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Assessment Of Condylar Osseous Changes in Patients with Bruxism Using Cone-Beam Computed Tomography-A Cross Sectional Observational Study

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Abstract

Background: Pain is one of the commonest symptoms involving the orofacial-region and masticatory system. Pain arising from the extra-oral region may be due to disorders of neighbouring anatomical structures, especially the Temporomandibular joint (TMJ) which may contribute to Temporomandibular joint disorders (TMD). Although various etiologies may contribute to TMD, stress and oral parafunctional habits like bruxism was considered to be one of the initiating factors for the development of TMD. Due to bruxism, teeth clenching force will have a direct effect on TMJ and its associated structures will tend to remodel at an early age. It may cause some bony changes which may progress to TMD. In this study, we assessed the correlation between the condylar osseous changes in bruxism patients with symptomatic and asymptomatic TMJ using cone-beam computerized tomography (CBCT).
Aim: The aim of the study was to assess the correlation between the condylar osseous changes in bruxism patients with symptomatic and asymptomatic TMJ using CBCT.
Settings and Design: The present study is an institution-based, observational cross-sectional study.
Materials and methods: 132 Bilateral Temporomandibular joint sectional CBCT images in 33 bruxism patients with symptomatic TMJ and 33 bruxism patients with asymptomatic TMJ aged between18 to 35 were assessed for condylar osseous changes by two examiners. Both groups were also assessed for changes in tooth structure by using tooth wear index
Statistical analysis: Pearson correlation analysis was done to assess the osseous changes and tooth wear index among the study group. P-value >0.05 was considered to be statistically significant.

Results: The correlation analysis shows that statistically significant difference in osteophyte and surface erosion was predominant osseous changes that was observed in bruxism patients with asymptomatic TMJ than in bruxism patients with symptomatic TMJ.

Conclusion: The incidence of condylar osseous changes in young adults with bruxism were early indication of osteoarthritis of TMJ. So, early detection of such changes using CBCT can help in controlling the progression of disease by timely management.

Keywords – Bruxism, osseous changes, TMD, CBCT

INTRODUCTION:

Pain around and around the face, above the neck and anterior to the ears, is known as orofacial pain. This form of pain is recurring. Regional structures might be ill or disordered, which is why it happens. The prevalence of orofacial discomfort in the general population might be as high as 7%.[1,2]. Diagnosing and treating orofacial pain can be a difficult task, thus a thorough history and physical examination are recommended as the first steps in making an accurate diagnosis. Orofacial pain, which accounts for 7–26% of all presenting symptoms of TMD, is often acknowledged as the most common feature of TMD [3,4] Bruxism has been linked to TMDs [5,6] both bruxism and stress and predisposing factors have been linked to sleep disorders. Its possible age, gender, and genetics have an impact on bruxism prevalence [7]. Oral parafunctional habit bruxism is frequently assumed to be one of the dangerous causes for the commencement of TMD [8]. However, several variables may contribute to the onset of TMD. There are other non-painful signs and symptoms associated with TMD, however the most prevalent one is pain[9]. One of the most prevalent oral parafunctional habits is bruxism, which has been linked to the development of TMD-related clinical characteristics. As early as 1972, Drum coined the term “parafunction” [10] to distinguish between the forces generated by chewing and the occlusal stress caused by occlusal tension applied in the absence of typical chewing motions. When we talk about nonfunctional oromandibular actions, we're referring to things like teeth clenching, lip biting, cheek biting, nail biting, and other oral parafunctional habits that aren't part of typical functional activities. There were first use of the term "bruxomanie" in 1907 by Marie Pietkiewicz; after that, it became "bruxism" to describe clenching and grinding the teeth for non-functional reasons[11]. When it happens when you're awake, it's called diurnal bruxism, and when it happens while you're sleeping, it's called sleep bruxism (SB). Awake Bruxism is a habitual clenching of the teeth that can be brought on by stress at work. Sleep bruxism was defined as a sleep-related movement disorder[11] in the Sleep Disorders classification. Mandibular condyle is a complicated anatomic feature of the TMJ that varies widely among persons of all ages. A variety of disorders, such as malocclusion, trauma, and TMD, can lead to condyle morphological changes. [12,13]. Detecting the degree of TMD might be challenging using radiographic imaging of condylar surface morphological changes. The pantomogram and other specialised TMJ images are among the 2D imaging modalities used for TMJ imaging. These imaging methods, however, result in distortion and superimposed images. Fortunately, 3D imaging methods like computed tomography (CT) and magnetic resonance imaging (MRI) provide a wealth of information on the changes in ginglymo-arthrodial joint hard and soft tissues[13]. The use of these imaging methods by dentists was restricted because of the high radiation exposure and the costly cost. As a novel 3D imaging technology, Cone Beam Computed Tomography [14] (CBCT) has gained interest in the field of oral and maxillofacial radiology for its low radiation dose and high patient acceptance rate. Using CBCT, the radiological characteristics of TMJ-OA have been investigated. The condylar and coronoid process alterations in bruxism patients' mandibular surface area were dramatically reduced utilising panoramic imaging, according to several studies[31]. CBCT can be useful in detecting the amount of condylar osseous changes in bruxism patients with symptomatic and asymptomatic TMJ, since only a few studies in the literature have utilised CBCT to evaluate the morphological changes of the condyle. As a result, we used CBCT to examine the condylar osseous alterations in bruxism patients with and without TMJ symptoms in order to make a connection between the two.

