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Research Article

Assessment of Morphological Analysis of the Spectrum of Osteophytes in Temporomandibular Joint Using Cone Beam Computed Tomography- A Radiographic Cross Sectional Study

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Abstract

Background: The aim of the study was to analyze the different transitions and alterations in the temporomandibular joint and analysis of varied appearances of osteophytes using three dimensional imaging findings obtained using CBCT as imaging modality.

Method: The present study was conducted in the Department of Oral Medicine and Radiology, Annoor Dental College, Muvattupuzha, Kerala. The samples were selected from the archives of the patients who have come to department's OPD from a period of October 2019 to Feb 2020 for CBCT scanning with any indication of temporomandibular joint disorder. A total of 45 samples were selected from the archives i.e. (30 females and 15 males) were selected for the study. Statistical analysis was done using Pearson's Chi-square test. The abnormal changes in the articulating surface of condyles were radiologically evaluated and assessed for osteophytic changes.

Result: In this study, out of these 30 females, 21 cases showed positive radiographic findings of TMD. The maximum percentage of radiographic findings were observed for the female gender (70%). All the age groups showed significant TMD association with the highest percentages (24.4%) of radiographic findings observed for mean age groups between 41 - 50 years and 51 - 60 years with a maximum percentage of (22.2%). The younger age groups in the mean range of 20 - 30 years also showed significant percentage (22.2%). In the present study 31.1% cases showed significant osteophytic changes with flattening of articulating surface of condylar head.

Conclusion: In conclusion, Age had no specific association with the TMD's and all the age groups were equally vulnerable and susceptible for TMD's. Women have a greater predisposition to degenerative bone changes in the TMJ. Flattening and osteophytes are the most prevalent types of degenerative bone changes. CBCT imaging modality was found to be useful in terms of diagnosing osseous changes in the condyle, glenoid fossa and in analyzing the changes associated with TMJ space.

Keywords: *Temporomandibular Joint; Osteophyte; Flattening; Glenoid Fossa; Condyle*

Introduction

Temporomandibular joint syndrome is also known as temporomandibular disorder (TMD) comes under musculoskeletal disorder in the orofacial region, broadly divided to involve the masticatory muscles, temporomandibular joint (TMJ) and associated structures [1].

The aetiology of TMD is poorly understood but is likely to be multifactorial and includes anatomical, pathophysiological and psychosocial factors [2,3].

Epidemiological data shows a very high prevalence of TMD dysfunction. Liu F., *et al*. study reports indicate that 39.2% have at least one symptom of TMD. The incidence rate is 3.9% among elderly adults and 4.6% among adolescents. Older age groups demonstrate to be more symptomatic than the young. In terms of gender, female to male ratio was observed as 2 to 1 in population-based studies, and 4 to 1 in clinical settings. No gender differences have appeared in children, but the female to male ration in young adults reported to be 2:1 [4].

The diagnosis of TMD is mostly done by taking history, physical examination and associated symptoms. The symptoms of TMD are associated with jaw movement and pain in the preauricular, masseter, or temple region. Reproducible tenderness to palpation of the TMJ with pain on opening and closing is suggestive of intra-articular derangement [5]. Clicking or crepitus upon mandibular function might be quite evident in some cases, and the detection might be aided by the use of a stethoscope. The existence or location of clicking identified by the clinician might be different from that described by the patient [6]. Early stages of disc displacement are characterised by clicking. Clicking can be heard while opening the mouth, while closing the mouth, or both. An opening click occurs when there is recapture of the displaced disc between the articulating joint surfaces. A closing click occurs just prior to tooth contact and is not as loud as the opening click. When the disc becomes non-reducible, the clicking reduces in intensity or vanishes [7].

Imaging can aid in the identification of TMD when history and physical examination findings are ambiguous. Anatomic complexity of TMJ pose real difficulty in imaging and it requires ideal decision making in choosing proper imaging modality. Cone beam computed tomography contributes to high-resolution, Multiplanar reconstructed images in all three planes (sagittal, axial, coronal) sections of the TMJ, without superimposition of the bony structures [8] attaining 3D images in closed and opened-mouth positions. Signs of degenerative changes in the joint, like surface erosions, osteophytes, remodeling, subcortical sclerosis, articular surface flattening can be better evaluated using CBCT [9].

