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Association between mandibular condylar position and clinical dysfunction index

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ABSTRACT

Objectives: Condylar position in the glenoid fossa has been associated with temporomandibular disorders. The purpose of the present study was to investigate the correlation between clinical dysfunction index (Di) and mandibular condylar position in patients with temporomandibular joint dysfunction (TMD) using cone beam computed tomography (CBCT).

Methods: In this cross-sectional study, participants were recruited from the Department of Maxillofacial Radiology at Shiraz Dental University in Iran. The condylar position was assessed on the CBCT images of 120 temporomandibular joints in 60 patients with TMD. Patients were divided into 3 groups based on Helkimo's clinical Di. The chi-square test was used to correlate degree of the Helkimo's Di with the mandibular condylar position. The p value was set at 0.05.

Results: A total of 60 patients (42 women and 18 men; mean age, 33.4 years) participated in this study. Significant differences in condylar position were found among the 3 groups (Di I, II, and III) ($p < 0.05$). Patients with mild to moderate TMD were found to have anteriorly and concentric seated condyles. Posteriorly seated condyles were found in patients with severe TMD.

Conclusion: Condylar position is associated with different severity of TMD.

1. Introduction

Joint space measurements were first introduced by Ricketts to assess condylar position on transcranial radiographs (Ricketts, 1950). The radiographic joint space is a radiolucent area between the mandibular condyle and the temporal bone. The condylar position can be determined by the relative dimensions of the radiographic joint spaces between the glenoid fossa and the mandibular condyle (White and Pharaoh, 2013).

Controversy persists over the clinical significance of condylar position in the temporomandibular joint (TMJ) (Bonilla-Aragon et al., 1999; Menezes et al., 2008; Okur et al., 2012). Some studies have associated the posterior condylar position with the TMD (Sanromán et al., 1997; Rammelsberg et al., 2000; Kurita et al., 2001; Incesu et al., 2004; Gateno et al., 2004; Huang and Zhang, 2012; Ikeda and Kawamura, 2013). However, other studies have failed to demonstrate a significant association between the condylar positioning and internal derangement or signs and symptoms of patients with TMD (Bonilla-Aragon et al., 1999; Okur et al., 2012).

Several radiographic modalities have been used to determine condylar position, such as plain film radiography (José Pereira et al., 2004; Serra and Gavião, 2006), conventional tomography (Major et al., 2002; Kikuchi et al., 2003; Wiese et al., 2008), computed tomography (CT) (Tsuruta et al., 2004; Okur et al., 2012), cone beam computed tomography (CBCT) (Ikeda and Kawamura, 2009; Ikeda et al., 2011; Cho and Jung, 2012; Ikeda and Kawamura, 2013), and magnetic resonance imaging (MRI) (Incesu et al., 2004; Robinson de Senna et al., 2009; Kandasamy et al., 2013).

CBCT a relatively new imaging technique and is becoming the modality of choice for evaluation of TMJ osseous components (Barghan et al., 2012). This modality provides accurate and reliable linear measurements for imaging of dental and maxillofacial structures (Scarfe et al., 2006; Mischkowski et al., 2007). Therefore, in the present study, the observers have used CBCT to study condylar positioning.

Helkimo's clinical dysfunction index (Di) is 1 of the most widely used indices that developed by Helkimo (Helkimo, 1974). This index is based on 5 criteria including mandibular mobility, TMJ function, and presence of the pain during mandibular movement, TMJ pain

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during palpation, and muscle tenderness. This index classifies individuals into 4 groups including normal (index 0), mild (index 1), moderate (index 2), and severe (index 3). This index is a reliable evaluation of signs and symptoms of patients with the different severity of TMD, and it is used to measure the severity of TMJ disorders and to evaluate the improvement of patients' condition after treatment (Helkimo, 1974; Vojdani et al., 2009).

A review of the published literature by authors revealed no studies on the relationship between the condylar position and Helkimo's clinical Di in patients with TMD expressing different severities of TMD using CBCT. The aim of the present study was to assess the condylar position association with the clinical dysfunction index in patients with different severity of TMD using CBCT.

