Original Research

The Prevalence of Partial Changes in the Condylar Head in the Patients with Osteoarthritis: A Cone Beam Computed Tomography (CBCT) Study

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Abstract

Introduction: The present study aimed to review the condylar changes in the patients with osteoarthritis using cone beam computed tomography (CBCT) images. **Methods:** In this study, 80 CBCT images of the temporomandibular joint (TMJ) pertaining 20 patients with osteoarthritis and 20 healthy individuals were evaluated, as well as the CBCT images that were obtained for other reasons. The images were reviewed in the coronal and sagittal sections. Considering the higher prevalence of osteoarthritis in women and after eliminating gender-based interventions, all the female patients were enrolled in the study. Chi-square was used to evaluate the correlations between the changes in the condylar head by the grouping of the patients, and the significance level was considered at 0.05. **Results:** The correlation of condylar head flattening (P=0.051) and Ely's cysts (P=0.544) was assessed in the control group and osteoarthritis patients, and no significant difference was observed between the two variables and patient classification. In addition, the association between erosion (P<0.001) and osteophyte (P=0.002) of the condylar head was evaluated in the control group and osteoarthritis patients, and the presence or absence of these conditions had a significant correlation with disease grouping. **Conclusion:** According to the results, the presence of osteophyte and erosion was more significant in the osteoarthritis group compared to the healthy subjects. The most prevalent bony changes in the condylar head were due to flattening, and the less prevalent changes were associated with Ely's cysts. Moreover, osteophyte and erosion were more prevalent in the patients with osteoarthritis.

Keywords: TMJ, CBCT, Osteoarthritis, Partial Changes, Osteophyte.

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Introduction

The temporomandibular joint (TMJ) is classified as one of the most complicated joints in the body. TMJ is composed of a movable segment (condylar head) and a fixed segment (mandibular fossa) and differs from the other joints in the body (1). TMJ disorders are generally referred to as temporomandibular joint disorders (TMDs), which encompass a large, heterogeneous group of diagnostic items. TMDs could be classified as group I (muscle disorders), group II (disk displacement), and group III (arthralgia, arthritis, and arthrosis) (2).

Degenerative TMJ disorders have been categorized as osteoarthritis and osteoarthritis by the International Research Diagnostic Criteria for Temporomandibular Disorder (RDC/TMD) (3). Degenerative arthritis or osteoarthritis is an age-dependent disorder, which is the most prevalent state of TMJ. The bony changes associated with osteoarthritis include flattening, sclerosis, erosions, osteophyte formation, condylar head resorption, and reduced joint space. These changes are commonly detected in the condylar, while they may engage the glenoid fossa or joint space as well (4, 5).

Imaging is among the leading diagnostic modalities for the assessment of the bony changes in the TMJ, along with clinical examination and various radiographic methods. A clear image of the affected area is essential to the effective treatment of TMDs. However, factors such as the superimposing of the adjacent structures, various angles of the condylar, limitations in mouth opening in some patients, presence of artifacts, and mandible movements during imaging are among the major challenges associated with imaging modalities (5).

Various radiological techniques are used to assess the changes in the TMJ following traumas, degenerative disorders, and deformations, each of which has a specified value for proper clinical examination. Some of these methods include transcranial images, transorbital images, transpharyngeal images, panoramic images, CT-scan, cone beam computed tomography (CBCT) and magnetic resonance imaging (MRI) (6).

CBCT has been introduced as the standard technique for the evaluation of the bony changes in the TMJ (7). The reduced dose received by the patient and higher spatial resolution of the CBCT images are among the key advantages of CBCT over CT-scan (8). Imaging modalities such as MRI and sonography are also particularly used for the review of the disk and soft tissues (9). CBCT provides a three-dimensional (3D) image from the mineralized tissues of the mandibular-facial area with the least distortion and is efficient in specifying various bony changes affecting the TMJ (6).

The present study aimed to review the TMJ bony changes in the patients with osteoarthritis using CBCT.

Materials and Methods

This cross-sectional study was conducted on 40 patients referring to the Radiology department of the School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran for the imaging of the posterior maxilla and implant replacement. The patients were divided into two groups and matched in terms of age and gender. The exclusion criteria of the study included the history of orthodontic and TMJ treatments, craniofacial anomalies, and systemic diseases affecting the joints (e.g., arthritic rheumatoid scleroderma and gout).

Diagnosis of TMD was performed based on the Research Diagnostic Criteria for Temporomandibular Disorder (RDC/TMD) (group III), and the patients were exanimated by a prosthetics expert and a radiologist, who were trained on RDC/TMD. CBCT imaging was carried out from the right and left sides using the Promax3D unit (Planmeca, Helsinki, Finland) with closed mouth, maximum tooth intercuspation, field of view (FoV) size of 80*80*80 millimeters, voxel size of %16 millimeters, and exposure time of 12 seconds. CBCT was selected for the current research due to the low dose and ability to show bony changes and analyze the lateral sections separately or in combination with the coronal sections (6).

