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Original

Prevalence of bifid mandibular condyle in a Turkish population

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Abstract: The aim of this study was to determine the frequency of bifid mandibular condyle (BMC) using panoramic radiographs supported by different radiographic techniques. A retrospective study was carried out by evaluating panoramic radiographs of 18,798 patients referred to the Department of Dentomaxillofacial Radiology. *T*-tests were used to compare the frequency of BMC between left and right sides and between female and male patients. In this study, 98 patients (0.52%) were found to have BMC. Of these patients, 51 (52%) were females and 47 (48%) were males. Of the 98 patients, 71 (72.4%) had unilateral and 27 (27.6%) had bilateral BMC. A total of 125 BMCs were found in 98 patients. No statistically significant differences were found between the right and left BMCs or between female and male patients ($P > 0.05$). Because symptoms associated with BMC are either absent or minimal, it is usually discovered as an incidental finding during routine radiographic examination. Different appearances of BMC can be seen on panoramic radiographs. The exact orientation of the condyles can only be determined using 3D imaging techniques. BMC may be a more frequent condition in the Turkish population. (J Oral Sci 53, 433-437, 2011)

Keywords: panoramic; frequency; bifid mandibular condyle.

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Introduction

Bifid mandibular condyle (BMC) is considered to be a rare anomaly (1-3). It is characterized by duplication of the mandibular condyle and a groove between these two articular heads. Bifid condyles are reported to be oriented anteroposteriorly and mediolaterally, and the groove between the duplicated condylar heads may be distinct or indistinct (1-3).

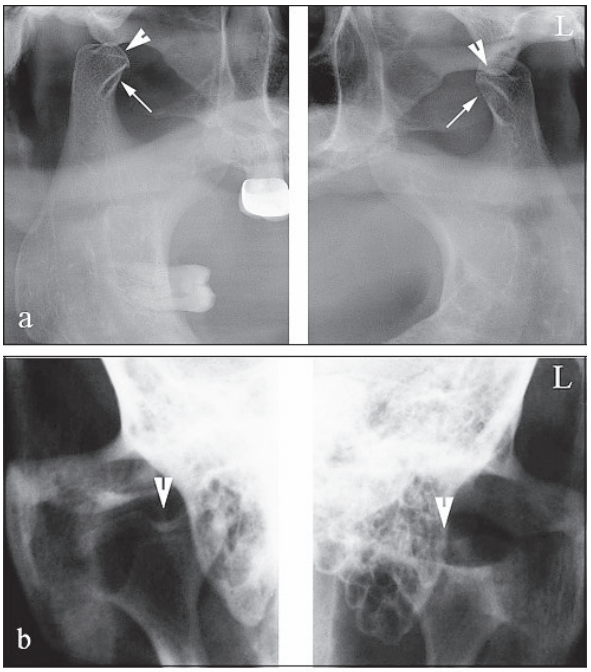
A review of the literature revealed 112 cases of BMC in living subjects (2,4-8). BMC is usually diagnosed as an incidental finding during routine radiographic examination and typically has no distinct clinical symptoms (1-3). The exact etiology is unknown, but circumstances such as trauma, teratogenic drug use, genetic tendency, infection and exposure to radiation have been identified as possible causes for these variations (9,10). Others reported that BMC could be an embryological malformation (8,11,12).

Although BMC is reported to be a rare condition, it is increasingly being detected due to use of advanced imaging techniques, particularly computerized tomography (CT), cone beam computerized tomography (CBCT) and magnetic resonance imaging (MRI) (4,7,10).

Many cases of BMC have been reported, particularly in the last decade. However, due to lack of epidemiological data, there is not enough information to determine the true frequency and characteristics of this morphological variation. The goal of this study was to assess the prevalence of BMC using panoramic and other conventional radiographic techniques in a Turkish population.

Materials and Methods

A retrospective study was performed using the panoramic radiographs of 18,810 patients referred to the



R; right, L; left

Fig. 1 (a) Open-mouth TMJ projection of the bilateral BMC. Arrows show the main condyle, arrowheads show the smaller one. (b) Transorbital projection (the X-ray beam is directed from the front of the patient through the ipsilateral orbit) of the same patient. Arrowheads show the groove between the duplicated condylar heads.

