www.jmscr.igmpublication.org
Impact Factor (SJIF): 6.379
Index Copernicus Value: 79.54
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v6i10.171

IGM Publication Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Original Article

Comparative evaluation of bony changes in temporomandibular joint osteoarthritis in patients with and without Generalized Osteoarthritis

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Abstract

Aims & Objective: *To compare the bony changes in TMJ OA with and without generalized OA & to estimate the prevalence of TMJ OA in generalized OA.*

Materials & Methods*: The study contained three groups consisting of total 156 patients. The bony changes in TMJ was evaluated according to Ahmed et al criteria, using CBCT and the data was analysed statistically.*

Results: *TMJ OA in generalized OA was 63.4%. Flattening of TMJ was common finding in group I and II although more in group II. Subchondral sclerosis was found more in group I while osteophytes formation was absent in Group I. According to Ahmed et al criteria, indeterminate osteoarthritis and osteoarthritis was more in group II.*

Conclusion: *The pattern of bone change is different in TMJ OA with generalized OA and without generalized OA. Therefore, we propose that radiographic evaluation of TMJ should be contemplated in patients with generalized osteoarthritis.*

Keywords: *Temporomandibular joint osteoarthritis, generalized Osteoarthritis, CBCT.*

Introduction

Temporomandibular Disorders (TMD) is the most common cause of non-dental pain in the orofacial region. TMD is seen most commonly in people between the ages of 20 to 40 years, and occurs more often in women than in men[1]. It is found that 28% of the adult population has symptoms and clinical signs of temporomandibular joint disorders.[2]

Osteoarthritis (OA) of temporomandibular joint (TMJ) is one of the common TMD. TMJ OA is a local inflammatory condition that occurs when the dynamic equilibrium between the breakdown and the repair of joint tissue is compromised.[3] The prevalence of TMJ OA in non-patient (elderly populations) ranged from 8.9% to 36%, while in patient populations (for different age groups) estimates varies from 38% to 65%.[4,5]

Epidemiologic studies of TMJ OA have revealed that aging is one of the main risk factors for the incidence and the prevalence has increased noticeably after 45 years of age.[6]

However, recent research has identified TMJ OA in the majority of young patients with TMJ pain and dysfunction[7,8,9]. Furthermore, Ok et al.[10] reported that TMJ OA is significantly increased in adolescents over the last several years (2000-2008).

In the TMJ, the most common signs and symptoms of OA is palpable tenderness of the joint, crepitation, and limited mandibular movement. Joint pain is usually mild in the morning and gets worse in the evening after a day's activity.[11,12] With advanced degeneration, the subchondral cortical layer is lost and erosion and other radiographic signs of OA appear[10,13]. The radiographic signs of TMJ OA are as follows: subchondral bone sclerosis, erosion, flattening/irregularities or deformation of the surface of the mandibular condyle, osteophytes formation and reduction of joint space[7,10,14,15,16,17,18,19].

A variety of imaging modalities have been used to evaluate the TMJ. Recent guidelines recommend CBCT as the modality of choice for evaluation of TMJ osseous changes.[20] CBCT offers several advantages over medical CT. First, the radiation dose from CBCT examinations is typically much lower than that from medical CT units[21,22]. Second, the spatial resolution of CBCT images is typically higher than that of medical CT imaging protocols. The diagnostic efficacy of CBCT is as good as conventional CT[47] and is superior to that of panoramic radiography and linear tomography.[23]

Generalized osteoarthritis and TMJ osteoarthritis are independent entities. We searched in the literature and could not found any correlation between the two discussed pathologies. Therefore, we planned this study to evaluate the bone changes in TMJ in patients diagnosed with generalized osteoarthritis and TMJ osteoarthritis without generalized osteoarthritis using CBCT. We also estimated the prevalence of TMJ osteoarthritis in patients with Generalized osteoarthritis.