Radiographic changes are not directly related to pain in TMJ. Some patients with osseous abnormalities may experience pain, others may be pain free. In CBCT we can also identify intactness of the cortex, normal size and shape of the condyles and their centered position in the fossa and the adequateness of joint spaces.

Purpose of the Study

The purpose of the study was to analyze the different transitions and alterations in the temporomandibular joint and analysis of varied appearances of osteophytes obtained using CBCT as imaging modality.

Materials and Methods

The present study was conducted in the Department of Oral Medicine and Radiology, Annoor Dental College, Muvattupuzha, Kerala, India. The samples were selected from the archives of the patients who have come to department's OPD from a period of October 2019 to February 2020 for CBCT scanning with any indication of temporomandibular joint disorder. The selection of images for study is taken to fit in the inclusion criteria i.e. CBCT images of patient's aged between 20 - 60 years and CBCT images without any artifacts. The CBCT images with artifacts, with a known history of RTA and scans of patients with any developmental disorders of TMJ were excluded from the study. Ethical clearance was obtained from the Institutional Review Ethical Committee, before the onset of the study. A total of 45 samples were selected from the archives i.e. (30 females and 15 males) were selected for the study.

The CBCT scans were acquired using NEW TOM GIANO HR CBCT MACHINE with NNT software for image reconstructions. Volumes selected in the study include those of various FOVs (Field of View) taken in the TMJ view for the indicated joint. The CBCT images included in this study were high Resolution images, free of artifacts, taken in various field of views. The parameter for exposure in acquiring these images are 85Kv, 10 mA, with a mean exposure time of 12s. The subjects were standing and were biting their teeth into maximum intercuspal position. Their heads were positioned with the Frankfurt plane parallel to the floor and the joint. CBCT data of all samples were evaluated in axial, coronal, and sagittal sections by two expert oral radiologists. Both observers were blinded to the personal details of the patient. The findings of the study were then validated by a third well experienced maxilla-facial radiologist.

The images were checked for following osseous changes predominantly for flattening (a flat bony con-tour deviating from the convex form) (Figure 1) of the articular surface and osteophyte (marginal bony outgrowths on the condyle) (Figure 2).

Figure 1: *Reformated CBCT image showing Flattening of the condyle.*

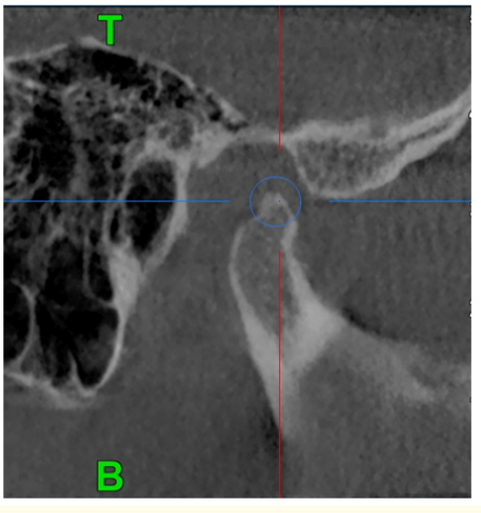

Figure 2: *Reformated CBCT images showing osteophytes.*

The collected data was entered in Microsoft Excel, analysed using descriptive statistics. Data is expressed in terms of frequency and percentage. Pearson Chi-Square test is used to check the association between the joint disorders, age and gender. A *p*-value of <0.05 was considered to be statistically significant.

Results

Number of TMD cases against each age group and their percentage is included in table 1, graphical representation of same is given in figure 3. Pearson Chi-square test was done to see if there is any association between age and TMDs (Table 2). Test result shows, there is no association between Age group and TMDs. Though the age group of 50 - 60 shows maximum number of TMDs, result was not statistically significant.