2. Material and methods

The research plan received approval from the Ethics Committee of Shiraz Dental School. 60 patients (42 women and 18 men) with clinical signs and symptoms of TMD were recruited in this study. These patients were referred to the Department of Maxillofacial Radiology at Shiraz Dental University in Iran for the treatment of TMDs and required CBCT for further investigation. The age of the patients ranged from 20 to 42 years (33.4 ± 2.94 years). All individuals had a full complement of permanent teeth with or without third molar with normal (class I) occlusion. The exclusion criteria were a positive history of temporomandibular surgery and/or jaw trauma and/or a fracture or pathology in the region of the temporomandibular and/or the presence of any congenital abnormalities and/or any systemic disease that could affect the joint morphology such as rheumatoid arthritis. Patients had no history of occlusal, prosthodontic, or orthodontic therapies. According to CBCT findings, the subjects with degenerative joint disease were also eliminated from enrollment.

All of the participants took part voluntarily in this study, and written consent forms were signed by each patient after patients were informed about the nature of the study in detail.

2.1. Clinical examination

Patients were evaluated according to the Helkimo's clinical Di (Helkimo, 1974). According to the Helkimo's clinical Di, clinical examinations including mandibular mobility, TMJ function, TMJ pain, muscular pain, and pain during movement were scored between 0 and 5. A summary is given in Table 1. Depending on the clinical dysfunction score, the patients were classified as having a clinical dysfunction index (Di) of I (1–4 points, mild TMD), Di II (5–9 points, moderate TMD), or Di III (10–25 points, severe TMD).

All of the examinations were carried out by a single well-trained clinician who was previously trained. The use of 1 examiner in this study ensured continuity of interpretation of the answers provided by the patients.

2.2. CBCT of the TMJ

The CBCT scans of bilateral TMJs were performed by a New Tom VGi with the exposure factors set at 120 kVp, 4.8 mA and exposure time of 20 s. The field of view size was 13 × 13 cm. The subjects were standing and biting their teeth into maximum intercuspal position. Their heads were positioned with the Frankfort plane parallel to the floor.

2.3. Condylar position assessment

A specialist in dentomaxillofacial radiology interpreted all of the images. For evaluating the condylar position, the axial view on which the condylar process showed the widest mediolateral extent was used as the reference view for the secondary reconstruction. On this selected axial view, a line parallel to the long axis of the condylar process was drawn, and lateral slices were reconstructed with 0.5-mm slice interval and 0.5-mm thickness (Fig. 1a). On the central sagittal section, the values of the narrowest posterior (P) and anterior (A) joint space were measured accurately using CBCT software (Fig. 1b). As described by Pullinger and Hollender (Pullinger et al., 1985), condylar position was expressed as anterior, concentric, or posterior according to the following formula:

$$\text{Linear ratio} = (P - A)/(P + A) \times 100$$

where P is the posterior linear measurement and A the anterior. If the linear ratio was smaller than −12%, the condylar position was considered posterior. If the range was ±12%, the position of the condyle was considered concentric, and if the ratio was greater than +12%, the condyle was considered to be in an anterior position.

2.4. Statistical analysis

Statistical calculations were performed using SPSS software version 15 (http://www-01.ibm.com/software/analytics/spss). A chi-square test was used to assess the correlation between the condylar position and the degree of Helkimo's Di in the 3 groups (Di I, II, and III).

Table 1
Clinical dysfunction index (Di), based on evaluation of 5 different symptoms.

A. Impaired TMJ function			
Smooth movement without TM joint sounds and deviation on opening or closing movements ≤2 mm			0
TM joint sounds in 1 or both joints and/or deviation ≥2 mm on opening or closing movements			1
Locking and/or luxation of TM joint			5
B. Muscle pain			
No tenderness to palpation			0
Tenderness to palpation in 1–3 palpation sites.			1
Tenderness to palpation in ≥4 palpation sites			5
C. TMJ pain			
No tenderness to palpation			0
Tenderness to palpation laterally			1
Tenderness to palpation posteriorly			5
D. Pain on movement of the mandible			
No pain on movement			0
Pain on 1 movement			1
Pain on ≥2 movements			5
E. Range of mandibular mobility			
		Sum 1 + 2 + 3 + 4	
1. Maximum opening of mouth			
>40 mm	0		
30–39 mm	1		
<30 mm	5		
2. Maximum lateral movement to the right			
≥7 mm	0	0 points	0
4–6 mm	1		
0–3 mm	5	1–4 points	1
3. Maximum lateral movement to the left			
≥7 mm	0	5–20 points	5
4–6 mm	1		
0–3 mm	5		
4. Maximum protrusion			
≥7 mm	0		
4–6 mm	1		
0–3 mm	5		
Sum of A + B + C + D + E			Clinical dysfunction index