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DIAGNOSTIC EFFICACY OF CBCT IN TMJ DISORDERS- A PILOT STUDY

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Key Words: Temporomandibular joint, sclerosis, erosion, osteophyte, flattening, condyle, Jaw pain, Temporomandibular joint disorder; Cone beam computed tomography.

ABSTRACT: Joint Imaging provides information about joint status and function that helps establish a definitive diagnosis in TMJ and cervical joint disorders. The use of CBCT imaging to examine the bony parts of TMJ is growing quickly. CBCT uses less radiation than CT and creates high-resolution multiplanar pictures of Temporomandibular Joint. The statement of Problem here is that the clinical findings and its related digital imaging findings may show a poor correlation in Temporomandibular joint analysis. The aim of the present study was to evaluate the bony changes in symptomatic and asymptomatic subjects employing Cone Beam Computed Tomography (CBCT) imaging technique. A total 30 subjects were selected for examination including 15 patients with TMDs and 15 healthy asymptomatic subjects without any TMJ sign or symptom. Data was statistically analyzed using SPSS statistical tool software with chi-square statistical test ($p < 0.05$). The findings of the present study suggest that the frequency of various osteoarticular changes in TMJ using CBCT imaging is comparable in symptomatic subjects with TMD complaint and with asymptomatic subjects without any TMJ complaint. It shows that few individuals with some TMJ structural damage in imaging may not show clinically. Hence the present study stresses the need for use of CBCT imaging along with USG imaging for disc changes in TMJ along with clinical examination as an examination protocol for detection of TMDs.

Introduction: Temporomandibular joint disorders (TMDs) are a large group of musculoskeletal conditions, which are considered as the leading factor behind non-odontogenic originated orofacial pain. After low back pain, TMDs comprise the second most common musculoskeletal pain. Its prevalence is widespread in the adolescences 16.3 to 68% showing its diversity and around 43% in the general adult population. [1] The origin of TMD is multifactorial. Various studies associated TMDs with anxiety and depression, parafunctional oral habit, poor

socioeconomic level, and various genetic conditions. [2] TMDs have a gender prediction as women are more likely to develop TMD, perhaps due to behavioral, hormonal, anatomic and psychosocial causes. [6] The sign and symptoms of TMDs include pain and tenderness in TMJ and pre-auricular region, reduced mouth opening or TMJ click sound during jaw movement. [3] Sone other rare complaints include tinnitus, depression, hearing impairment or loss, ear plugging sensation and earache, difficulty in swallowing, and vertigo. Previous studies showed bony and/or soft tissue alterations in TMJ in TMDs. [4] For TMJ imaging, its anatomy can be evaluated using various techniques like panoramic radiography, transcranial radiography, cone-beam computed tomography (CBCT) and magnetic resonance imaging (MRI). Currently CBCT is most commonly used in the assessment of bony and dental pathologic conditions including fractures, maxillofacial deformity, fracture recognition, preoperative assessment of impacted tooth, TMJ disorders and in analysis of available bone for implant placement. The incorporation of 3D into dental practice and craniofacial imaging is now a reality. CBCT is a considered as a reliable diagnostic imaging modality for the assessment of osseous defects in TMJ.[5] Digital CBCT is comparable to computed tomography (CT) in its accuracy, however; CBCT possess less radiation exposure and preferable to CT. [6] CBCT imaging of TMJ guide us about osseous changes like osteophyte, erosion, flattening, subchondral bone sclerosis, ankylosis and pseudocysts. [7] Previous studies reported that patients with TMJ disorders might show anatomical changes in temporomandibular joint. Some studies additionally report that few patients without TMDs also demonstrate bony damage in TMJ. Hence it can be concluded that osseous changes in TMJ happen in asymptomatic individuals also and not necessarily with TMDs. [8] Therefore, there is a need to understand the importance of radiographic imaging and its correlation to TMD-related complaints or not. The aim of the present study was to evaluate the bony changes of temporomandibular joint (TMJ) in patients with a complaint of TMD and without complaint employing use of digital cone beam computed tomography (CBCT) imaging.