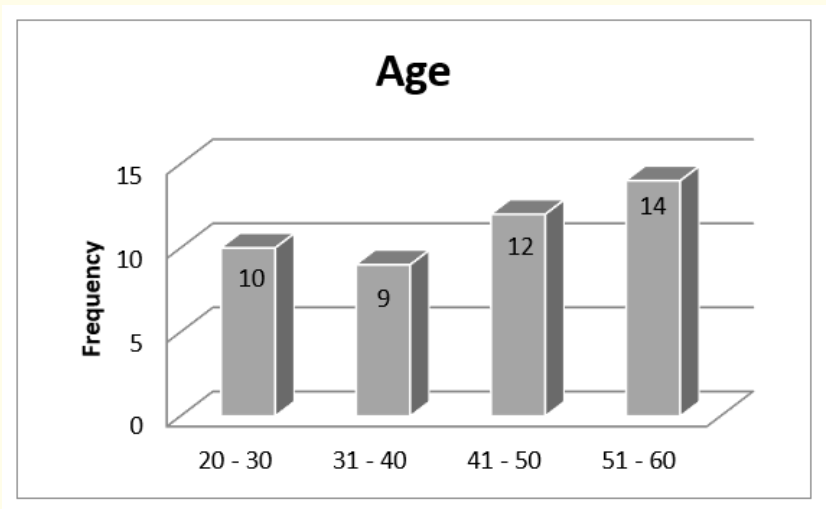

Figure 3

Age	Frequency	Percentage
20 - 30	10	22.2
31 - 40	9	20.0
41 - 50	12	26.7
51 - 60	14	31.1
Total	45	100.0

Table 1: *Association with age.*

Age	TMJ Involved		Total no of TMD cases	Pearson Chi-Square	p Value
	Left	Right			
20 - 30	3	7	10	6.333	0.096
31 - 40	3	6	9		
41 - 50	8	4	12		
51 - 60	10	4	14		
Total	24	21	45		

Table 2: *Test result shows, there is no association between age group and TMDs.*

Total number of male and female cases with TMDs and their percentage is represented in table 3. Figure 4 shows pie chart presentation of the same, indicating female gender shows maximum incidence (66.7%) of TMD

Gender	Frequency	Percentage
Female	30	66.7
Male	15	33.3
Total	45	100.0

Table 3: *Association with gender.*

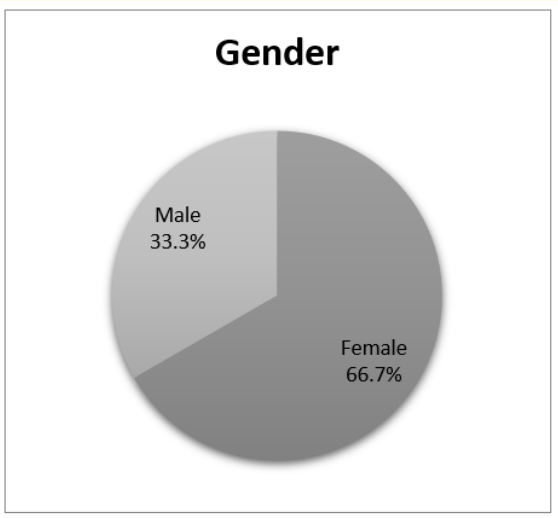

Figure 4

Among the evaluated temporomandibular joint changes the maximum incidence of radiologic findings showed Results shows Flattening (53.3%) with maximum incidence followed by Osteophytes (31.1%) (Figure 5). However, most of these findings were seen in co-occurrence with each other and are represented in Venn diagram as figure 6.

