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Evaluation of Joint Space in Patients with Normal Temporomandibular Joint using Cone Beam Computed Tomography

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***Abstract*: This paper presents evaluation of joint space in patients with normal temporomandibular joint using cone beam computed tomography.**

***Keywords*: Temporomandibular, beam computed tomography**

1. Introduction

The mandibular condyle varies greatly in different groups and individuals; this might be due to developmental variability or condylar remodeling. The anterior limit of the glenoid fossa is convex in shape and is formed by the articular eminence [1], [2]. The inclination of articular eminence varies in peoples; it determines the path of condylar movement as well as the degree of rotation of the disc over the condyle [3], [4]. Researches are continued to find the best method for detecting the ideal position of condyle in glenoid fossa. This would assess temporomandibular joint disorder (TMD), and the most predictable approach is by measurement of dimension of joint space. The joint space describes the radiolucent zone between condylar and temporal bony parts [5], [6]. The clinical significance of condylar-fossa relationships in the temporomandibular joint (TMJ) is controversial [7]. Some studies proposed an association between eccentric condylar position and TMD [8], [9]. However, other studies failed to demonstrate a significant association between the condylar position and the incidence of TMD [10], [11].

Conventional radiographs cannot show anatomical relationships exactly, as a result, modern imaging modalities such as MRI and CT are now being used more frequently for radiographic TMJ examination. Magnetic Resonance Imaging (MRI) is considered as one of the most useful tools that show disc displacement [10]-[12]. Unfortunately MRI gives a little information of the bone TMJ structures. Computed tomography (CT) provides images of the bony components of TMJ. CT has the advantage of presentation of the three-dimensional details of bone structure [15]. Yamada et al. showed the slope of eminence decreased with an increase in the severity of the condylar bone change in the CT images [16]. Cone-beam computed tomography (CBCT) is a newer technique producing reconstructed images of high diagnostic quality using lower radiation doses and higher resolution than normal CT. This technique provides images that are obtained in planes parallel or perpendicular to the long axis of the condyle instead of the true anatomic coronal and sagittal planes. Thus, high quality images of the bony components on all planes will be produced [9]. CBCT technique allows the measurement of the position of condyle in the glenoid fossa with high accuracy [13]. In order that there is no quantitative standard for the optimal position of mandibular condyle in the glenoid fossa in our population and due to the ability of CBCT technique in measuring the TMJ position with high accuracy, the purpose of this study is to assess quantitatively and qualitatively position of the condyle by CBCT images in people with normal function of TMJ.

2. Review of literature

Dalili et al. measured the distance from the most prominent medial and lateral poles of each condyle to the intersection point of two tangent lines from the deepest point of the glenoid fossa to the respective medial and lateral slopes.

Ikeda et al. divided the mediolateral width of the condyle in sextants in the coronal view and projected the midpoint perpendicularly to the true horizontal line (THL) to its surface to find the central coronal point. The medial and lateral coronal points derived from lines perpendicular to the THL extending from the junction of the medial or lateral first and second sextants, respectively. The shortest distances from the medial, central and lateral points to the fossa were then measured.

Henriques et al. identified the most medial and lateral points of the condyle and draw a line and its midpoint was considered to trace another line at 90 degrees and two other at 45 degrees laterally and medially respectively. The intersection point of these lines with the condyle surface and the glenoid fossa were determined and the distance in between measured.

Christiansen et al. (10) measured the closest distance between the most centred and superior point of the condyle (CJS) and the most medial point of the condyle (MJS) to the glenoid fossa.

A. Aim

To evaluate the joint space in patients among 18-55 years with normal temporomandibular joint using cone beam computed tomography.

B. Objectives

- To measure the superior, anterior , posterior, medial and lateral joint spaces and variation according to gender and age.

C. Materials and method

Study design: Observational cross-sectional study
Study setting: Radiology clinic of the Department of Oral Medicine and Radiology, Government Dental College, Kottayam
Duration of study: 3 months

D. Inclusion criteria

1. CBCT scans of Mandible for different dental purposes those who reported the department of Oral Medicine and Radiology
2. Age among 18-55 years.

E. Exclusion criteria

1. CBCT exams with artefacts or pathological lesions
2. History of fracture, trauma, orthognathic surgery
3. Patients with facial skeletal deformities.

F. Sample size: Method

A quantitative research approach was used to assess evaluation of joint space in patients with normal temporomandibular joint using cone beam computed tomography and the research design adopted for the present study was descriptive cross sectional. The target population for the study were patients reported at the Department of Oral Medicine and Radiology of Government Dental College Kottayam from June 2015 to June 2019. Sample size was 100 i.e., (50 with TJD (Study group) and 50 without any history of TMD (Control group)). Purposive sampling technique was used. CBCT evaluation of joint space in patients with normal temporomandibular joint using Planmeca, Promax, 3D machine.

Image analysis will be performed using the Romexis viewer software, Planmeca, Promex, 3D machine. A multiplanar reconstruction image will be used, where axial, coronal, sagittal axes will be visualized at intervals of 0.2 mm. The standardized linear measurements of space between condyle and the articular fossa were done in accordance with Ikeda and Kawamura.

From reconstructed sagittal sections, two horizontal lines were drawn; the first one is tangent to the uppermost area of the glenoid fossa (A) and parallel to Frankfort horizontal plane. The second line was drawn tangent to the most superior surface of the condyle (B). Two other lines were drawn tangential to the most anterior surface (D) and to the most posterior surface (E) of the condyle. A perpendicular distance between A and B, C and D, and E and F were then measured and considered as superior joint space (SJS), anterior joint space, and posterior joint space (PJS) distances, respectively. Medial joint space (MJS) and lateral joint space (LJS) were measured from reconstructed coronal sections; the most prominent point on medial (M) and lateral (L) poles of the head of the condyle were first identified. Two tangential lines were then drawn on medial and lateral slopes of the glenoid fossa. A perpendicular distance between M point and the medial tangent and between L point and lateral tangent was measured as MJS and LJS distances, respectively.

