A Retrospective Evaluation of The Morphologic Features of The Glenoid Fossa Using Cone Beam Computed Tomography

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Abstract

Aim: The aim of this study is to examine the morphologic features of the glenoid fossa according to age and gender.
Material and methods: CBCT images of 764 temporomandibular joints (TMJ) were analyzed retrospectively. The shape of the glenoid fossa was examined in four groups as deformed, flattened, sigmoid and box. These groups were evaluated separately for both sexes and for five separate decades.
Results: Sigmoid and flattened shaped glenoid fossa were more common in men, and box shaped glenoid fossa was more common in women ($p<0.05$). The sigmoid shape was observed in the 30-39 age range, the box shape was observed in the 40-49 age range, and the flattened and deformed shape in the 60-69 age range was significantly higher ($p<0.05$).
Conclusions: While the sigmoid shape of the glenoid fossa is common in men, the box shape is more common in women. Deformed and flattened shapes increased with age. The box shape of the glenoid fossa may be a predisposing factor for disc displacement in women. Flattened and deformed forms can be interpreted as different forms of the bone remodeling process.

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Keywords: Shape of the glenoid fossa, cone beam ct, temporomandibular joint, oral radiology, anatomy.

Introduction

The temporomandibular joint (TMJ) is one of the most important joints of the body, involved in vital functions such as chewing, swallowing, speaking and breathing (1,2). With its unique structure, it enables the mandible to perform all movements perfectly (3). TMJ is in harmony with masticatory muscles, ligaments, teeth and surrounding soft tissues, and jaw movements are controlled by all these structures (4). The bony components of the joint are formed by the processus condylaris of the mandible, the glenoid fossa of the temporal bone, and the tuberculum articulare. The processus condylaris shows more convexity in the anteroposterior direction and less in the mediolateral direction. The mandibular fossa is concave in line with this. The articular tubercle in front of the fossa restricts the anterior movement of the processus condylaris(5,6). The bone structure of the joint may show anatomical variations[7]. With this; age, gender, occlusal changes, trauma, presence of pathology may cause the joint to be followed in different ways (4). In addition, conditions that directly concern the joint such as disc perforation, disc displacement, degenerative joint disease can also change the radiological appearance of hard tissues (1,8,9).

It is a matter of debate whether the bone morphology of the TMJ and temporomandibular disorders (TMD) are related. There are studies showing that the risk of TMD increases when the articular tubercle is in an upright structure (10,11,12). However, there are not adequate studies on this subject and a comprehensive examination has not been made according to patient groups.

TMJ can be examined with different imaging methods. Orthopantomography, lateral projections, frontal projections, ultrasonography, magnetic resonance imaging (MRI), computed tomography, cone-beam computed tomography (CBCT) are some of them (13,14). CBCT is often used to examine the bony components of the joint (15). It provides an ideal diagnostic quality with its low radiation dose and cost (16).

The aim of this study is to examine the morphological features of glenoid fossa according to age and gender. It is known that anatomical differences can be a predisposing factor for pathologies. Knowing the anatomy of the hard tissue will shed light on the diagnosis and treatment of clinical symptoms (10,17).

Materials and Methods

The presented retrospective study was conducted at Cukurova University Faculty of Dentistry Department of Oral and Maxillofacial Radiology. Ethical approval for the study was obtained from University Ethics Committee (decision no: 18, date: 10.09.2021).

Images were taken with the Planmeca ProMax 3D Mid device and analyzed with a Romexis software program (Planmeca Oy, Helsinki, Finland) with a 15×15cm field of view. Images were acquired at 110 kVp, 3 mA and 3.3 seconds irradiation time. The patients were standing with the Frankfort plane parallel to the horizontal plane laterally. In the images, the section with the largest mediolateral diameter of the condylar prominence was used. Measurements were made in the central sagittal section of the condyle. Images were created with a cross-section range of 0.5 mm and thickness, and it was ensured that all measurements were made from the same standard point.

In this study, the angle between the Frankfort plane of the articular eminence slope and the plane passing through the highest point on the roof of the glenoid fossa and the plane passing through the lowest point on the apex of the articular eminence was evaluated. Evaluation is based on observation, not angular measurement. For this reason, the images were examined by two experienced radiologists. All images were re-evaluated one week later to avoid a possible error.