MATERIALS AND METHODS: The study participants were selected from the outpatient department who reported with the chief complaint of orofacial pain were selected and a questionnaire was given for diagnosis of bruxism based on non-instrumental approach for assessment of bruxism given by Lobbezoo et al in the international consensus on the assessment of bruxism[20]. The patients aged between 18-35years and with oral para-functional habit bruxism were included in this study whereas patients with a recent history of trauma to the jaw, congenital craniofacial abnormalities, rheumatoid arthritis, orthodontic treatment, infectious temporomandibular joint diseases, and patients during pregnancy were excluded from the study. All the eligible participants were selected with informed written consent and methodology of this study was got registered by Clinical Trail registry of India (registration number: CTRI/2021/07/035312).This study was incorporated on 66 patients (i.e.132 joints), of which 24 are males and the rest 42 are females. These 66 patients are divided into two groups, in which, bruxism patients with painful joints are considered as study group and bruxism patients with non-painful joints were kept as control group.

Non-instrumental approach Diagnostic criteria for bruxism:
In order to determine if bruxism is a possibility, the following surveys were created:
1. Sleep grinding item: Do you know that you grind your teeth at night?
2. Sleep grinding referral item: Have you ever been told that you grind your teeth at night?
3. Sleep clenching item: Have you ever observed your jaws protrude or braced when you wake up in the morning or at night?
4. Awake clenching item: Do you grind your teeth when you're awake?
5. Awake grinding item: Do you grind your teeth during awake?

In a dualistic approach, all items on the questionnaire might be answered "yes" or "no." Patients were told to only answer the questions if they believed the behaviour was frequent enough to be clinically significant.

Following that patients were examined by a clinician for possible signs and symptoms of bruxism. Patients' responses to the questionnaire were kept from the doctor, who made the diagnosis of potential bruxism based on clinical examination and correlation with the same questionnaires described above but without having the answers of the patient.

Based on the interview and clinical examination, the physician employed the following basic parameters to reach an agreement on the assessment of bruxism habit:
1. Sleep grinding item: teeth wear patches on the cusps of the front and posterior teeth regions were clinically confirmed by the patient's positive answer to the question of whether or not he grinds his teeth as he sleeps.
2. Sleep grinding referral item: The patient's bed companion confirmed the occurrence of tooth grinding at least three times each week.
3. Sleep clenching item: The presence of at least two of the following symptoms indicated the existence of jaw clenching when sleeping: On palpation, there is discomfort in the masseter muscle, a clinical evaluation of masseter muscular hypertrophy, and lateral tongue indentations.
4. Awake clenching item: The clinical criteria for a positive answer for teeth or jaw clenching while awake were the same as those listed in item 3.
5. Awake grinding item: The same clinical criteria listed in item 1 validated the patient's positive response to becoming aware of their teeth grinding.

Extra-oral palpation of the TMJ and a score of 3 or higher on the visual analogue scale are used to classify patients with bruxism as either symptomatic or asymptomatic TMJ. The tooth wear index was used to determine the dentition state of both groups, and then Cone Beam Computed Tomography was performed on each participant (CBCT).

