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# Radiologic Changes in Patients with Temporomandibular Joint Hypermobility: A Cone Beam Computed Tomography Study

## Temporomandibular Eklem Hipermobilitesi Olan Hastalarda Radyolojik Değişiklikler: Koni Işınlı Bilgisayarlı Tomografi Çalışması

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## ABSTRACT

**Objective:** This study aimed to evaluate radiologic changes in patients with temporomandibular joint hypermobility using Cone Beam Computed Tomography (CBCT).

**Methods:** This retrospective study included the first-visit CBCT images of 41 patients (mean age, 32.83 ± 13.63 years) treated for TMJ hypermobility. CBCT images of sixty-eight joints with TMJ hypermobility taken by using NewTom 3G were evaluated. Condylar erosion, sclerosis, hypoplasia, and flattening were assessed on the CBCT images. In addition, flattening of articular eminence, subchondral cyst, and pneumatization were also evaluated in the images. Descriptive statistical analysis was performed on the data.

**Results:** Degenerations were observed in 47 joints (%69.11). Condylar erosion was the most common finding of TMJ hypermobility (43 of 68 joints, 63.2%). Other frequent condylar bony changes were condylar osteophyte (32 joints, 47.1%), sclerosis (8 joints, 11.8%), hypoplasia (8 joints, 11.8%), and flattening (6 joints, 8.8%). The flattening of articular eminence (3 joints, 4.4%) and subchondral cyst (3 joints, 4.4%)), and) were other findings on CBCT images. One joint showed a bifid condyle and pneumatization (1.5 %) (Table 1).

**Conclusion:** The present study showed that two of three patients with TMJ hypermobility had joint degenerations. Condylar erosion and osteophyte are the most common degenerations observed in these patients. Therefore, CBCT is recommended for the diagnosis and management of TMJ hypermobility.

Keywords: Cone beam computed tomography, TMJ hypermobility, Diagnosis

## ÖZ

**Amaç :** Bu çalışmada temporomandibular eklem hipermobilitesi olan hastalarda Koni Işınlı Bilgisayarlı Tomografi (CBCT) kullanılarak radyolojik değişikliklerin değerlendirilmesi amaçlandı.

**Yöntemler:** Bu retrospektif çalışmaya, TME hipermobilitesi nedeniyle tedavi edilen 41 hastanın (ortalama yaş, 32,83 ± 13,63 yıl) ilk ziyaret KIBT görüntüleri dahil edildi. TME hipermobilitesi olan 68 eklemin NewTom 3G kullanılarak alınan KIBT görüntüleri değerlendirildi. KIBT görüntülerinde kondiler erozyon, skleroz, hipoplazi ve düzleşme değerlendirildi. Ayrıca görüntülerde eklem eminensinde düzleşme, subkondral kist ve pnömatizasyon da değerlendirildi. Veriler üzerinde tanımlayıcı istatistiksel analiz yapıldı.

**Bulgular :** 47 eklemde (%69,11) dejenerasyon gözlendi. Kondiler erozyon, TME hipermobilitesinin en sık görülen bulgusuydu (68 eklemden 43'ü, %63,2). Kondiler osteofit (32 eklem, %47,1), skleroz (8 eklem, %11,8), hipoplazi (8 eklem, %11,8) ve düzleşme (6 eklem, %8,8) diğer sık görülen kondiler kemik değişiklikleriydi. Artiküler eminenste düzleşme (3 eklem, %4,4) ve subkondral kist (3 eklem, %4,4) ve) KIBT görüntülerindeki diğer bulgulardı. Bir eklemde bifid kondil ve pnömatizasyon (%1,5) görüldü (Tablo 1).

**Sonuç:** Bu çalışma TME hipermobilitesi olan üç hastadan ikisinde eklem dejenerasyonunun olduğunu gösterdi. Bu hastalarda en sık görülen dejenerasyonlar kondiler erozyon ve osteofittir. Bu nedenle TME hipermobilitesinin tanı ve tedavisinde KIBT önerilmektedir.

**Anahtar Kelimeler :** Konik ışınlı bilgisayarlı tomografi, TME hipermobilitesi, Tanı

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## INTRODUCTION

Temporomandibular joint (TMJ) hypermobility is a disorder that involves condyle-disc complex and eminence. The temporomandibular joint (TMJ) dislocation occurs when the condyle moves beyond the eminence during an extensive mandibular opening. Before returning to the fossa, the condyle catches in an open position.[1,2] A temporary pause is followed by a sudden jump or leap to the maximal position. This jump creates a sound like a thud, not clicking. According to the Diagnostic Criteria for Temporomandibular Disorders (DC/ TMD), the jaw can close spontaneously, or the patient can close the jaw with self-maneuver.[2,3] This situation is called subluxation or hypermobility.[1,2] According to Schiffman et al,[3] Temporomandibular joint dislocation is characterized by an "open lock" of the lower jaw, and diagnosis of the TMJ dislocation is based on patient history. If a patient is able to reduce the dislocation, it is called "subluxation." If a patient is unable to reduce this dislocation, the dislocation requires an interventional reduction and it is called "luxation".