CBCT images of 382 random patients who applied for various dental treatments between 2019-2021 were analyzed. Patients who had undergone surgery or trauma in the joint area, patients with rheumatological disorders and patients with syndrome were not included in the study. Artifacted and low-quality CBCT images were also excluded.

The present study included 191 male and 191 female patients. The mean age of the cases was 42.28 ± 13.08 (min: 22 max: 68). The patients were divided into five groups according to age: 20-29, 30-39, 40-49, 50-59 and 60-69 years.

Image Analysis

The morphology of the glenoid fossa was evaluated according to the classification of Kurita et al. (18).

1) Box type: It was classified as box type if the posterior slope of the eminence was steep (Figure 1a)
2) Sigmoid type: if it was softer (Figure 1b),
3) Flattened type: if it was completely flattened (Figure 1c)
4) Deformed type: If there was deformation in the cortical layer (Figure 1d).

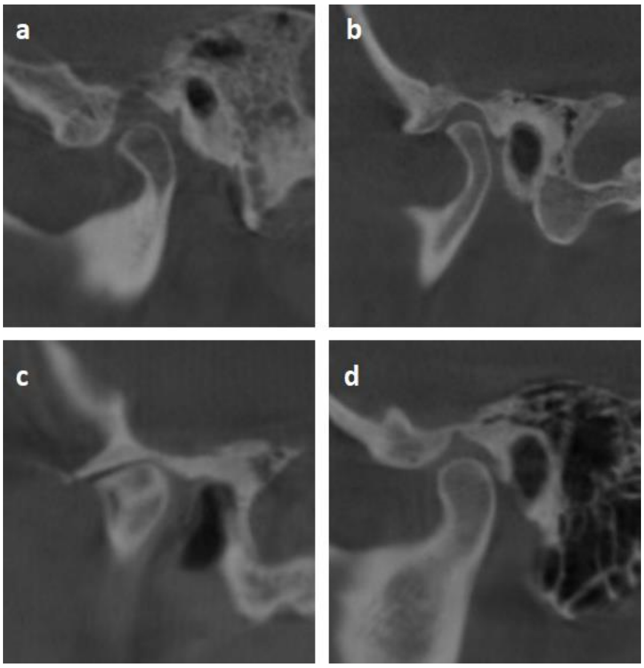

Figure 1. Sagittal cone beam computed tomography images of glenoid fossa. a. Box b. Sigmoid c. Flattened d. Deformed

Statistical Analysis

Statistical analysis was performed using SPSS software package 25.0 (Chicago, IL, USA). The age and gender of the patients were determined. The significance level was set at $p<0.05$. Chi-square test was used to evaluate the distribution of categorical variables.

Results

A total number of 764 joints were evaluated. The distribution of glenoid fossa shape findings by gender is shown in Table 1.

Sigmoid and flattened shaped glenoid fossa were more common in men, and box shaped glenoid fossa was more common in women ($p<0.05$) (Table 1).

Another parameter examined is the distribution of the shape of the glenoid fossa by age groups. Statistical results are shown in Table 2.

When the shape of the glenoid fossa was examined according to age, the sigmoid shape was observed in the 30-39 age range, the box shape was observed in the 40-49 age range, and the flattened and deformed shape in the 60-69 age range was significantly higher ($p<0.05$).

Table 1. Distribution of glenoid fossa shape by gender

SGF**	Female	Male	Total	*p* value
Sigmoid	206	151	357	
	40,60%	59,00%	46,70%	**0.000***
Box	212	30	242	
	41,70%	11,70%	31,70%	**0.000***
Flattened	63	66	129	
	12,40%	25,80%	16,90%	**0.000***
Deformed	27	9	36	
	5,30%	3,50%	4,70%	0.268
Total	508	256	764	
	100,00%	100,00%	100,00%	

Chi-square test (*$p<0.05$).