Materials & Methods

The present study was carried after obtaining ethical approval from Institutional Review Board with reference no 6079/ethics/r.cell-15. The study contained three groups

a) **Group I:** Patients with osteoarthritis of any other joint of the body without any TMJ symptoms.
b) **Group II:** Patients with clinically diagnosed TMJ osteoarthritis with/ without involvement of any other joints.
c) **Group III:** Control individuals.

The patient reporting to the Department of Oral Medicine and Radiology and Department of Orthopaedics were divided into the group discussed above. Subjects for control group were taken from database stored in the department of Oral Radiology. TMJ osteoarthritis patients were diagnosed on the basis of RDC criteria given by Dworkin *et al.*[24] in 1992 and modified criteria given by Schiffman *et al*[25] in 2010. Consent form for the study was filled by all the participants after explaining the purpose and outcome of the study.

Inclusion criteria

Those patients who satisfy the Dworkin and Schiffman's criteria were included in the study

Exclusion Criteria

Patients previously treated for oro-maxillofacial trauma, underwent any surgery of TMJ, having developmental disorder, history of traumatic extraction, having cervical spondylitis, having other systemic condition including bone disease, suffering from any degenerative joint disorder.

Sample size calculation

After calculation and taking 95% of confidence level, the sample size in each group was 52 (156 in all three groups)

Radiographic Evaluation

Romexis 3.2.0.R software version was used to view the DICOM volumes. Images were viewed in the axial, coronal and sagittal planes in the software's multi-planar reformatted.

Any images which showed motion un-sharpness or artifacts were discarded from the evaluation. All images were interpreted by 2 oral and maxillofacial radiologists. If any doubt about classification assignment, the DICOM volume was re-discussed with the radiologist who initially interpreted the image until an agreement was reached.

Image Evaluation

The criteria for determination of the type of condylar bony changes is categorized as N for no proliferation or thickening on the cortical surface of the condyle, F for flattened contour at the anteroposterior and/or postero-superior portions of the condyle or flattening, E for proliferation or partial hypodense change with or without roughening of the cortical surface of the condyle or erosion, S for sclerosis or hyperdense area on the superior border and O for erosion, deformity, osteophyte and marginal proliferation (FIG 1). We also used criterion given by Ahmad *et al*.[26]

This present study classified the bony changes of the glenoid fossa as "positive" in the presence of flattening, erosion, and/or sclerosis; or "negative" when the glenoid fossa appeared normal.

Statistical Analysis

The age of all the three groups were compared by analysis of variance (ANOVA) followed by Tukey's post hoc test. The categorical sex and outcome measures (left condyle and right condyle findings) of three groups were compared by chi-square (χ^2) test. A two-tailed (α=2) p value less than 0.05 ($p<0.05$) was considered statistically significant. All analyses were performed on SPSS software version 17.0.

Results & Observations

The age of group I, II and III ranged from 45-88 years (65.77± 10.55), 22-69 years (44.67±9.38) and 30-74 years (52.88±9.33) respectively. The mean age of group I was the highest followed by group III and group II. The mean age of group II lowered significantly ($p<0.001$) as compared to group III.

The percentage of TMJ osteoarthriris in group I was found to be 63.4%. We screened total of 627 patients in the time frame of 6 months and found prevalence of TMJ OA without osteoarthritis is 8.2%.

Outcome measures

I) Left condyle CBCT findings

Comparing the frequency (%) of CBCT findings of left condyle in all three groups, χ^2 test revealed significantly different and higher frequency of erosion, flattening and subchondral sclerosis in both group I and II as compared to group III (χ^2=49.62, $p<0.001$). Moreover, the presence or higher frequency of osteophyte formation (11.5%) in group II also makes it dissimilar from group III and I as no osteophyte formation was seen in later two groups. The CBCT findings for all the three are summarized in table I. According to Ahmed et al classification, table II summarizes the findings

Right condyle CBCT findings

Comparing the frequency (%) of CBCT findings of right condyle in all three groups, χ2 test revealed significantly different and higher frequency of erosion, flattening and subchondral sclerosis in both group I and II as compared to group III (χ2=38.73, p<0.001). Moreover, the presence or higher frequency of osteophyte formation (11.5%) in group II also makes it dissimilar from group III and group I as no osteophyte formation was seen in later two groups. The CBCT findings of right side condyle are summarized in table III. The CBCT findings according to Ahmed et al is summarized in table IV.