Score	Surface	Criteria
0	B/L/O I C	No characteristic loss of enamel surface and contour
1	B/L/O I C	Characteristic loss of enamel surface with minimal loss of contour.
2	B/L/O I C	Loss of enamel just exposing dentine involving defect less than 1mm
3	B/L/O I C	Complete loss of enamel and substantial loss of dentine involving defect less than 1-2mm deep
4	B/L/O I C	Complete loss of enamel with pulp exposure leading to secondary dentin exposure involving defect more than 2mm deep.

B: Buccal aspect; L: lingual aspect; O: Occlusal aspect; I: Incisal aspect; C: Cervical

Then the patients were subjected to sectional CBCT (fig.1.A and B) Inside the CBCT machine's revolving gantry, patients are allowed to stand with their heads within. The view was confined to the TMJ, namely the condyles, with a field of view of 5X5cm. The photos were captured using a 90 KVp, 10mA, 78m voxel size camera and a 10-second exposure duration. On-demand 3 Dimensional software version 1.0 was used to assess the CBCT pictures. Laptop computers with a 15.6-inch LCD screen with excellent contrast and brightness were used to examine the DICOM files in ambient light. Sagittal and coronal slices of 132 CBCT images were reviewed by two radiologist for any osseous changes in condyles. (Figure 2A and 2B to figure 5A and 5B).