The sagittal sections were perpendicular to the panoramic curve line, which links the outer pole of the condylar to the inner pole, along with the condylar curvature and the coronal section, which were perpendicular to the panoramic line in parallel to the transverse axis, which was recreated with a slice interval of one millimeter.

Two independent observers who were blinded to the study reviewed the CBCT images of the patients and the partial changes in the condylar head (flattening, erosion, osteophyte, and Ely's cysts; Fig. 1) in the control and osteoarthritis groups (Figs 2, 3).

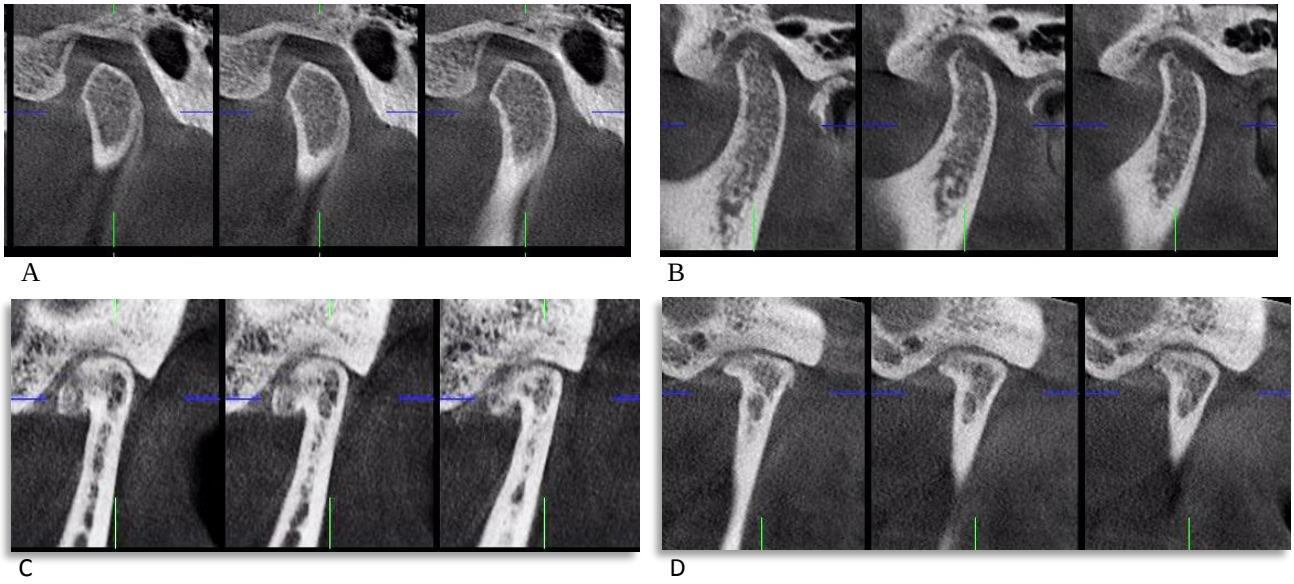

Figure 1. Sagittal Images of Osteoarthritis Patients (**A**: Flattening, **B**: Erosion, **C**: Osteophyte, **D**: Ely's cysts)

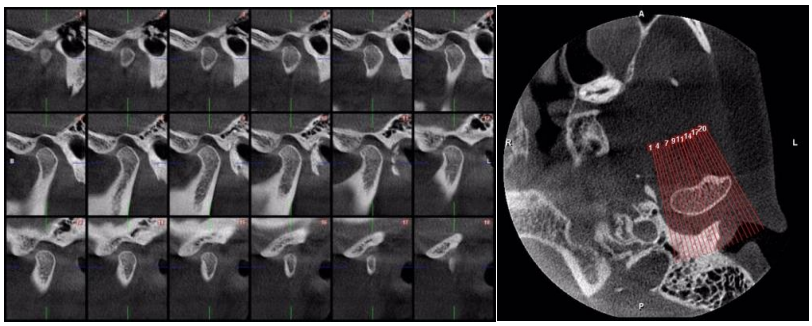

Figure 2. Sagittal Images of Normal Subjects (sections drawn vertically to panoramic line parallel to longitudinal axis of condylar in axial plane)