No Changes was observed in glenoid fossa in right and left TMJ

Inter-rater agreement

The inter-rater agreement of left and right condyle CBCT findings between two observers for each of three groups were compared by Kappa-test and showed very good agreement between observers in group III (Kappa=0.95), group I (Kappa=0.94) and group II (Kappa=0.87). With regards to Ahmed et al classification, the inter rater agreement also showed very good agreement between observers in both group III (Kappa=0.90) and group I (Kappa=0.82) and good in group II (Kappa=0.79).

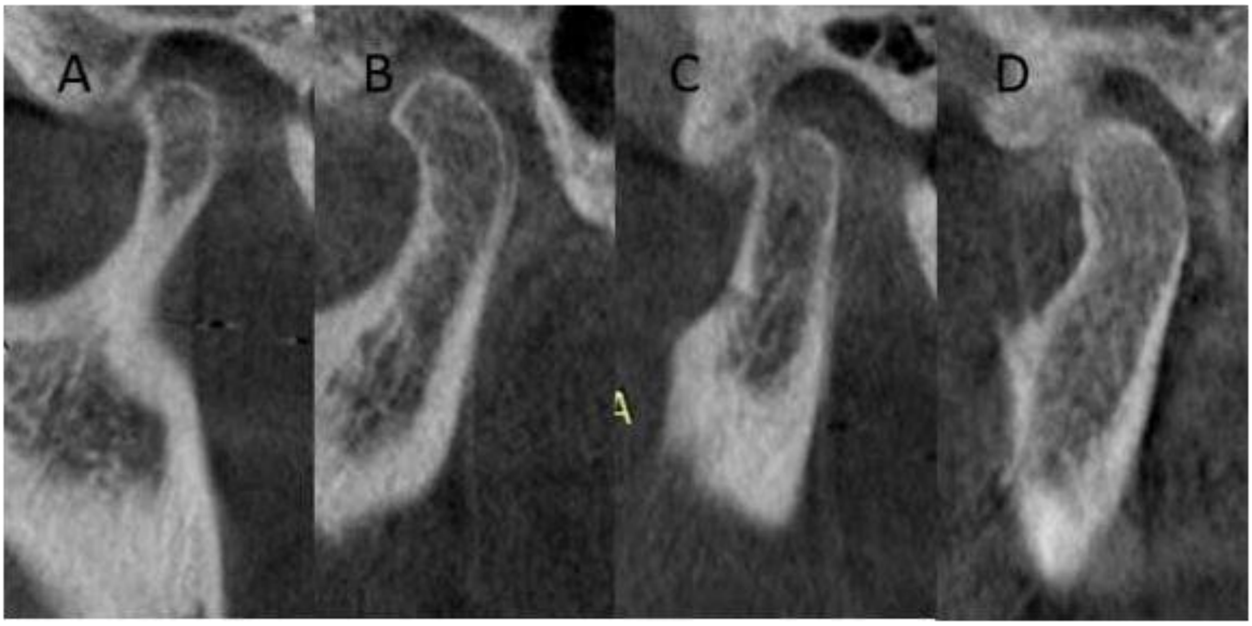

Figure 1: Picture showing A. normal Condyle, B: flattening of condyle, C: Erosion of Condyle, D: Sclerosis of Condyle, E: Osteophyte formation

