental hospitals. *Br Dent J* 203:E14
11. Habets LL, Bezuur JN, Naeiji M, Hansson TL (1988) The orthopantomogram, an aid in diagnosis of temporomandibular joint problems. II. The vertical symmetry. *J Oral Rehabil* 15:465–471
12. Azevedo AR, Janson G, Henriques JF, Freitas MR (2006) Evaluation of asymmetries between subjects with class II subdivision and apparent facial asymmetry and those with normal occlusion. *Am J Orthod Dentofac Orthop* 129:376–383
13. Dahlberg G (1940) Statistical methods for medical and biological students. Interscience, New York
14. Miller VJ, Smidt A (1996) Condylar asymmetry and age in patients with an Angle's class II division 2 malocclusion. *J Oral Rehabil* 23:712–715
15. Miller VJ, Bodner L (1997) Condylar asymmetry measurements in patients with an Angle's class III malocclusion. *J Oral Rehabil* 24:247–249
16. Kurt G, Bayram M, Uysal T, Özer M (2010) Mandibular asymmetry in cleft lip and palate patients. *Eur J Orthod* 32:19–23
17. Kiki A, Kiliç N, Oktay H (2007) Condylar asymmetry in bilateral posterior crossbite patients. *Angle Orthod* 77:77–81
18. Uysal T, Şisman Y, Kurt G, Ramoglu SI (2009) Condylar and ramal vertical asymmetry in unilateral and bilateral posterior crossbite patients and a normal occlusion sample. *Am J Orthod Dentofac Orthop* 136:37–43
19. Kılıç N, Kiki A, Oktay H (2008) Condylar asymmetry in unilateral posterior crossbite patients. *Am J Orthod Dentofac Orthop* 133:382–387
20. O'Byrne BL, Sadowsky C, Schneider B, BeGole EA (1995) An evaluation of mandibular asymmetry in adults with unilateral posterior crossbite. *Am J Orthod Dentofac Orthop* 107:394–400
21. Letzer GM, Kronman JH (1967) A posteroanterior cephalometric evaluation of craniofacial asymmetry. *Angle Orthod* 37:205–211
22. Alavi DG, BeGole EA, Schneider BJ (1988) Facial and dental arch asymmetries in class II subdivision malocclusion. *Am J Orthod Dentofac Orthop* 93:38–46
23. Wang MQ, He JJ, Chen CS, Widmalm SE (2011) A preliminary anatomical study on the association of condylar and occlusal asymmetry. *Cranio* 29:111–116
24. Sanders DA, Rigali PH, Neace WP, Uribe F, Nanda R (2010) Skeletal and dental asymmetries in class II subdivision malocclusions using cone-beam computed tomography. *Am J Orthod Dentofac Orthop* 138(5):542.e1–542.e20
25. Ramirez-Yañez GO, Stewart A, Franken E, Campos K (2011) Prevalence of mandibular asymmetries in growing patients. *Eur J Orthod* 33:236–242
26. Van Elslande DC, Russett SJ, Major PW, Flores-Mir C (2008) Mandibular asymmetry diagnosis with panoramic imaging. *Am J Orthod Dentofac Orthop* 134:183–192
27. Saglam AM (2003) The condylar asymmetry measurements in different skeletal patterns. *J Oral Rehabil* 30:738–742
28. Lin YT, Lin WH, Lin YT (2007) Immediate and six-month space changes after premature loss of a primary maxillary first molar. *J Am Dent Assoc* 138:362–368
29. Janson G, Carvalho PE, Cançado RH, de Freitas MR, Henriques JF (2007) Cephalometric evaluation of symmetric and asymmetric extraction treatment for patients with class II subdivision malocclusions. *Am J Orthod Dentofac Orthop* 132:28–35
30. Rebellato J (1998) Asymmetric extractions used in the treatment of patients with asymmetries. *Semin Orthod* 4:180–188
31. Pirttiniemi P, Kantomaa T (1992) Relation of glenoid fossa morphology to mandibulofacial asymmetry, studied in dry human skulls. *Acta Odontol Scand* 50:235–243
32. Yüksel S, Tortop Üçem T (1994) Effects of congenitally absent second premolars on facial and dental asymmetry. *Turk J Orthod* 7:201–206
33. Habets LL, Bezuur JN, VanOoij CP, Hansson TL (1987) The orthopantomogram, an aid in diagnosis of temporomandibular joint problems. I. The factor of vertical magnification. *J Oral Rehabil* 14:475–480

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