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The association between condylar bone changes revealed in cone beam computed tomography and clinical dysfunction index in patients with or without temporomandibular joint disorders

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Objective. The aim of the present study was to compare cone beam computed tomography (CBCT) findings pertinent to patients with temporomandibular disorder (TMD) and patients without TMD (non-TMD), as well as to investigate the correlation between these findings and the clinical dysfunction index (Di).

Study Design. In this cross-sectional study, CBCT images of temporomandibular joints (TMJs) were evaluated for condylar bone changes in 84 patients with TMD. The patients were assigned a score using Helkimo's clinical Di, ranging from 1 to 25, and were thereafter subdivided into 3 groups based on the degree of Helkimo's Di. CBCT and clinical records of sex- and age-matched non-TMD patients were used as the control group.

Results. There was a significant difference in the prevalence of all types of bone changes between TMD and non-TMD groups (all $P < .05$), except for loose joint bodies. Furthermore, there was a significant correlation between the total amount of bone change and the Helkimo Di score ($P < .001$).

Conclusion. Evaluation of CBCT images in the present study revealed significant differences between TMD and non-TMD condyles. There was also a significant relationship between the Helkimo clinical Di and the total amount of condylar bone change in patients with TMD. (Oral Surg Oral Med Oral Pathol Oral Radiol 2017;123:600-605)

Temporomandibular disorders (TMDs), which affect the muscular soft tissue and bony components of the temporomandibular joint (TMJ), present variable clinical signs and symptoms such as pain, popping, clicking, limited opening, mandibular deviation on opening and closing, muscle tenderness, headaches, earaches, and malocclusion.[1] TMDs are frequently associated with degenerative changes in bone structures of the TMJ.[2] Exploration of these bone changes is essential for correct diagnosis of the dysfunctions associated with TMDs, and also for devising an adequate treatment plan.[3] Radiographic examination techniques, which are essential methods for the diagnosis of degenerative bone changes in TMDs, include panoramic radiography, conventional tomography, computed tomography (CT), and magnetic resonance imaging (MRI).[4,5] Recently, cone beam computed tomography (CBCT) has become the modality of choice for evaluation of TMJ osseous components.[6] This modality, which provides greater accuracy as well as superior reliability compared with panoramic radiography and conventional tomography, allows visualization of the bony components in all dimensions in addition to providing a view of osseous changes.[7] Furthermore, compared with CT, CBCT is less costly and involves a lower dose of radiation.[8]

An estimated 10%-70% of the entire population seems to show symptoms of TMD, such as myofascial dysfunction.[9] Many researchers believe it is necessary to have a standardized classification for assessing the signs and symptoms of TMD, to measure and compare the severity of TMJ disorders, and to assess the patient's condition after treatment, while emphasizing the need for an effective tool to study the etiologic factors.[10] Helkimo's clinical dysfunction index (Di), developed in 1974, is a functional evaluation of the masticatory system, which classifies individuals based on 5 basic signs, including impaired range of mandibular movement, impaired TMJ function, TMJ pain during palpation, muscular tenderness, and pain during mandibular movement.[11]

Many researchers have evaluated the correlation between the presence of some signs and symptoms of TMD and the bone changes in the TMJ using CBCT.[12-14] However, the relationship between the radiographically detected bone changes from CBCT and the clinical signs and symptoms, as well as the reliability of CBCT in the diagnosis of TMD, are still questionable topics.[12,13,15,16] This study aims to compare CBCT findings in patients with TMD patients without, and also to determine the possible relationship between the prevalence of condylar head bone changes in sectional CBCT images and Helkimo's clinical Di in different patients with a varied range of TMD severity.

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METHODS AND MATERIALS

The research protocol was approved by the Ethics Committee of the Shiraz Dental School. Eighty-four patients (62 women and 22 men) with clinical signs and symptoms of TMD that required further investigation using CBCT were recruited in this study. Patients were aged 18 to 65 years (33.93 ± 13.18 years).