Table I: CBCT findings for all three groups for left condyle

Left condyle CBCT findings	Group I (n=52) (%)	Group II (n=52) (%)	Group III (n=52) (%)	χ^2 value	p value
Normal	19 (36.5)	8 (15.4)	40 (76.9)	49.62	<0.001
Flatening	19 (36.5)	22 (42.3)	6 (11.5)		
Erosion	10 (19.2)	11 (21.2)	4 (7.7)		
Subchondral sclerosis	4 (7.7)	5 (9.6)	2 (3.8)		
Osteophyte	0 (0.0)	6 (11.5)	0 (0.0)		

Table 2: CBCT finding of left condyle according to Ahmed et al classification

Right condyle findings	Group I (n=52) (%)	Group II (n=52) (%)	Group III (n=52) (%)	χ^2 value	p value
No OA	19 (36.5)	8 (15.4)	40 (76.9)	42.35	<0.001
Indeterminate for OA	23 (44.2)	27 (51.9)	8 (15.4)		
OA	10 (19.2)	17 (32.7)	4 (7.7)		

Table 3: CBCT findings of right condyle for all three groups

Right condyle CBCT findings	Group I (n=52) (%)	Group II (n=52) (%)	Group III (n=52) (%)	χ^2 value	p value
Normal	23 (44.2)	9 (17.3)	36 (69.2)	38.73	<0.001
Flatening	13 (25.0)	22 (42.3)	10 (19.2)		
Erosion	10 (19.2)	11 (21.2)	4 (7.7)		
Subchondral sclerosis	6 (11.5)	4 (7.7)	2 (3.8)		
Osteophyte	0 (0.0)	6 (11.5)	0 (0.0)		

Table 4: CBCT findings according to Ahmed et al Classification for all three groups

Right condyle findings	Group I (n=52) (%)	Group II (n=52) (%)	Group III (n=52) (%)	χ^2 value	p value
No OA	23 (44.2)	9 (17.3)	36 (69.2)	29.44	<0.001
Indeterminate for OA	19 (36.5)	26 (50.0)	12 (23.1)		
OA	10 (19.2)	17 (32.7)	4 (7.7)		

Discussion

The present study was conducted on 156 patients divided into 3 groups, generalized osteoarthritis, TMJ osteoarthritis and control which were designated as Group I, Group II and Group III respectively in an attempt to evaluate TMJ changes using CBCT.

With regards to age, literature reveals approximately 40% of patients with TMJ osteoarthritis are over the age of 40 years [Martinez- blanco *et al.*[27] (46.6 years), Ardic *et al.*[28](45.3 ±13.5), Gynther and Tronje G.[29] (44 years), Troller PA *et al.*[30] (42.7 years)]. Our study showed the similar result with mean age of 44.6 years. However, a study by Oliveria *et al.*[31] indicated that the osteoarthritis of the TMJ were found in 75% with age above 65 years and the occurrence increased sharply in individuals older than 40 years of age. Zhao *et al.*[32] showed that radiographic TMJ osteoarthritic changes were common in adolescent and young adult patients (<30 years of age) and the occurrence of OA was also greater in the age range of 11 to 19 years. Gray et *al.*[33] states that OA is generally unilateral, and when bilateral involvement does occur, one side usually exhibits greater severity.

We studied TMJ changes in patients diagnosed with generalized osteoarthritis. To the best of available English literature, this is the first study where changes in TMJ were noted in patients with generalized osteoarthritis. The findings included were flattening, erosion, subchondral sclerosis although osteophytes were not found. Group I patients who had generalized osteoarthritis too had shown features of osteoarthritic changes but less as compared to Group II who had TMJ OA. The prevalence of condylar changes without any TMJ symptoms ranges from 55.8% (left condyle)- 63.5% (right condyle) which reflect that in generalized OA, TMJ is also affected along with weight bearing joints and radiographic examination of TMJ should also be considered in such patients.

