

RESEARCH

The frequency of bifid mandibular condyle in a Turkish patient population

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Objective: The objective of this study was to investigate the frequency and pattern of bifid mandibular condyles (BMCs).

Methods: A retrospective study was performed using panoramic radiographs from 10 200 patients undergoing dental treatment in the Department of Oral and Maxillofacial Radiology (Erzurum, Turkey) between 1996 and 2008.

Results: Of the 10 200 patients, 32 (0.3%) had BMCs, of whom 17 were female (53.1%) and 15 were male (46.9%). The age range of the patients with BMCs was 5 to 71 years (mean age 30.0 ± 0.40). Of these 32 patients, 24 (75.0%) had unilateral and 8 (25.0%) had bilateral BMCs, none of the patients had a history of trauma. No symptoms associated with bifid condyles were observed in any of the patients with BMCs.

Conclusions: It is possible that BMC is a more frequent condition than is commonly perceived. However, because of the minimal symptoms associated with this condition, the authors believe that it will remain an incidental finding upon routine radiographic examination, rather than a clinical observation. Nevertheless, in symptomatic cases or in cases where surgical treatment is planned, panoramic radiographs should be supplemented with CT.

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Introduction

Bifid mandibular condyle (BMC) is a rare condition characterized by a division of the mandibular condylar head. Two articulating surfaces of the bifid condyle are divided by a groove that can be oriented mediolaterally or anteroposteriorly. The condylar split can range from a shallow groove to two distinct condyles with a separate neck. Reported cases in living people and in preserved specimens are mostly unilateral and, usually, asymptomatic.^{1–5}

When reviewing the literature regarding BMC using the PubMed Database (National Library of Medicine), the authors found that it listed only 65 cases in living people^{1–40} (Table 1). Although the number of reports continues to accumulate, BMC remains a relatively uncommon condition. However, because of the lack of

epidemiological data, there is insufficient information about the true frequency of this malformation. It may be the case that the condition occurs more frequently than is presently supposed. Therefore, to assess the frequency of this phenomenon, a retrospective study was carried out using panoramic radiographs from 10 200 patients.

Patients and methods

A retrospective cohort study was designed consisting of 10 200 panoramic radiographs from patients who presented to the Oral and Maxillofacial Radiology Service at the Ataturk University Dentistry Faculty between January 1996 and January 2008. All radiographs had been taken using an orthopantomography device (Planmeca Proline CC 2002, 60–80 kVp, 8–10 mA, 12.8 s exposure time, Helsinki, Finland) by a

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Table 1 Literature review of the bifid condyle in living subjects

Reported cases	Gender	Age	Side
Schier, 1948 ¹	NA	NA	NA
Stadnicki, 1971 ²	F	3	L
Lysell and Oberg, 1975 ³	F	21	R
Farmand, 1981 ⁴	M	45	L
Forman and Smith, 1984 ⁵	M	28	L
	M	30	L
Smith, 1985 ⁶	F	32	L
Balciunas, 1986 ⁷	F	67	L
Thomason and Yusuf, 1986 ⁸	F	5	R
	F	6	R
Quayle and Adams, 1986 ⁹	F	15	R
Shaber, 1987 ¹⁰	F	26	L&R
Gundlach et al, 1987 ¹¹	M	23	L
	NA	NA	L
	NA	NA	L
	NA	NA	R
Zohar and Laurian, 1987 ¹²	NA	NA	NA
Sahm and Witt, 1989 ¹³	NA	NA	NA
McCormick et al, 1989 ¹⁴	M	38	L&R
	F	61	L&R
	M	50	L&R
To, 1989 ¹⁵	M	34	R
To, 1989 ¹⁶	M	53	L
Loh and Yeo, 1990 ¹⁷	M	24	L
	M	21	R
	F	27	R
	M	59	L
	M	59	L
Philips and Delzer, 1992 ¹⁸	NA	NA	NA
Antoniades et al, 1993 ¹⁹	NA	NA	NA
Fields and Frederiksen, 1993 ²⁰	NA	NA	NA
Wu et al, 1994 ²¹	M	21	L
	M	23	R
Kahl et al, 1995 ²²	F	14	R
Cowan and Ferguson, 1997 ²³	F	24	L
Stefanou et al, 1998 ²⁴	F	55	L&R
	M	47	L&R
	F	39	L&R
	F	69	L&R
Garcia-Gonzalez et al, 2000 ²⁵	M	63	L
Artvinli and Kansu, 2003 ²⁶	F	25	L&R
Antoniades et al, 2004 ²⁷	M	15	L&R
de Sales et al, 2004 ²⁸	M	4	R
Hersek et al, 2004 ²⁹	F	36	L
Alpaslan et al, 2004 ³⁰	M	40	L&R
Shriki et al, 2005 ³¹	F	48	R
	F	17	L&R
Daniels and Ali, 2005 ³²	M	32	R
Corchero-Martin et al, 2005 ³³	F	42	R
Ramos et al, 2006 ³⁴	F	20	L
Espinosa-Femenia, 2006 ³⁵	M	29	L&R
Agarwal et al, 2006 ³⁶	F	57	L&R
	F	46	R
Acikgoz, 2006 ³⁷	F	54	L&R
Tunçbilek et al, 2006 ³⁸	M	8	L
Sales et al, 2007 ³⁹	F	8	L
Menezes et al, 2008 ⁴⁰	F	28	L
	M	30	L
	F	74	L&R
	F	20	L
	M	43	L&R
	F	53	R
	F	72	L
	F	52	R
	F	29	R