Literature Review: In this pilot study, CBCT imaging modality was used for evaluation of bony changes in TMJ in symptomatic and asymptomatic group. Panoramic radiography has inadequate diagnostic validity in TMDs and little information for bony changes in TMJ structures is provided by MRI technique & CT scan has higher dose of radiation. This pilot study compared the incidence of TMJ alteration in patients with and without TMD related complaints. Wiberg et al [9] in their study found 66% prevalence of bony changes in TMDs in young subjects. In a previous study by Sanchez et al [10] being done on pediatric population with TMJ dysfunctions using different imaging techniques reported that the frequency of alteration in TMJ was in 85% of patients. In another study done by Price et al [11], the findings of TMDs were 15.4% with CBCT imaging. The high frequency of bony changes in the asymptomatic group may have happened due to anatomic variations in areas close to TMJ, though they did not present any TMJ complaints. This finding may suggest that the disorders involving such structures may be associated with the development of bony changes in TMJ. Edwards et al [12] reported that TMJ alterations represented 12.6% of incidental findings in CBCT among orthodontic patients. Previous studies done by Pette [13] and Allareddy [14] demonstrated a prevalence of 3.9% to 6.2% of TMJ changes in CBCT images of patients for dental implant. Molinari [15] in their review stated that in addition, the high prevalence of bony changes among the asymptomatic group might be attributed to compensatory potential of TMJ. Since the joint encompasses various adaptive mechanisms, the structural damages may be asymptomatic or minimally apparent for a long time.

Our findings highlight a similar incidence of these bony structural alterations between symptomatic patients and asymptomatic subjects. Wiese et al [16] revealed that clinical complains of patients with TMJ disorders were not associated with findings in TMJ tomograms. Concerning the osseous changes, no significant differences were found between TMD patients and asymptomatic groups in the current study, which employed CBCT as its diagnostic tool. This finding could emphasize that clinical manifestations of TMJ disorders display a poor correspondence to internal derangements identified in radiographic images. In line with this finding, Peterson [17] in a review study, stated that radiological findings of the TMJ might not constantly correlate to clinical findings in patients with TMJ disorders. Moreover, Palconet et al [18] reported a poor correlation between structural changes on CBCT images and clinical signs and symptoms in TMJ disorders. Magnusson et al [19] in a series of panoramic radiographies corresponding to patients with TMJ disorder, reported clinically relevant radiographic findings related to the TMJ in 25% of cases, while 11% showed relevant X-ray findings not related to TMJ disorder. The results of these studies suggest that a combination of physiologic and degenerative mechanism may participate in development of bony changes in TMJ, since Edwards et al [12] notified flattening and subchondral sclerosis as physiologic remodeling, while condylar erosions and osteophyte formation as active degeneration. Osteophytes occur in advanced stages of degenerative changes when the body adjusts itself to repair the joint.

Materials and Method: This study was conducted as a pilot study in Alabeer Medical Center, Jeddah, Kingdom of Saudi Arabia as a part of PhD Thesis. 30 subjects were selected to participate with prior consent. 15 subjects with sign and symptoms of TMDs after clinical examination were selected under symptomatic group who met the RDC/TMD criteria. [20]

Research diagnostic criteria/TMD classification (1992) [20]

Clinical location	RDC/TMD diagnosis
Muscle	Myofascial pain
	Myofascial pain with limited opening
Disc displacement	Disc displacement with reduction
	Disc displacement without reduction with limited Opening
	Disc displacement without reduction, without limited opening
Articular bone	Arthralgia
	Osteoarthritis of TMJ
	Osteoarthrosis of TMJ

While 15 subjects especially who visited dental department for other reasons like dental implants for second molar teeth, extraction of wisdom teeth, bone thickness evaluation, paranasal sinus check and without any sign and symptoms of TMDs after clinical examination were selected as asymptomatic group. After selection of participants, they were referred to Oral Radiology Department for CBCT imaging. As a standard operating procedure, right TMJ side was selected for CBCT in asymptomatic group while for symptomatic group, site coinciding with site of pain was selected for CBCT Imaging. All selected participants must have a full complement of permanent erupted teeth from incisors till first molars in each quadrant with normal (class I)

occlusion. No history of joint trauma or surgery. The symptomatic group included both 8 female and 7 males subjects aged 20 to 41 years with clinical signs and symptoms of TMD based on RCD/ TMD criteria as follows:

- Pain-free unassisted mandibular opening <40mm
- Maximum assisted opening (passive stretch) < 5mm greater than pain-free unassisted opening.
- Presence of click or crepitation in joints and disharmonic movements of joints
- Pain in the jaw, temple region, facial pain, preauricular or inside the ear pain both at rest or during functional activity.
- Pain on palpation of these muscle sites; posterior temporalis, middle temporalis, anterior temporalis, origin of masseter, insertion of masseter, posterior mandibular region, submandibular region, and at least one of the painful sites must be on the same side as the complaint of pain. [20]