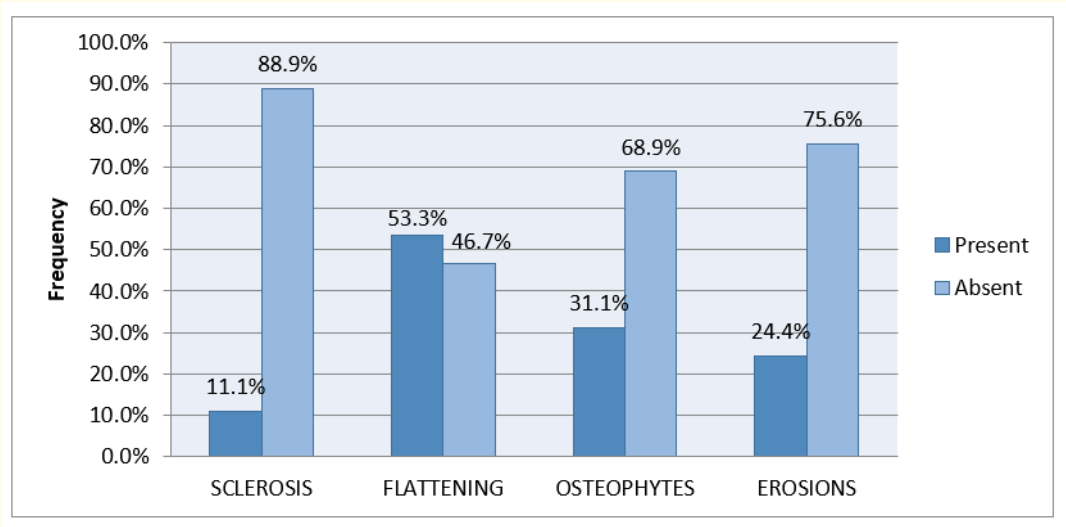

Figure 5

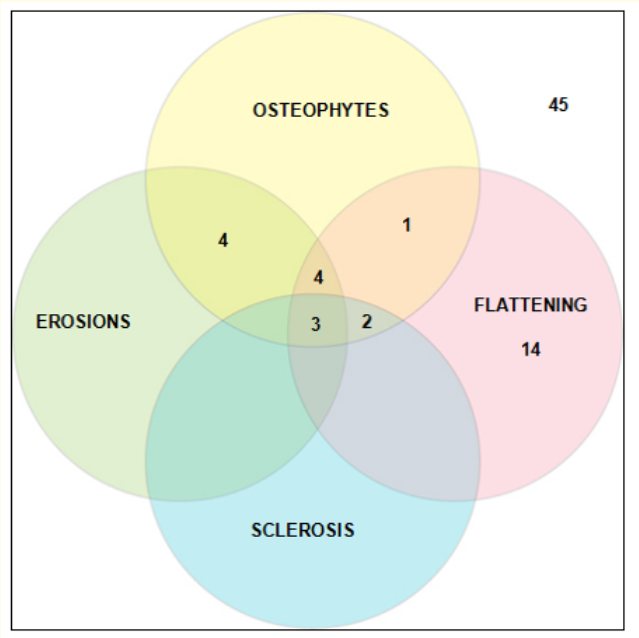

Figure 6

Discussion

The temporomandibular joint (TMJ) consists of the articular bony components of the temporal bone and mandibular condyle, as well as of soft tissue components attached to the bony parts of the TMJ. The Temporomandibular joint disorders (TMD) have expeditiously become more common in recent years, with the incidence being more common in the younger individuals [10].

TMJ disorders (TMD) belong to a category of degenerative musculoskeletal conditions associated with morphological and functional distortions of TMJ [11]. Osseous alterations of TMJ can manifest as flattening, osteophyte formation, sclerosis, erosion, subchondral bone cysts, reduced/ increased glenoid fossa space etc [12]. TMJ over a period of time can undergo considerable changes and the causes are complex and multifactorial, Degenerative remodeling present in pathologic TMJs may result from either decreased adaptive capacity in the articulating structures or from excessive or sustained physical stress to the articulating structures [13]. Because of the high prevalence of TMD's in women of reproductive age group, it has been postulated that sex-based determinants, such as hormonal influences from estrogen, progesterone, and relaxin, may make an individual susceptible to TMJ diseases [14]. Another possible mechanism by which TMD's may arise is from alterations in the extracellular matrix, caused directly from genetic perturbations or indirectly from hormones that influence the composition and/or turnover of the extracellular matrix of the TMJ.

According to Stohler CS., *et al*. the age distribution of TMD patients is characterized by a Gaussian curve, with a peak between the age of 35 and 45 years and a lower prevalence in younger and older people [15]. Luca Guarda-Nardini., *et al*. conducted a study to evaluate the pattern of age distribution of temporomandibular disorders (TMD) and to identify prevalence peaks for the different diagnosis and they found out disc displacements decreases with age and degenerative changes increases with age [16]. However, in our study, all the age groups showed significant TMD association with the highest percentages (24.4%) of radiographic findings observed for mean age groups between 41 - 50 years and 51 - 60 years with a maximum percentage of (22.2%). The younger age groups in the mean range of 20 - 30 years also showed significant percentage (22.2%). Hence, in our study age had no specific association with the TMD's and all the age groups were equally vulnerable and susceptible for TMD's.