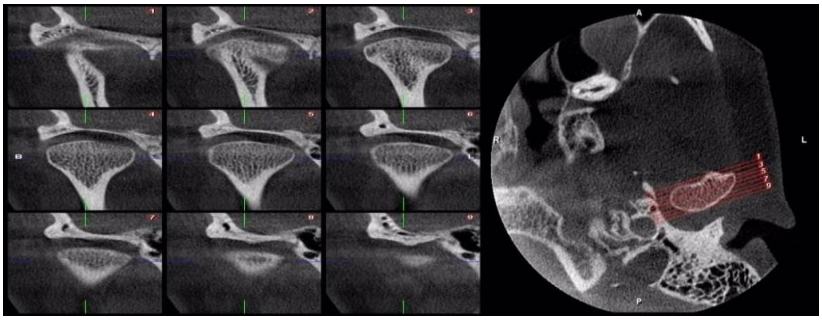

Figure 3. Coronal Images of Normal Subjects (sections drawn vertically to panoramic line parallel to transvers axis of condylar in axial plane)

CBCT was required in order to diagnose the disorder in the patients with osteoarthritis, and no ethical problem was observed. Regarding the control group, since TMJ imaging is not often reasonable in healthy individuals, the image field was adjusted, so that the condylar would also be imaged in the subjects referring to receive fixing implants or wisdom tooth surgery in the posterior areas of the upper jaw. Before performing imaging, written informed consent was obtained from the patients. In addition, the study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences (code: 931516).

Data analysis was performed in SPSS version 21 using Chi-square and Fisher's exact test to assess the correlations between the changes in the condylar head in the control and osteoarthritis groups. In all the statistical analyses, the significance level was considered at 0.05.

Results

In total, 40 female patients (20 with osteoarthritis and 20 controls with healthy TMJ and class I occlusion) were enrolled in the present study. The mean age of the subjects in the control and osteoarthritis groups was 29.1±6.047 and 34.8±10.957 years, respectively (Table I).

The correlation between flattening and Ely's cysts of the condylar head was investigated in the healthy subjects and patients with osteoarthritis. Fisher's exact test was used since the expected number of one of the cells was 25% (<5). Furthermore, the association between erosion and osteophyte of the condylar head was investigated in the healthy individuals and patients with osteoarthritis. Since the expected number of none of the cells was less than five, the P-values of the Chi-square test were used, which were <0.001 and 0.002, respectively. According to the obtained results, the presence or absence of erosion had a significant effect on disease grouping. Moreover, erosion and osteophyte were more prevalent in the patients with osteoarthritis compared to the controls (Table II). On the other hand, the findings indicated the P-values of 0.051 and 0.544, respectively, and no significant correlation was observed between the two variables (Table II).

Table I. Comparison of Mean Age in Normal Individuals and Osteoarthritis Patients Based on Kolmogorov-Smirnov Test

Group	N	Mean	Std. Deviation	Minimum	Maximum	P-value
Normal	20	29.1	6.047	21	45	P>0.05
Osteoarthritis	20	34.8	10.957	20	50	P>0.05

Table II. Correlations of Flattening, Erosion, Osteophyte, and Ely's Cysts of Condylar Head in Normal Individuals and Osteoarthritis Patients

	Flattening N (%)		Erosion N (%)		Osteophyte N (%)		Ely's Cysts N (%)	
	Yes	No	Yes	No	Yes	No	Yes	No
Osteoarthritis	34 (85)	6 (15)	25 (62.5)	15 (37.5)	15 (37.5)	5 (62.5)	3 (7.5)	37 (92.5)
Normal	12 (60)	8 (40)	0 (0)	20 (100)	0 (0)	20 (100)	0 (0)	20 (100)
Total	46 (76.7)	14 (23.3)	25 (41.7)	35 (58.3)	15 (25)	25 (75)	3 (5)	57 (95)
P-value	0.051		<0.001		0.002		0.544	

Discussion

TMD is considered as a subgroup of musculoskeletal pathologies and is the main cause of the pains with a non-tooth origin. The most common symptoms of TMD include joint pain, muscle pain, constraints in mouth opening, clicks, and crepitus. Osteoarthritis is a chronic, degenerative, inflammatory disease, which is the most prevalent state of arthritis (10). Osteoarthritis mostly affects middle-aged and elderly individuals, particularly women aged more than 50 years. The higher prevalence of this disorder in women could be attributed to estrogen and prolactin hormones, which intensify the degradation of cartilage and bony structures, as well as the immune response stimulus in TMJ (5). Although osteoarthritis mostly affects the knees, pelvic joints, and spine, which bear most of the body weight, it could also engage the neck, arms, and TMJ. The most prevalent symptom of osteoarthritis in TMJ are touchable inflammation, joint tenderness, crepitation, and limitations in the movements of the mandible. The disease has been reported to be mild in the joints in the early morning, while it could become more severe in the afternoon due to daily activities. Therefore, it is critical for dentists to recognize the anatomic specifications of the TMJ surfaces in order to identify the changes occurring following TMD (11).