The asymptomatic group included 15 subjects with 7 females and 8 males who had no TMD sign or symptoms and had negative history of any occlusal or masticatory disorders. The age of the patients in the control group ranged from 26 to 39 years. Subjects in control group were referred to the dental department for reasons other than TMJ problems. TMJ area was detectable in these images and participants were matched for age and gender with symptomatic group. All subjects voluntarily took part in this pilot study. They were given adequate information about the study procedures and the general aims of the study. They were reassured that their personal information confidentiality will be maintained and only the results of this pilot study will be published without naming them. After collecting informed consents from subjects or their legal guardians, clinical examination and history taking was performed for all selected subjects by one radiologist under supervision of one experienced professor to detect any pain or tenderness in TMJ, as well as in masticatory, head, and neck muscles. TMJ sounds were evaluated by using a stethoscope and recorded as no sound or clicks/crepitation. Mouth opening limitation being identified by the examiner. Exclusion criteria included positive history of trauma, surgery or any congenital anomalies in the head and neck region, severe bruxism, attrition and generalized tooth wear in teeth.

CBCT image of selected TMJ side was made using Durr CBCT Machine; Vista Vox S, Durr Dental, Germany. The field of view was EDS-Extended Diameter Scan; (130 x 85 mm) – for TMJ evaluation with acquisition time of 1.9 sec and full 3d image construction with 18 secs. The voltage (KVp): 60, Current: 4 Milli-Amp, and high resolution: 49.5um. The subjects were made to stand and bite their teeth into maximum intercuspation position with the head positioned with as Frankfurt plane parallel to the floor. CBCT data of all participants in both groups were evaluated in axial, coronal, and sagittal sections. For standardization, it was decided to present the sagittal images in this report. For determining the plan of reference, same protocol was used as per Tabrizi et al [21] for making axial, coronal, and sagittal slices through TMJ. The axial section of the condylar process with widest mediolateral diameter was chosen as the reference view. A line parallel to the long axis of the condylar process was drawn and sagittal images were reconstructed as 0.5mm slice interval and slice thickness. The images were checked for following osseous changes as per the criteria given under RDC/TMD-Axis I- Dworkin 1992: [21]

- Flattening of the articular surface (a flat bony con-tour deviating from the convex form) (Figure 1)
- Surface erosion (an area of decreased density of the cortical bone and adjacent subcortical bone) (Figure 2)
- Osteophyte (marginal bony outgrowths on the condyle) (Figure 3)
- Sclerosis (an area of increased density of cortical bone extending into the bone marrow) (Figure 4)
- Ely cyst (small round radiolucent area with regular margins surrounded by varying area of increased density which are deep to the articulating surfaces) (Figure 5)
- Joint mice (synovial chondromatosis of TMJ with presence of loose bodies) (Figure 6)

Results:

Table- 1 GENDER DISTRIBUTION OF STUDY SUBJECTS

	Male	Female
N	15	15
Percentage	50%	50%

The gender distribution of the study subjects was assessed. It was observed that equal distribution of gender was there with 15 male subjects that is 50% and of 15 females with 50%.

Table- 2 AGE GROUP WISE DISTRIBUTION OF SUBJECTS

	N	Percentage
20-25 Years	9	30.0
26-30 Years	8	26.6
31-35 Years	5	16.6
36-40 Years	7	23.3
41-45 Years	1	3.3

Table- 3 OSSEOUS CHANGES IN SYMPTOMATIC PATIENTS

	Flattening	Irregularity	Osteophyte	Erosion	Sclerosis	Sub-chondral Cyst	Joint mice
CBCT	11	7	8	7	3	0	0
	73.3	46.6	53.3	46.6	20.0	0	0

It was observed that of all the osteoarthritic changes seen in symptomatic patients, flattening was seen maximum of 11 with 73.3%, followed by osteophyte in 8 with 53.3%, irregularity and erosion in 7 with 46 6% sclerosis in 3 with 20%

Table- 4 OSSEOUS CHANGES IN ASYMPTOMATIC PATIENTS

	Flattening	Inflammation	Osteophyte	Erosion	Sclerosis	Joint mice	Sub-chondral Cyst
CBCT	10	5	7	6	1	1	0
	66.6	33.3	46.6	40.0	6.6	6.6	0

The osteoarthritic changes in asymptomatic patients showed maximum of flattening of 10 with 66.6%, then osteophyte in 7 with 46.6%, erosion of 6 with 40%, inflammation of 5 with 33.3%, sclerosis and joint mice in 1 with 6.6%.