The most common radiographic findings of the condylar head in our study were flattening, erosion, subchondral sclerosis and osteophytes which are in congruence with results from previous studies of patients with TMJ degenerative arthritis. The different signs of TMJ-OA may represent different stages of disease; erosive lesions may indicate acute early changes, whereas subchondral sclerosis and osteophyte formation may indicate late changes in the TMJ, reflect a stage of bone repair[34]. Results obtained by Meng *et al*.[35] in 2007 and Badel *et al*.[36] in 2009 also showed that the most common findings in TMJ osteoarthritis were sclerosis, bone proliferation or osteophyte formation and ill-defined boundary of cortical bone. Studies done by Alexiou *et al*.[37], using CBCT, found erosion, flattening and osteophytes to be the most common radiographic finding of the condyle. The order of frequency of these changes is different in various studies, which can be due to different radiographic techniques, interpretations, sample size or ethnic diversity[38,39]. Moreover, expressing diagnostic importance of each of these findings in separate form is rather difficult.

In a recent study, Talaat *et al*.[40] performed a CBCT analysis of the bony changes associated with temporomandibular disorders (TMD) and found that osteoarthritic TMJ had significantly more condylar irregularities, osteophytes, and condylar flattening than non-TMD joints. We found condylar flattening in about 42.3 % of patients in group II. Gynther and Tronje G. *et al*.[34] in their study found flattening in 40% of cases which was in consistent finding with our study. However we found percentages of subchondral sclerosis (7.7%) and osteophyte (11.5%) less as compared to their study in which subchondral sclerosis and osteophyte were found to be 35% and 55% respectively. In our study, the high prevalence of flattening may be explained by the possibility that the bone change represents an adaptive alteration as the first sign of a progressive disease[41,42]. The prevalence of condylar bony changes in this study was lower than that found by Cevidanes *et al*.[41] in 2010. They observed condylar flattening in 60%, and osteoarthritic surface irregularities such as erosions and osteophytes in 40% of condyles in a TMJ osteoarthritis group.

We also compared erosion and subchondral sclerosis in group I, II, & III and observed that the incidence of erosion was more in group II whereas the incidence of the Subchondral sclerosis is more in Group I. This can be explained by the fact that generalized osteoarthritis is systemic condition affecting load bearing joints and reactionary bone formation is more.

We also noted that the formation of osteophyte was more in group II as compared to group I which might be correlated to the aetiology of the TMJ osteoarthritis as TMJ OA can occur due to overloading of the TM Joint

According to Campos *et al*.[43] in 2008, degenerative bone changes are significantly more frequent in the condyle than the articular eminence, which is in agreement with the results of our study.

The CBCT findings of left condyle were also be categorized as per Ahmad *et al*.[26] criteria as : No Osteoarthritis (Group III >Group I> Group III), Indeterminate for Osteoarthritis (Group II>Group I > Group III) and Osteoarthritis (Group II>Group I > Group III).

The CBCT findings of Right condyle were also be classified as: No Osteoarthritis (Group III >Group I> Group II), Indeterminate for Osteoarthritis (Group II>Group I > Group III) and Osteoarthritis (Group II>Group I > Group III).

These findings suggest that TMJ OA is associated with more of destructive and reparative changes, which can be due to factors and etiology directly affecting TMJ, as compared to Generalized osteoarthritis, where the changes reflects more of age related. Similarly findings in control group, which are predominantly towards normal, represent a balance physiological change associated with joint

Similarly we also found agreement amongst both the observers using kappa statistical tool indicating high reliability of left and right condyle CBCT findings. CBCT provides a definite advantage over other techniques due to its low radiation dose, smaller equipment and ability to provide multiplanar reformation and 3D images. In the present study, the qualitative analysis of bony changes of TMJ OA has been assessed. Further studies should consider the quantification of bony changes in TMJ OA based on a large sample size and will provide a better knowledge of TMJ OA. Present study enlightens the effects of Generalized OA on TMJ but further studies require exploring TMJ changes in various arthritic conditions.

Conflict of Interest: None

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