The etiology of TMJ hypermobility is mainly associated with the morphological structure of the joint. Other etiological factors include generalized joint laxity, elongation of the ligaments, internal derangement and disc interference disorders, and occlusal disturbances.[2,3]

CBCT has remarkable research areas in TMJ imaging. The 3-D imaging modality of CBCT provides influential diagnostic assessments of a variety of TMJ conditions, such as osteoarthritis and hypermobility.[4,5]

CBCT has several advantages over conventional CT for diagnosis and treatment planning: lower cost and radiation dose, 3D imaging ability, better resolution, shorter acquisition time, and more essential details. In addition, osseous components of the TMJ joint, integrity of cortical bone, and destruction/production of subcortical bone can be viewed with superior sensitivity on CBCT, [4,5].

CBCT findings of temporomandibular joint disorders have been subjected to several studies.[5-7] A recent study found that most joints showed degenerations on CBCT evaluations.[6] Other studies[7] assessed the CBCT images to detect degenerative changes in TMJ. The most common osseous changes in degenerative joint disease are erosion, osteophytes, and flattening.

CBCT evaluations of patients with TMJ hypermobility have been carried out in a few studies.[8] However, bony osseous changes of the mandibular condyle and articular fossa were never evaluated in previous studies with large sample-sized populations. Therefore, this study aimed to evaluate radiologic changes in patients with temporomandibular joint hypermobility using Cone Beam Computed Tomography (CBCT).

## METHODS

This retrospective study included the first-visit CBCT images of 41 patients (mean age, 32.83 ± 13.63 years) treated for TMJ hypermobility. CBCT images of sixty-eight joints with TMJ hypermobility were evaluated. All participants signed the informed consent, and the informed consents were included in the study. The Ethics Committee of the Faculty of Dentistry, XXX University, approved this study (Approval Date: 28.04.2014; Approval Number: 2014/11).

Diagnosis of TMJ hypermobility was based on the condylar movement that the condyle slides just anterior to the articular eminence and then goes back to the glenoid fossa by active jaw manipulation of the patient or self-reduction.

The inclusion criteria were as follows:1) had clinical complaints of TMJ-hypermobility according to DC/TMD axis I group IIc, 2) existing CBCT with high quality, 3) age > 16 years. Exclusion criteria were as follows: 1.) had previous temporomandibular joint disorder treatment; 2.) had a hematologic or neurologic disorder and any disease of inflammatory or connective tissues 3.) had pregnancy; 4.) a history of drug allergy; immunosuppressive drug intake, and degenerative TMJ disorders.

**CBCT Evaluation**

During the mouth closed position, a NewTom 3G flat panel was used to get CBCT of TMJ (Quantitative Radiology, Verona, Italy). All images were recorded at 5.4 second exposure time, 110 kV and 3-5 mA, and .16 mm voxel size. CBCT images were assessed in three planes: axial (0.5 mm), coronal, and sagittal (2 mm). The CBCT evaluations were performed on lateral slices using the NewTom CBCT software.

Condylar erosion, sclerosis, hypoplasia, and flattening were assessed on the CBCT images. In addition, flattening of articular eminence, fossa resorption and sclerosis, subchondral cyst, and pneumatization was also evaluated on the images.

**Statistical Analysis**

All statistical analyses were conducted using the SPSS 17.0 (Statistical Package of Social Sciences, Chicago, IL, USA) software program. Descriptive statistical analysis was performed on the data.

## RESULTS

Degenerations were observed in 47 joints (%69.11). Condylar erosion was the most common finding of TMJ hypermobility (43 of 68 joints, 63.2%). Other frequent condylar bony changes were condylar osteophyte (32 joints, 47.1%), sclerosis (8 joints, 11.8%), hypoplasia (8 joints, 11.8%), and flattening (6 joints, 8.8%). The flattening of articular eminence (3 joints, 4.4%) and subchondral cyst (3 joints, 4.4%)), and) were other findings on CBCT images. One joint showed a bifid condyle and pneumatization (1.5 %) (Table 1).

**Table 1.** CBCT results show osseous changes related to the condyle, articular fossa, and eminence.

| **CBCT findings** | ***n*** | **%** | **CBCT findings** | ***n*** | **%** |
|---|---|---|---|---|---|
| Condylar erosion | 43 | 63.2 | Fossa resorption | 2 | 3.6 |
| Condylar osteophyte | 32 | 47.1 | Fossa sclerosis | 3 | 5.5 |
| Condylar sclerosis | 8 | 11.8 | Subcortical cyst | 3 | 4.4 |
| Condylar hypoplasia | 8 | 11.8 | Flattening of art. eminence | 3 | 4.4 |
| Condylar flattening | 6 | 8.8 | Bifid condyle | 1 | 1.5 |
| Pneumatization | 1 | 1.5 | | | |

CBCT, cone beam, computed tomography.
*n* = number of joints.