F, female; L, left; M, male; R, right

radiographic technician who had a minimum of 5 years experience, as of 1996. Radiographs were taken using 15 cm green-sensitive panoramic film (Medical, Konica Co., Tokyo, Japan) and an appropriate cassette-intensifying screen (15 × 30 cm, Panoramic X-Ray Film Cassette, Planmeca, Helsinki, Finland; Lanex Screen, Kodak Eastman Co., Rochester NY).

During filming, exposure adjustments were made as required for each individual and the films were developed using an automatic film-processing machine (Velopex, Extra-X, London, UK).

Researchers examined the radiographs at the same time, using standard light boxes. For those patients in whom bifid condyles were suspected, but could not be conclusively ascertained from the panoramic radiographs, and with whom contact was possible, a supplementary transcranial radiograph was taken to confirm the diagnosis. However, when examiners failed to reach a decisive opinion, the examiners discussed the particular case and either established a consensus and included it in the study, or discarded the case (*n* = 2). Observations were made as to the right/left localization, symptom, aetiology and number of BMCs, as well as gender and age of patients.

Results

32 (0.3%) of 10 200 individuals had BMCs, of whom 17 (53.1%) were female and 15 (46.9%) were male. The ages of the patients ranged from 5 to 71 years (mean age 30.0 ± 0.40). 24 cases (75.0%) were unilateral and 8 (25.0%) cases were bilateral (Figure 1). Of the 24 unilateral cases, 10 (41.7%) were on the left and 14 (58.3%) were on the right side (Figure 2). None of these patients had a history of trauma. In two of the patients, symptoms associated with temporomandibular joint (TMJ) pain dysfunction syndrome were reported; nevertheless, this pain could not be clearly related to the BMC. One patient had periodic pain in the TMJ region associated with bruxism. The patient, who was treated with interocclusal appliance therapy, was followed up. Another patient who had a clicking



Figure 1 Bilateral duplication of the condylar head (patient 7)

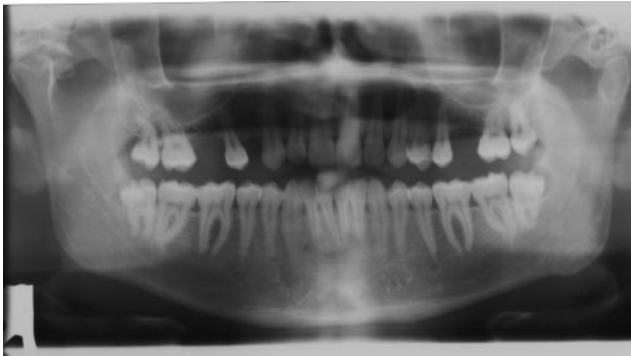


Figure 2 View of a right bifid condyle that is divided into two parts of more or less equal size by a deep groove (patient 11)

sound associated with subluxation was prescribed exercise therapy and followed up (Table 2). Figure 3 shows a lateral transcranio-oblique film obtained from a patient who was suspected of having BMC from panoramic radiography.

Discussion

A review of the literature supports the conclusion that bifid condyle is usually discovered as an incidental finding on panoramic radiographs. Thus, a sudden increase from the number of cases reported can be attributed to the current widespread use of radiographs. Hrdlicka,⁴¹ in 1941, first reported this anomaly in 21 specimens from an unspecified number of dried skulls in the Smithsonian Institution Washington, DC. A subsequent survey by



Figure 3 View of the right bifid condyle in a transcranio-oblique projection (patient 28)

Szentpétery *et al*⁴² of 1882 prehistoric skulls with 2077 condyles found only 7 (0.3%) cases of bifid condyles. However, in both studies, precise determination of the frequency of the anomaly was not possible. To the authors knowledge, only five cases have been reported in Turkey.^{26,29,30,37,38} This retrospective study presents 32 previously unreported cases examined between 1996 and 2008. Menezes *et al*⁴⁰ examined 50 080 panoramic radiographs between 1999 and 2006 and reported only 9 bifid condyle cases. This high frequency suggests that BMC is a more frequent condition than is presently perceived.

The aetiology of bifid condyle is largely unknown, although various factors have been suggested as possible causes: endocrine disturbances, exposure to teratogens, nutritional deficiencies and, infection and radiation.⁹ It is claimed that the condyle divides because of an obstructed blood supply during its development.⁴¹ Blackwood⁴³ stated that the condylar cartilage, during the early stages of development, is divided by well-vascularized fibrous septa. He suggested that persistence of this type of septum in exaggerated form within the growing cartilage might lead to an error in development that would, in turn, give rise to the bifid condition. However, Gundlach and colleagues¹¹ found no evidence of persistent septa in the cases of BMC that they examined. They believed that the bifid condyle is a form of embryopathy caused by a combination of a teratogenic agent and misdirection of muscle fibres, which then influences bone formation. MacAlister⁴⁴ reported that there were observed down-growths covering the histological section of an 18-week-old intrauterine fetal specimen.