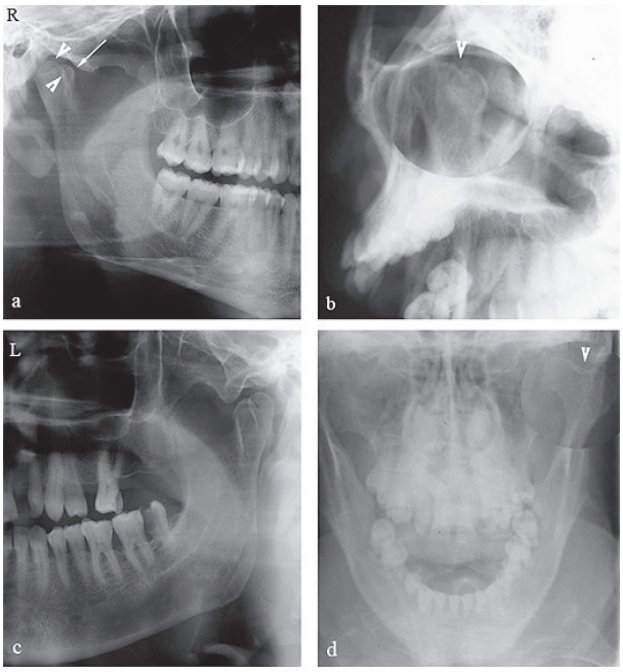


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Fig. 2 (a) Panoramic radiograph of the right BMC. Arrow shows the first and arrowheads show the second condylar head. (b) Transorbital projection (the X-ray beam is directed from the front of the patient through the contralateral orbit) of the same patient. Arrowhead shows the groove between the duplicated condylar heads. (c) Panoramic radiograph of the left BMC. (d) Reverse Towne projection of the same patient. Arrowhead shows the groove between the duplicated condylar heads.

Department of Dentomaxillofacial Radiology, Erciyes University, Kayseri, Turkey between 2005 and 2010. Radiographs which were unclear or of poor quality were excluded (n = 12). The remaining 18,798 panoramic radiographs were reviewed in this study. Radiographs were obtained with two different orthopantomography devices (Instrumentarium OC100, 66-73 kVp, 10-16 mA, 17.6 exposure time, Tuusula, Finland; and Instrumentarium OP200 D digital, 66-85 kVp, 10-16 mA, 14.1 exposure time, Tuusula, Finland) by a radiology technician. Exposure factors varied according to the requirements of each individual. The position of the patients was standardized in edge to edge position. The panoramic radiographs were processed according to the manufacturer's recommendations in an automatic film processor (Velopex, Extra-X, London, UK) and laser imager (Konica Minolta, Drypro model 832, Tokyo, Japan).

All radiographs were viewed by two observers together using standard light boxes. The observers were oral radiologists who had ten and five years experience in panoramic imaging. To ensure the accuracy of diagnosis, only cases that were confirmed by both observers to have BMC were scored as present. The BMCs in these panoramic radiographs were analyzed in accordance with age, gender and side.

As the BMCs could be clearly distinguished, panoramic radiographs were sufficient for diagnosis in most cases. Additional extraoral radiographs, such as temporomandibular joint (TMJ) (Fig. 1a), transorbital (Figs. 1b and 2b) or reverse Towne (Fig. 2d) projections were performed in 21 cases to verify the diagnosis of BMC. Some of these patients had TMJ complaints and all of them were informed about the additional radiation dose. In this panoramic radiograph-based study, we observed very different types of BMC and 12 samples are presented here (Fig. 3).