CBCT images and clinical records of another population of 84 patients (60 women and 24 men aged 18 to 65 years) (35.67 ± 10.75 years) who sought treatment for purposes other than TMD were used as the control. Selective sampling was performed to ensure that the age and sex distribution of the patients in the non-TMD group were similar to those of the patients in the TMD group, to avoid arbitrary effects on the results. Inclusion criteria for the non-TMD group were: no pain affecting the TMJ area or muscles of mastication, no joint sounds, and no limitation of movement or function in the TMJs (Helkimo clinical Di = 0).

The exclusion criteria for the TMD and non-TMD groups included either 1 or all of the following: A positive history of temporomandibular surgery or acute trauma, the presence of congenital abnormalities, musculoskeletal or neurologic disorders, and any systemic diseases that could affect joint morphology. All of the patients voluntarily participated in this study, were informed about the nature of the investigation, and signed a written consent form.

Patients were clinically evaluated according to Helkimo's clinical Di and a score of 0 to 5 was assigned for each of the 5 clinical signs based on severity. The total of the allocated scores for these 5 items was recorded as the patient's clinical dysfunction or Helkimo score. Depending on the score attained (total score), the individuals were classified as having a clinical Di between 0 and 4, as presented below:

Di 0 (0 points, absence of clinical symptoms)
Di I (1-4 points, mild TMD)
Di II (5-9 points, moderate TMD)
Di III (10-25 points, severe TMD)

To ensure consistency of the interpretation of the answers provided by the patients, all patients were evaluated by a single prosthodontist with more than 15 years of experience in the diagnosis and treatment of TMD patients.

CBCT examination was performed for all patients using a NewTom VGi scanner (NewTom, Verona, Italy) with the exposure parameters set at 120 kVp, 4.8 mA, and exposure time of 20 s in the standard resolution mode (voxel size 0.3 mm). The images were obtained in maximum intercuspation. The field of view (FOV) size was 15 × 12 cm.

The NewTom Cone Beam 3D Imaging System workstation (NNT Software version 6.2) was employed to prepare the TMJ images. The primary reconstruction of the raw data was localized to the TMJ region. The system automatically generated axial images, which were then scrolled to identify the axial view on which the condylar process revealed the widest mediolateral extent. The thickness and interval of the image slices were set at 1 mm. The next stage of the process involved rectifying sagittal (lateral) and coronal (frontal) cross sections, followed by reconstructing them perpendicular and parallel to the long axis of the condyle, respectively.[8,15] Two dentomaxillofacial radiologists, whose regular practice involved interpretation of TMJ CBCT images, and who each possessed more than 20 years of experience, evaluated the images. During two 2-day calibration sessions, the observers engaged in reviewing and discussing the characteristics of condylar bone changes in cases which were not included this study. The observers independently assessed the images twice with a minimum interval of 14 days.

Condylar bone changes were classified into distinct types, according to previous studies[8,17] as follows: (1) normal (Figure 1); (2) flattening (a flat bone contour, deviating from the convex form); (3) surface erosion (loss of continuity of articular cortex); (4) subcortical cyst (Ely cyst): Round radiolucent area just below the cortical plate or deep in trabecular bone; (5) subcortical sclerosis: Any increased thickness of the cortical plate; (6) generalized sclerosis: Increased radiopacity of the spongy bone; (7) marginal bony overgrowth (osteophytes): Local outgrowth of bone arising from the mineralized surface; and (8) loose joint body: Osteophytes that break off and lie free within the joint space.

The right and left TMJ areas of each patient were evaluated. The presence or absence of any of the prementioned radiographic signs in either joint was recorded respectively as "1" or "0" for that particular sign. The total numbers of patients linked with a given variable were calculated.

The consistency between the first and second set of records produced by each specialist, as well as the inter-examiner reliability for each of the criteria, were evaluated using the κ statistic. Strong inter-examiner agreement was observed (κ coefficient: 0.832 to 1). The intra-examiner agreement index was also very satisfying (0.851 to 1 and 0.837 to 1 for the 2 specialists). Therefore, in case any disagreement was found during the data collection procedure, the set of data presented by the first observer, who had achieved a higher reliability index, was included.

To establish the correlation between the condylar bone changes and the clinical dysfunction index, the total amount of bone changes in each patient was calculated by adding up the scores related to any of the radiographic findings investigated. For example, the total amount of condylar bone changes of a patient was