G. Statistical analysis

Chi-square test will be used to assess the significance of joint space between males and females, and unpaired t test will be used assess the significance of different quantitative variables such as anterior, posterior, superior, medial and lateral joint spaces between males and females. The data will be compiled and analyzed by the SPSS 16.0 version software.

3. Results

In this study, CBCT images of 100 patients (50 with TJD and 50 without any history of TMD) were assessed. It was found that only left AJS of control and study groups was significantly smaller than that of the right side ($P < 0.01$).

There was a significant association with M-L and SJS, LJS in males both experimental and control group but in females group, MJS was the only parameter showed significant association. Compare to males, females have flatter condylar angle. Eminence angle of female group was found to have lesser values when compared with that of male group ($P < 0.05$). Paired t-test result revealed the difference in the mean values of the studied parameters, SJS and MJS were significantly greater in the affected joints when compared with the normal counterpart of male group. Eminence angle was significantly greater in the affected joints (40.71° ± 10.69° vs. 31.01° ±9.37°), whereas, condylar angle was flatter in the affected joint (18.37° ± 5.2° vs. 24.19° ± 6.43°). When compared with the normal counterpart condylar axial angle was significantly reduced and became flatter in the affected joints (14.53 ± 7.45 vs. 22.18 ± 6.53). It was found that SJS had relationship between PJS, MJS, Eminence and condylar height in normal joints. In joints with TMD, it was found that SJS was directly proportional with PJS, MJS, eminence angle, and height.

4. Discussion

Radiographically, the joint space is a radiolucent zone. It indicates the area between mandibular condyle and temporal bone. Among all modern imaging modalities, CBCT provides accurate and reliable linear measurements for reconstruction

and imaging of almost all maxillofacial structures. Degenerative joint disease is one of the conditions that can deteriorate the joint by loss of articular disc and bone erosion. The joint space becomes reduced and irregular, and the articular surface is flattened. All these changes are seen best on tomograms or CT scans. Differential diagnosis for TJD according to its subtypes is considered to be difficult, especially in research due to overlapping of signs and symptoms between different subgroups that will consequently affect the selection of homogenous subject group for research. Thus, it is necessary to make a standardized data collection and instruments to measure the degree of severity of TJD.

In this study, patients were examined and classified according to RDC/TMD index. The present study included patients who had positive responses in dysfunction index; this assessed the presence of joint problems, such as disc displacement with or without reduction. The aim of this study was to evaluate the condylar position in patients with various signs and symptoms of functional joint problems using the normal protocol of patient positioning in CBCT machine. The results of the present study showed a predominance of AJS which was smaller than the posterior space. This result was in accordance with that Al-Rawi et.al Superior and MJS parameters were the ones that showed significant differences between affected and non-affected joints. The mean axial condylar angle was smaller in joints with abnormal TMJ. This indicates that the condyles of the affected joints may rotate inward.

Evaluating asymptomatic subjects, it was also possible to observe that the values of joint space in this study were greater than that of previous studies. This difference is mainly due to different protocols used for CBCT imaging. Most previous studies used maximal occlusal intercuspation which was not the same used in normal Sironal CBCT protocols (edge-to-edge incisal relationship). Ikeda and Kawamura evaluated joint spaces on the central cuts of joints within 3.5 mm range medially and laterally to the central cut in CBCT. However, there is a controversy over the clinical significance of condylar position. Many studies have reported nonconcentric condylar position in association with disc displacement, osteoarthritic changes, remodelling of the articular eminence, and the condyle. In the present investigation, it has been found that most normal and affected joints were anteriorly displaced (due to edge-to-edge incisal relationship during CBCT imaging) and this reduces the AJS and increases the posterior and SJS. Nonconcentric condylar positioning is seen in 1/3 to ½ of asymptomatic volunteers. On the other hand, concentric positioning in patients with TMD has high prevalence.

According to the present study, condylar eccentricity alone is not a sufficient evidence for the diagnosis of TMD. Similarly, many studies have concluded that the presence or absence of TMD was not correlated with condyle position in TMJ. In this study, superior and MJS were significantly different when affected joints in comparison with normal counterparts in both genders. Articular eminence may predispose to disc displacement since the shape of the articular eminence is related to the development of TMJ disc displacement.

Some studies found a gender difference in eminence inclination. In the present study, eminence inclination was greater in males which are in accordance with other studies. However, non-significant statistical differences in EH and angle inclination were observed between affected joints and normal counterparts in female groups, but with highly significant increase in eminence inclination in the affected joints of males group. Westesson et al. found that the mean axial condylar angle was the smallest in joints with a normal TMJ (21.3°) and become larger in affected joints (32.4° for disc displacement). Compared with prior study, the present investigation revealed an approximate 24.19° for males and 22.18° for females

with normal joints and 18.37° for males and 14.53° for females with affected joints which is exactly opposite to Westesson et al. findings. This may indicate that the condyles of the affected joints rotate inwardly, and this leads to decrease the axial condyle angle.

5. Conclusion

Superior and MJS parameters were the ones that showed significant differences between affected and non-affected joints. However, radiographic assessment of condylar joint space alone is not enough to prove or disprove the presence of TMD. The mean axial condylar angle was smaller in joints with abnormal TMJ which indicates that the condyles of the affected joints may rotate inward.

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