Table- 5 OSSEOUS CHANGES IN ALL PATIENTS (SYMPTOMATIC AND ASYMPTOMATIC)

	Flattening	Irregularity	Osteophyte	Erosion	Sclerosis	Joint mice	Sub-chondral Cyst
CBCT	21	12	15	13	4	1	0
	70.0%	40.0%	50%	43.3%	13.3%	3.3%	0

Assessment of osteoarthritic changes in all the patients including symptomatic and asymptomatic were done showing maximum of flattening in 21, osteophyte in 15, irregularity in 12, erosion in 13, sclerosis in 4, joint mice in 1 with 70%, 50%, 40%, 43.3%, 13.3% and 3.3% respectively.

Statistical analysis: The data was analyzed using the SPSS statistical software 23.0 Version. The level of the significance for was fixed at 5%. The variables were compared using Chi Square test, independent t-test and One Way ANOVA.

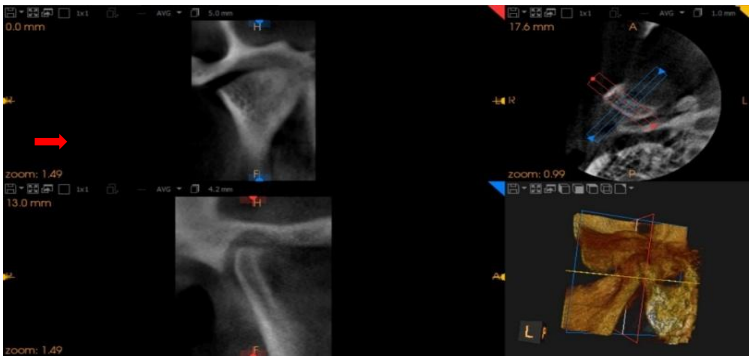

Figure 1. Flattening of condylar head of right TMJ

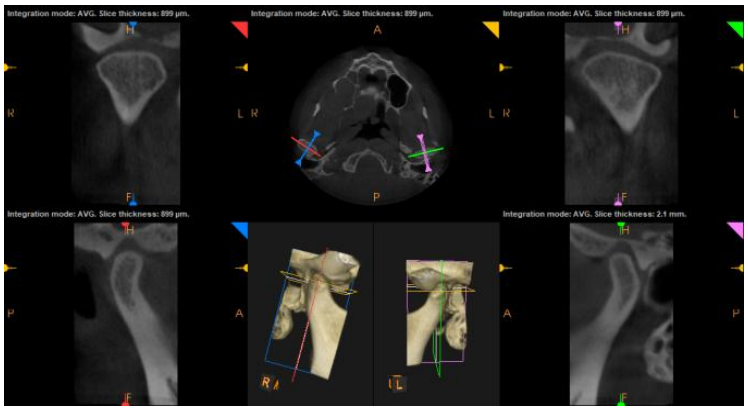

Figure 2. Erosion as seen in sagittal, coronal and axial view

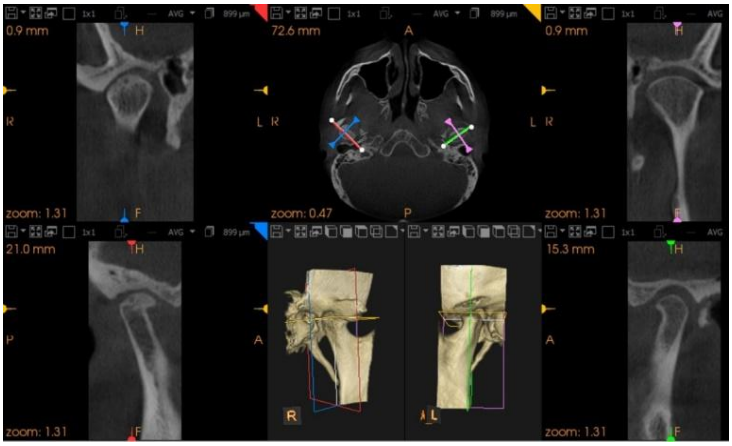

Figure 3. Osteophyte in condylar head as seen in sagittal, coronal and axial view