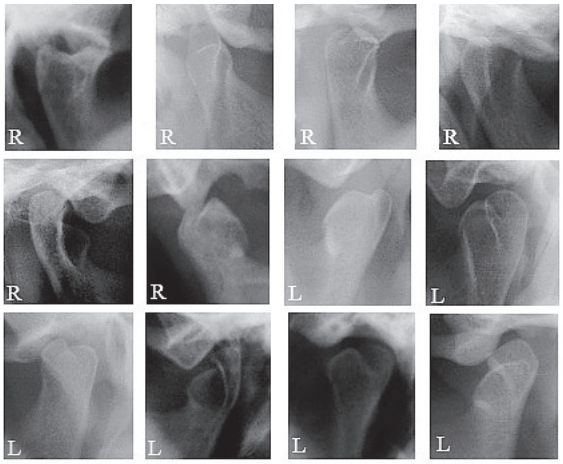
Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS), 15th version. *T*-tests were used for statistical analysis. *P* values less then 0.05 were accepted as statistically significant.

Results

A total of 18,810 panoramic radiographs were evalu-

Table 1 Characteristics of BMCs detected in this study

		Gender			Unilateral			Age	
	Number of patients	Male	Female	Bilateral	Right	Left	Total BMCs	Range	Mean
BMC cases	98	47	51	27	37	34	125	16-89	39.6 ± 14.3
Frequency (%)	0.52	0.58	0.48						



R; right, L; left

Fig. 3 Panoramic radiographs of varied types of BMC cases.

ated and 18,798 were included. Of these patients, 8,121 (43.2%) were males and 10,677 (56.8%) were females (age range 7 – 89 years; mean age 28.4 ± 15.6). A total of 125 BMCs were observed in 98 (0.52%) patients. Of these cases, 51 (52%) were females and 47 (48%) were males (age range 16 – 89 years; mean age 39.6 ± 14.3). The frequency of BMC was 0.58% in males and 0.48% in females. Of the 98 patients, 71 (72.4%) cases were unilateral and 27 (27.6%) were bilateral. Among the 71 unilateral cases, 37 (52%) were on the right and 34 (48%) were on the left side (Table 1).

Figure 1 shows the transorbital and TMJ projections of the bilateral BMCs. Figure 2 shows the panoramic, transorbital projections of the right-sided BMC and the panoramic, reverse Towne projections of the left-sided BMC. Figure 3 shows the varied BMC appearances observed in different patients.

No statistically significant differences were found between either the right and left BMCs ($P > 0.05$) or between female and male patients ($P > 0.05$).

Discussion

BMC is an uncommon anomaly (13). The term "bifid" is derived from the Latin word meaning "cleft into two parts". Due to lack of clinical symptoms, it is usually discovered as an incidental finding during routine radiographic examination (14).

Hrdlicka (15) first described bifid mandibular condyle in 1941. He found 21 cases in dried skulls from the Smithsonian Institution. Eighteen of these cases were unilateral and three were bilateral. In 1948, Schier (16) reported the first case in a living subject. In 1990, Szenpetery et al. (17) reported seven (0.3%) cases of BMC in 1,882 skulls with 2,077 condyles. However, epidemiological studies in this field are limited. To our knowledge, only two epidemiological studies have been carried out on living subjects. In 2008, Menezes et al. (14) examined 50,080 panoramic radiographs in a Brazilian population and found only nine (0.018%) cases of BMC. Subsequently, in 2010, Miloglu et al. (2) examined 10,200 panoramic radiographs in a Turkish population and reported 32 (0.3%) cases of BMC. Our study presents 98 (0.52%) cases of BMC in 18,798 patients examined between 2005 and 2010. Comparing previous studies, Miloglu et al. (2) found a significantly higher frequency than Menezes et al. (14). Also, the frequency found in our study is higher than the value reported by Miloglu et al. (2). Based on these findings, it may be assumed that BMC is more prevalent in the Turkish population. However, further epidemiological studies are required in this field.

In the literature, the occurrence of BMC does not show a predilection for any particular age group. In a study reported by Loh and Yeo (18), most of the patients were over 20 years old. This finding is consistent with the values reported by Lopez et al. (8), Miloglu et al. (2) and our study (age range 16-89 years; mean age 39.6 ± 14.3). In our country, the majority of patients referred to dental hospitals are adults and elders, which could explain these results.