## DISCUSSION

During a wide mouth opening, temporomandibular joint (TMJ) hypermobility occurs with an excessive translation of the condyle anterior to the eminence. TMJ hypermobility is mainly associated with the morphological structure of the joint. Other factors included occlusal disturbances and trauma, internal derangement and disc interference disorders, TMJ ligament and joint capsule laxity, and hyperactivity of the lateral pterygoid muscle.[2,3,9]

CT, MRI, plain radiography, arthrography, and panoramic radiography have been used with varying frequencies to get images of the TMJ and surrounding structures and to diagnose TMJ disorders. However, all these modalities have limitations and drawbacks for effectively visualizing TMJ structures. These modalities' main limitations and drawbacks are the presence of artifacts and the superimposition of the adjacent structures. On the other hand, CBCT lets precise measurements of the condyle surface and condylar volume with dose- and cost-effectiveness. CBCT provides an evaluation of hard tissue abnormalities of the TMJ with high-quality 3D images.[4] For accurate assessment of osseous TMJ structures, CBCT has been advocated due to its high-diagnostic accuracy.[10]

Scanning times of CBCT are significantly shorter (10-70 seconds), and it offers submillimeter spatial resolution images with lower radiation dosages than CT methods.[10]

Katakami et al[11] reported that CBCT showed high sensitivity in demonstrating hard tissue changes, which is consistent with our findings. These authors reported that CBCT images showed an erosive shift in the cortical bone. On the other hand, other authors[12] wrote that the sensitivity of CBCT depends on the defect's size, and the sensitivity is low in small-sized hard tissue defects.

CBCT has a sensitivity between 72.9–87.5% in detecting condylar bone changes[12], and condylar erosion can be seen more quickly than other degenerative changes.[12] It has been emphasized that defects smaller than 2 mm may be challenging to detect, and defect size is essential for CBCT sensitivity. However, some reports revealed that when using higher scanning resolutions (0.2-mm voxel size), bony defects can be detected with 80% sensitivity, regardless of the size of the defects.[13]

Tuijt et al[8] evaluated CBCTs of the patients with TMJ hypermobility. The authors used the CBCT to provide a patient-specific biomechanical model. However, hard-tissue changes of the condyle and fossa were never evaluated in previous studies with large sample-sized populations.

Therefore, this study evaluated radiological changes of the condyle and articular fossa in CBCT images of patients with TMJ hypermobility. The present study found that two of three patients showed joint degeneration. Condylar erosion was the most common finding of TMJ hypermobility (43 of 68 joints, 63.2%). Other frequent condylar bony changes were condylar osteophyte (32 joints, 47.1%), sclerosis and hypoplasia (8 joints, 11.8%), and flattening (6 joints, 8.8%). The flattening of articular eminence (3 joints, 4.4%) and subchondral cyst (3 joints, 4.4%)), and) were other findings on CBCT images. One joint showed a bifid condyle and pneumatization (1.5 %) (Table 1).

Lee at al.[14] evaluated patients with temporomandibular disorder (TMD) by means of clinical and MR findings. These authors reported that condylar degeneration, disc displacement, disc deformity were frequent among patients with TMD. The authors reported that 37 percent of the patients showed condylar degeneration.

Cömert Kilic et al[5] evaluated CBCT of 76 patients with temporomandibular joint osteoarthritis (TMJ-OA), and they reported 94 percent condylar erosion, 92 percent condylar flattening, approximately 80 percent osteophytes, and 12 percent sclerosis. In addition, five joints showed pneumatization and flattening of the articular eminence in this study.

Some experimental studies[15] have shown that alterations of functional TMJ loading cause a density loss in the subchondral bone of condyle and condylar cartilage.[15]

A CBCT analysis by Talaat et al.[16] revealed that joints with TMD patients had frequent flattening, condylar osteophytes, and irregularities. Some authors suggested that erosive lesions may indicate early and acute bony changes in TMJ structures. In contrast, osteophyte and flattening formation indicates late alterations in the TMJ and may suggest a bone repair.[17]

Ogütcen-Toller[18] suggested that temporomandibular joint sounds may be considered signs of an abnormal joint disorder. On the other hand, other researchers suggested that pathological bony changes in TMD patients osteophyte formation, erosion, or deformity) may be associated with joint sounds.[19]

## CONCLUSION

Findings of the present study showed that two of three patients with TMJ hypermobility had joint degenerations, and condylar erosion and osteophyte are the most common degenerations observed in these patients. Therefore, CBCT is recommended for the diagnosis and management of TMJ hypermobility.

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