In the current research, the morphological changes in the condylar (flattening, erosion, Ely's cysts, and osteophyte) were evaluated through reviewing the CBCT of the individuals with TMD. Erosion was identified within the early stages of degenerative changes, which indicated that TMJ was unstable, and immediate superficial bone changes were inevitable, which is highly likely in the case of occlusion change.

Flattening is a degenerative state, which is caused when a high load is imposed on the TMJ and may be associated with the engagement of the master and

temporal muscles. Osteophyte occurs at the end of degenerative changes while the body is adapting to the repair of the joints to stabilize and widen the joint surface, so that it could bear the excessive load on the joint.

Ely's cysts are also referred to as subcortical cysts and are a lucent circular area, which are placed exactly under the cortical bone or deep into the cortical bone (5). In present study, the most prevalent finding denoted by the two observers was joint surface flattening. On the other hand, Ely's cysts were reported to be the least prevalent observation. The reason for the higher prevalence of flattening is that this change was adjusted to resist the load imposed on the TMJ; however, it was complicated to differentiate the developed remodeling from the degenerative joint disease (6).

In a study by Nah et al (12), the condylar changes in the patients with TMD were assessed using CBCT. According to the findings, the most prevalent changes were sclerosis, erosion, and flattening. In addition, cases of Ely's cysts and osteophyte were reported in the mentioned research, which were scarce (4%); this is in line with the results of the present study. It is notable that in the study by Nah et al (12), there was no age limit, and the patients with various age ranges were examined. Although sclerosis was the most prevalent finding in the mentioned study, the definite identification of the changes was not possible, and it is a gradual process progressing over time.

With respect to flattening, Nah et al. only considered the upper surface flattening of the joint, while the flattening changes were also observed in the other surfaces of the condylar head, due to which the prevalence of flattening was reported to be low. In the current research, the flattening of all the joint surfaces of the condylar head was investigated, and a higher prevalence was observed compared to the study by Nah et al (12). In addition, the most prevalent bony changes in the condylar head were detected in flattening, while the least prevalence was reported in the case of Ely's cysts. Osteophyte and erosion were also more prevalent in the osteoarthritis group, which is consistent with the findings of Alexiou in the patients with joint arthritic degenerative changes (4).

In this regard, N. Alves et al (11). Evaluated the morphological features of TMJ, concluding that sclerosis, flattening, erosion, and osteophyte had the highest prevalence, which is in congruence with the results of the present study. On the other hand, Cevidanes et al (13). performed a study to analyze the condylar of the patients with osteoarthritis, and the prevalence of flattening, erosion, and osteophyte was reported to be 60%, 40%, and 40%, respectively. In another research, Dose Anjos Pantual et al (6). Assessed the bony changes in the TMJ using CBCT, stating that the prevalence of flattening was 59%. The results of the mentioned studies are in line with the current research.

In a study by Ujwala Shiravama Shety et al (5), condylar changes were investigated using digital tomography, and the most prevalent changes were erosion, flattening, and osteophyte as detected by three observers, which is consistent with the results of the present study in terms of the high prevalence of flattening. Furthermore, Marcella Quirino et al (6). Assessed degenerative bony changes using CBCT, reporting the prevalence of flattening, osteophyte, erosion, sclerosis, and Ely's cysts to be 58.8%, 3.44%, 6.22%, 2.13%, and 4.10%, respectively, which is in congruence with the findings of the current research. Similarly, Alexiou et al (14). investigated the severity of bony osteoarthritic changes in the TMJ, and the obtained results indicated that erosion, flattening, and osteophyte were the most prevalent degenerative condylar changes, while sclerosis had the lowest prevalence. These findings are consistent with the results of the present study in terms of the high prevalence of flattening. The high prevalence of flattening in the current research was also similar to the findings of Hintz et al. (15), which demonstrated condylar morphological changes based on CBCT and conventional tomography images (15).

In a study by Imani Moqadam et al (16). The correlation between bony changes and TMD grouping was investigated, and the authors concluded that flattening, erosion, and osteophyte were more prevalent in the RDCTMDIII group, including patients with osteoarthritis, compared to the other changes. This finding corresponds with the results of the present study.

Conclusion

According to the results, the prevalence of osteophyte and erosion was higher in the patients with osteoarthritis compared to the healthy subjects. Furthermore, the most prevalent bony changes in the condylar head were flattening, while Ely's cysts had the lowest prevalence. Also, osteophyte and erosion were more frequent in the patients with osteoarthritis compared to the normal subjects.

Recommendations

It is recommended that further investigation be conducted to assess the effects of variables such as anterior crossbite, number of the teeth found in the occlusion, and parathyroid hormone on the serum minerals and condylar head changes. Considering that the most of the patients with osteoarthritis are women, it is suggested that the levels of sex hormones be measured in further investigation in this regard in order to evaluate their possible effects.

Conflicts of Interest

None declared.

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