The occurrence of BMC also does not appear to show gender differences. In the literature, current reports reveal an average female-male ratio of 1.1:1 (a total of 112 cases of BMC, information was insufficient for six cases). Antoniades et al. (19) found a male-female ratio of 1.5:1, whereas Menezes et al. (14) found a significantly higher female-male ratio of 3.5:1. However, Miloglu et al. (2) reported a very similar ratio between the genders (female-male, 1.13:1) and consistent with this finding, the ratio in our study was also found to be very similar (female-male, the ratio of 1.1:1). In addition, statistically

no significant differences were found between the ratio of BMC in male (0.58%) and female (0.48%) patients ($P > 0.05$).

A current literature review in living patients revealed a total of 112 cases of BMC (information was insufficient for six cases) (2,4-8). Of the 106 cases, 26 were bilateral and 80 were unilateral: 38 were on the right side and 42 on the left (left–right, 1.1:1). The ratio of unilateral-bilateral cases was 3.1:1. In the present study, a ratio of 2.62:1 was observed, which is lower than that reported in the literature. However, the right-left ratio detected in our study was 1.08:1, which is very close to previous studies. No statistically significant differences were found between the right and left BMCs ($P > 0.05$).

The exact etiology of bifid mandibular condyle is unknown. However, the most likely cause is trauma (20,21). Thomason and Yusuf (22) reported two cases of traumatic condyle fracture with subsequent unilateral BMC. Antoniades et al. (21) also presented a case of unilateral BMC which resulted following a sagittal condylar fracture. On the other hand, minor trauma to the growth center or deficient remodeling of the mandibular condyle may subsequently result in a variation such as BMC (21,23,24). Also, TMJ ankylosis may cause the formation of BMC. Thus, in a retrospective study, Rehman et al. (7) reported 10 cases of BMC in 37 patients with TMJ ankylosis. Of those 10 cases, nine were post-traumatic and one was post-infectious. In addition, Gulati at al. (6) reported two cases of BMC with joint ankylosis. One of them was developmental and the other occurred secondary to trauma. Although trauma has been considered as the most common possible etiology, comparative studies have shown that most patients had no history of previous trauma or TMJ complaints (2,18,19).

In the literature, two patterns of BMC have been reported. Condylar heads can be oriented anteroposteriorly (anteroposterior pattern) or mediolaterally (mediolateral pattern) (2,3,8). However, the authors consider that this classification is not sufficient for all cases. For example, a BMC can be oriented in an oblique position, neither anteroposterior nor mediolateral. In accordance with this, the BMCs found in our study had very distinct appearances in panoramic radiographs (Fig. 3). In these samples, varied condylar orientations such as anteroposterior, superposed and adjacent were observed. Thus, it is impossible to make a definite diagnosis regarding the exact pattern of BMC with conventional radiographic techniques and clinicians could misdiagnose the orientation of duplicated condyles in panoramic radiographs.

Within the limitations of this study, it is not possible to obtain definite information about the orientation and shape of BMCs with 2D conventional radiographs. Therefore, further studies with advanced imaging techniques, especially with CBCT, may be very informative in this field. CBCT techniques may be the best choice to detect morphological characteristics of the condylar region. However, additional radiation dose given to the patient should be kept in mind.

In general, TMJ dysfunction or pain is not evident in cases of BMC. Hence, panoramic radiography and other conventional radiographic techniques are sufficient in most cases. However, in patients with clinical symptoms, advanced imaging techniques should be performed in order to support diagnosis and treatment planning. With the advances in three-dimensional visualization without superpositioning, tomographic techniques are the best choices for TMJ examination. In recent years, CBCT applications have become widespread. Thus, in order to avoid excessive radiation, clinicians should employ CBCT rather than other tomographic techniques. In addition, MRI is considered as the gold standard for TMJ imaging as it allows visualization of soft tissues and surrounding articular structures to determine the exact pathology of TMJ (25). As a result, if treatment is planned, panoramic radiographs should be supplemented by advanced imaging techniques.

Our study suggests that the frequency of BMC is likely to be higher in the Turkish population than previously considered. Also, more varied types of duplicated condylar heads may be observed in further studies using three-dimensional techniques. Epidemiological studies with advanced imaging techniques may provide more information in this field.

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