While checking the gender association with TMD's, in our study, among 45 cases evaluated, 30 cases were females (66.7%) and 15 were males (33.3%) who presented during the period with a positive history of TMD. It was found that, out of these 30 females, 21 cases showed positive radiographic findings of TMD. The maximum percentage of radiographic findings were observed for the female gender (70%). In the male gender**,** out of 15 cases evaluated 10 cases showed radiographic findings of TMD (i.e,66.7%). The results were in accordance to the study conducted by Bueno Ch., *et al*. who systematically evaluated gender differences in the prevalence of TMD and found out women had a two times greater risk of developing TMD as compared to men [17]. The greater occurrence in women may be explained by the hormonal influences of oestrogen and prolactin, which may exacerbate degradation of cartilage and articular bone in addition to stimulating a series of immunological responses in the TMJ [18].

When evaluating the degenerative radiographic findings of TMJ, the highest prevalence of joint changes were found to be flattening (53.3%) which was followed by osteophytes (31.1%). The findings were in accordance to the study conducted by Anjos Pontual., *et al*. [20] and Shahidi Sh., *et al*. [10] where flattening and osteophyte bone changes were the most predominant findings. In our study, the high prevalence of flattening may be explained by the possibility that this bone change represents an adaptive alteration, the first change of a progressive disease or degenerative change secondary to internal derangement. Flattening is also considered a degenerative alteration resulting from overload on the TMJ and it may be related to the involvement of the masseter and temporal muscles [19].

Osteophytes occur at a later stage of degenerative changes when the body adapts itself to repair the joint. The osteophyte appears to stabilize and widen the surface in an attempt to improve the overload resulting from occlusal forces, representing areas of neo-formed

cartilage [20]. Our study was in contrast to the study conducted by Gu¨ ler., *et al*. [20] using MRI in patients with bruxism, where the authors found no flattening or osteophytes in any of the TMJs assessed, and only a combination of osteophytes and erosion and osteophytes and sclerosis.

It is accepted that OA and internal derangement (ID) may co-exist in about one-third of the cases. In this case, we did not evaluate our patient's disc position, but the diagnosis of TMJ Osteoarthritis is doubtlessly based on clinical findings and no radiographic criterion is pathognomonic for rheumatoid diseases. All of them can show erosion, sclerosis, osteophytes, flattening, subchondral cysts, and a reduced joint space. However, reduced joint space, flattening of the condyle, and osteophytes have been reported to be more common in OA, whereas erosions in the condyle are more frequently found in RA [21].

Our findings and the results of these studies confirmed that a combination of physiologic and degenerative mechanism may participate in development of bony changes in TMJ, since Edwards., *et al*. [22] notified flattening and subchondral sclerosis as physiologic re-modeling, while condylar erosions and osteophyte formation as active degeneration.

Osteophyte is one of the hallmark radiographic feature of TMJ degenerative joint disease. There are three types of osteophytes, the traction spur present at the articulating surfaces, present as a syndesmophyte (or bridging osteophytes) at the site of insertion of tendons and ligaments to bone; and the genuine osteophyte, arise at the junction between cartilage and bone from the periosteum overlying the bone. Osteophyte may lie freely after breaking off from the condylar surface within the joint space as loose bodies also known as "joint mice" [23].

Conclusion

In conclusion, women have a greater predisposition to degenerative bone changes in the TMJ. The prevalence of TMD does not have any significant correlation with age, radiographic TMD findings were also observed for younger age groups. Age had no specific association with the TMD's and all the age groups were equally vulnerable and susceptible for TMD's.

Flattening and osteophytes are the most prevalent types of degenerative bone changes. Limitations of the sample size and further advanced TMJ imaging modalities have to be undertaken to assess an assortment of condylar morphologies.

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