Thomason and Yusuf⁸ described two cases of traumatic condyle fracture (bicycle accident) with subsequent unilateral formation of bifid condyles. This seems to confirm the conclusion of Walker⁴⁵ and Poswillo,⁴⁶ after experiments with *Macaca* monkeys, that bifid condyle can result from trauma.

The reported existence of two different patterns of condyle bifidism might be related to distinct causes for each type. Thus, the anteroposterior pattern might result from facial trauma during childhood, whereas the mediolateral form might be associated with persistence of the fibrous septa at the condylar cartilage.⁴² All of the cases investigated in the current study support this condition. However, some mediolateral bifid condyles have been reported following sagittal fracture through the condylar head.^{17,21}

A current literature review in living patients revealed a total of 65 cases (for 6 cases, information was insufficient). 17 cases were bilateral and 42 were unilateral: 24 on the left and 18 on the right side (left–right, 1.3:1). However, if dry skulls^{41,42} and cadavers¹⁷ are included, the ratio of unilateral–bilateral cases rises to 4.6:1. In the current study, a ratio of 3.0:1 was observed, which is close to those reported in the literature. However, the left–right ratio here has been determined to be 0.7:1 on average, which is different from the ratios reported in the literature.

Table 2 Bifid condyle in a Turkish patient population

Patient number	Gender	Age (years)	Bifid condyle, double-headed condyle and duplication of the condylar head	Aetiological factors or symptom
1	M	19	L&R	No
2	M	42	L&R	No
3	F	30	R	No
4	F	8	R	No
5	M	5	R	No
6	M	71	R	No
7	F	22	L&R	No
8	F	52	R	No
9	F	24	R	No
10	M	22	L	No
11	M	26	R	No
12	F	40	L	No
13	F	19	R	No
14	M	25	L	No
15	M	21	L	No
16	F	60	L	No
17	F	23	L	No
18	F	23	L	No
19	F	23	R	Clicking
20	F	21	L&R	No
21	M	45	L	No
22	M	13	L&R	No
23	F	28	R	No
24	M	45	L	No
25	F	21	L&R	Periodic pain
26	M	43	R	No
27	M	30	L&R	No
28	M	26	R	No
29	M	32	R	No
30	F	18	L&R	No
31	F	30	R	No
32	F	20	L	No

F, female; M, male; L, left; R, right

The occurrence of BMC does not appear to demonstrate age or gender differences, as the age of the patients ranged from 3 to 74 years. In addition, most of the reported patients, of known age, are over 20 years old.¹⁷ In this study, the sample consisted mostly of patients over 20 years (5–71 years, mean age 30.0 ± 0.40), which is again consistent with the literature.

A review of current reports in the literature reveals an average female–male ratio of 1.3:1. Antoniadis *et al*²⁷ found a male–female ratio of approximately 1.5:1. Menezes *et al*⁴⁰ found a higher BMC prevalence in women than in men. The ratio of female–male patients examined in the present study was found to be very similar (17/15).

Treatment of BMC depends on the presenting complaints of the patient. However, symptoms are not observed in the affected condyle in 67% of patients with BMC.¹⁷ Other than these asymptomatic cases, the most common and predominant symptoms are TMJ sounds.^{14,17} Pain, restriction of mandibular movement, trismus, swelling, ankylosis and facial asymmetries have also been described.^{4,5,9} Bilateral condylectomy and arthroplasty have been reported to restore function in a case of ankylosis accompanied by bifid condyle.¹⁶ In the current study, two patients had complained of TMJ

pain dysfunction; however, the examinations revealed that this was not associated with BMC.

Two patients were not included in the study because, they were suspected of having bifid condyles although, these could not be clearly diagnosed. Although panoramic radiography is a valid diagnostic tool for determination of BMC, it is also known to have certain disadvantages, including its inherent distortions and limitations. In contrast, CT is undoubtedly the best choice for TMJ examination because it allows bilateral visualization without osseous superpositioning. In particular, helical CT, which is based on the acquisition of multiple continuous slices of the anatomical site of interest, has several advantages, such as complete recording of the area with a single scan, short examination times, lower radiation dose and better image quality.^{11,17,19} The majority of BMC cases do not cause any TMJ dysfunction and require no treatment. However, in BMC cases with joint dysfunction or in which treatment is planned, panoramic radiography should be supplemented by CT.

In conclusion, our results suggest that the prevalence of BMC is likely to be higher than has been previously believed. There has been a marked increase in the number of reported BMC cases, in parallel with the development of new diagnostic techniques that allow

earlier and easier diagnosis of the pathologies in the maxillofacial region. Nevertheless, diagnosis of this anomaly has become incidental, because it does not

present any clinical symptoms and dentists are more interested in dental pathologies in the examination of radiographs.

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