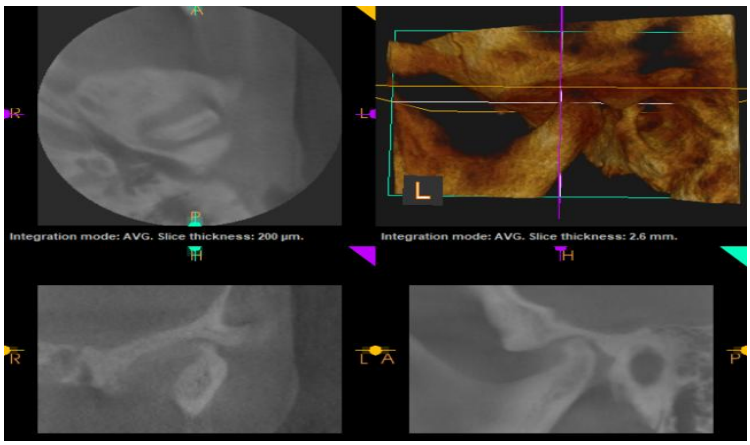

Figure 4. Sclerosis in TMJ as seen in sagittal, coronal and axial view

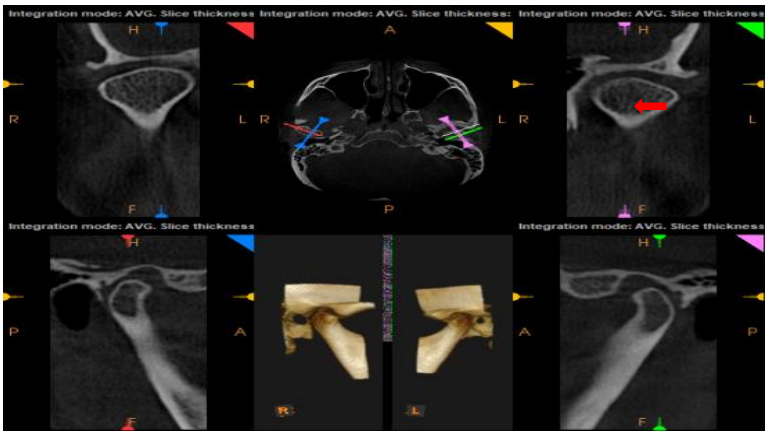

Figure 5. Ely's cyst in condylar head as seen in sagittal and coronal view

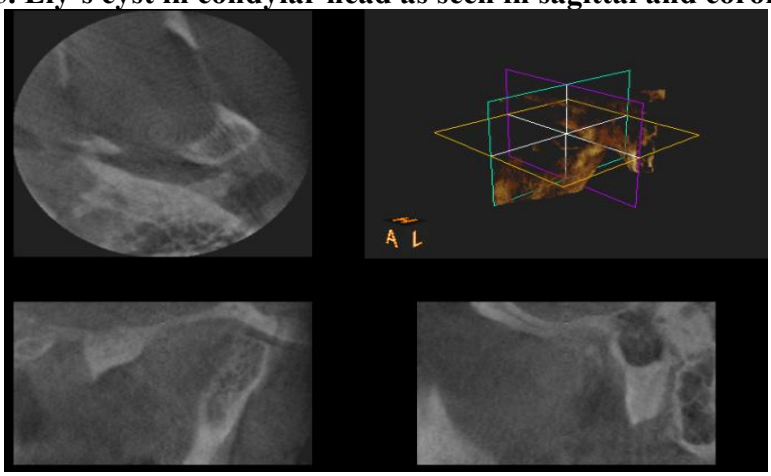

Figure 6. Joint mice in TMJ region seen in sagittal, coronal and axial view

Discussion: Alkhader et al [22] reported a high frequency of osteophyte in CBCT of patients with TMDs which is similar to our findings. A previous study done by Nah KH [23] 2012 reported that sclerotic changes are among most common degenerative changes in head of condyle which is not in agreement in our findings. They also reported that least no. of change was noted in form of Ely's cyst and joint mice which is similar to our current study. According to Shahab et al [24] 2017 flattening in TMJ region was seen in majority of cases which is similar to the present study for both symptomatic and asymptomatic subjects. A study done by Zarch SH et al [25] 2017 evaluated the condylar bony changes through CBCT and stated the least number of findings was Ely's cystic appearance of the condylar region which is in agreement with our study.

Conclusion: To conclude, the findings of this pilot study revealed that the incidence of various TMJ derangements as seen in CBCT images were comparable between both symptomatic group with TMJ disorders and asymptomatic group. Hence it may be suggested that CBCT alone sometimes is not sufficient to diagnose Temporomandibular Joint Disorders but consideration to be given for additional USG exam to correlate bony changes with disc positioning, muscle component along with clinical assessment to make a diagnosis.

Future considerations: More studies are needed with larger sample size to validate findings with CBCT, USG & MRI diagnostic comparison in TMDs.

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