** Shape of the glenoid fossa

Table 2. Distribution of glenoid fossa shape by age groups

SGF**	20-29	30-39	40-49	50-59	60-69	Total	*p* value
Sigmoid	132	138	78	6	3	357	
	64,70%	76,70%	41,90%	4,40%	5,30%	46,70%	**0.000***
Box	72	36	71	51	12	242	
	35,30%	20,00%	38,20%	37,20%	21,10%	31,70%	**0.000***
Flattened	-	-	28	68	33	129	
			15,10%	49,60%	57,90%	16,90%	**0.000***
Deformed	-	6	9	12	9	36	
		3,30%	4,80%	8,80%	15,80%	4,70%	**0.000***
Total	204	180	186	137	57	764	
	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	

Chi-square test (*$p<0.05$). ** Shape of the glenoid fossa

Discussion

Temporomandibular joint disorders are an important health problem affecting approximately 5-12% of the general population (19). The clinical symptoms of temporomandibular joint disorders can be listed as pain, arthralgia, limitation of movement, open or closed locking and joint sounds (19,20). The anatomy of the TMJ needs much more research to understand the etiology of all these symptoms. On the other hand, TMJ anatomy should be examined with all its aspects in order to reveal the goals and results of the treatments, apart from distinguishing physiological and pathological conditions (19). Brooks et al. (21) stated that the joint is difficult to examine due to its anatomical complexity and proximity to the temporal bone, mastoid air cells, and auditory structures.

Genetics acquired factors and patient age affect the morphology of the bone components of the joint (19,20). Morphological differences between the sexes can be explained by biological, physiological, genetic and psychological factors. To explain with an example, the load carried by the TMJ during chewing is different in both sexes. The anatomy of the bony components of the joint must be fully known in order to reveal the variations, together with their causes and consequences. These studies also shed light on preventive and therapeutic applications as orthodontic, prosthetic and surgical (2,19).

Examining the anatomy and degenerative disorders of the TMJ is important in both symptomatic and asymptomatic patients. Variations or bone changes should not necessarily be associated with symptomatic patients as they may be part of the age-related remodeling process or physiological response. The CBCT images included in this study were also selected without considering the clinical condition of the patients (22,23).

Kurita et al. (18) investigated the relationship between glenoid fossa shapes and disc displacement in their study on MR images of 220 patients. In their study, the glenoid fossa was examined in four groups according to its shape and flattened glenoid fossa was found to be associated with disc displacement. The fact that there is no research on whether the shape of the glenoid fossa depends on age and gender and their incidence has led us to include this subject in our study.

Sülün et al. (10) examined the articular eminence angle and mandibular fossa morphology in their study. The relationship between the hard tissue components of the TMJ and internal disorders has been investigated. High tuberculum articulare and narrow articular fossa structure, which we define as box form, were found to be associated with reduced disc displacement. The flattened form of the glenoid fossa is associated with unreduced disc displacement. Their study showed us that anatomical differences should be investigated first for the diagnosis and treatment of clinical findings.

Bone tissue adapts to the physiological and pathological forces, and this process is defined as remodeling (24). When the applied force is above physiological limits, pathological changes are observed (25). In another study by Kurita et al. (26), it was found that the internal derangements of the joint were related to the flattened type of glenoid fossa. This result once again demonstrated the importance of examining the bone component.

There are very few studies examining TMJ hard tissues in different patient groups. Paknahad et al. (17) evaluated the difference between the sexes in their study in which they examined the shape of the glenoid fossa. The steepness of the eminence did not make a significant difference in men and women. however, it was observed that the glenoid fossa resembled the box form in the group with internal derangement.

In the present study, when both genders are compared, sigmoid and flattened forms of the glenoid fossa in men and box form in women are frequently seen. There are studies showing that TMD symptoms are observed more frequently in women (27,28,29). In the light of this information, authors suggest that the box form of the glenoid fossa increases the frequency of TMD.

Conclusions

To summarize the results, the flattened shape of the glenoid fossa is associated with advanced age and male gender. While the sigmoid shape is frequently observed in men and in the third decade, the box formation is high in the fourth decade and in women. The deformed glenoid fossa was only associated with the sixth decade. According to these findings, it can be considered that the box form is a predisposing factor for TMD and the flattened and deformed forms are an adaptation of the bone against the forces.

Conflict of interest

Author declare that there is no conflict of interest.

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