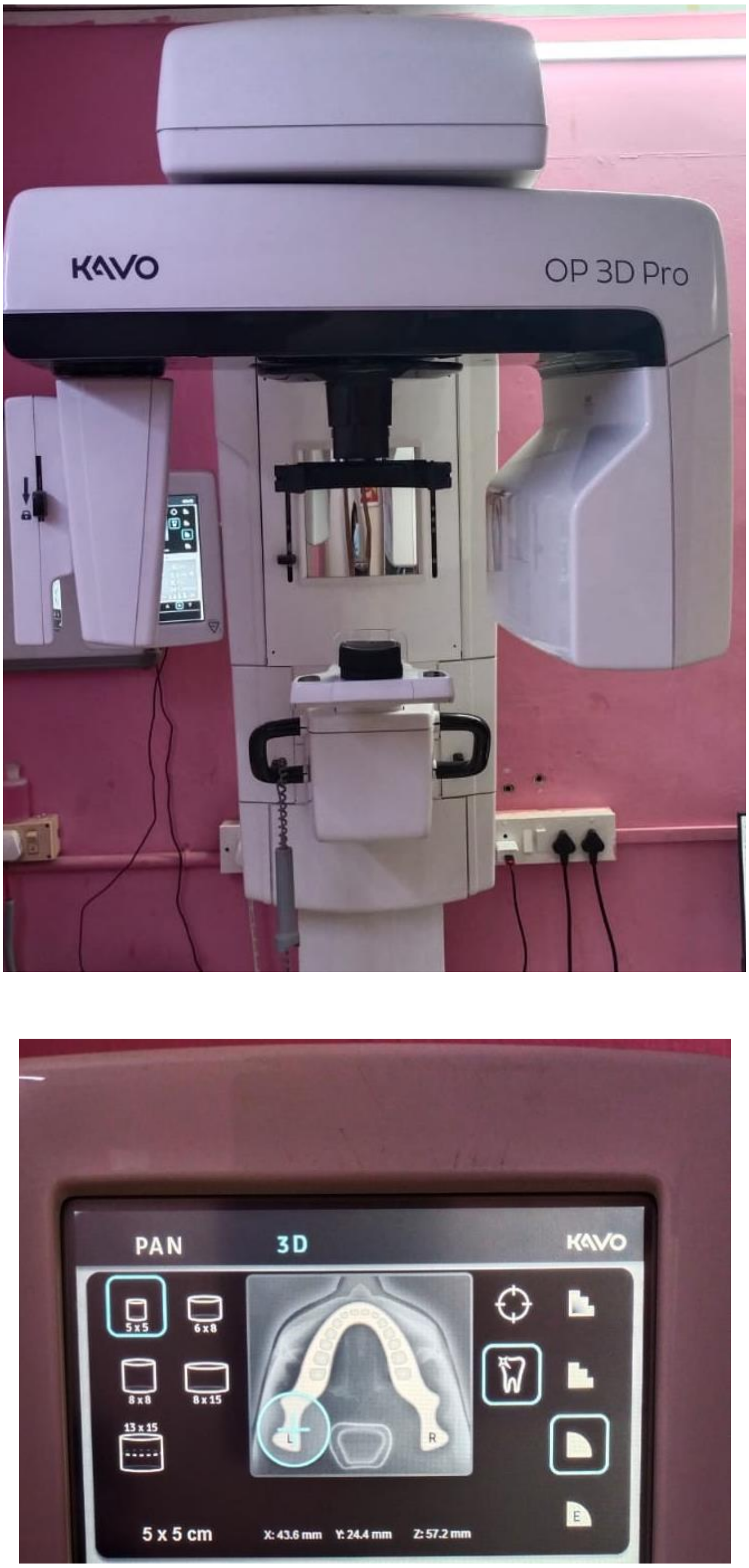


Fig.1.A and B. shows CBCT KAVO OP 3D PRO machine and the field of view restricted to 5X5 limited to condyles.

Fig.2.A. Corrected coronal view of left condyle in sectional CBCT shows flattening.

Fig.2.B. Corrected sagittal view of left condyle in sectional CBCT shows flattening.

Fig.3.A. Corrected coronal view of left condyle in sectional CBCT showing multiple osteophyte.

Fig.3.B. Corrected sagittal view of left condyle in sectional CBCT showing multiple osteophyte.

Fig.4.A. Corrected coronal view of right condyle in sectional CBCT showing sclerosis.

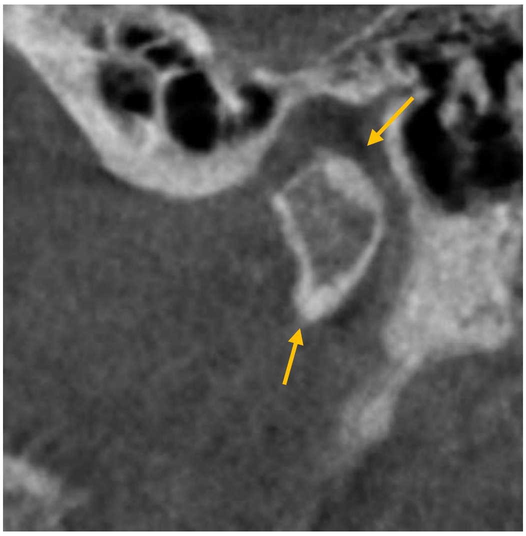


Fig.4.B. Corrected sagittal view of left condyle in sectional CBCT showing sclerosis.

Fig.5.A. Corrected coronal view of right condyle in sectional CBCT showing surface erosion.

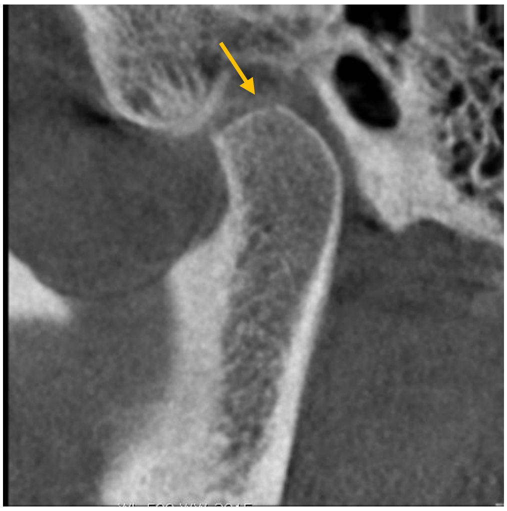


Fig.5.B. Corrected sagittal view of left condyle in sectional CBCT showing surface erosion.

STATISTICAL ANALYSIS

The findings of the normality tests, Kolmogorov-Smirnov and Shapiro-Wilks tests, show that the study followed a normal distribution.. Therefore, a parametric test was used to examine the data and determine its significance. The average of the research variables was calculated using descriptive statistics, and one-way ANOVA was performed to compare the mean values of all the variables in the research and a post hoc test was employed to examine pairwise comparisons. IBM SPSS Statistics for Windows, Version 26.0, Armonk, New York: IBM Corp., released in 2019 is used to analyse the data. The level of significance is set at 5% (α= 0.05). Statistically significant when the P-value is less than or equal to 0.05. The intra and inter-examiner reproducibility was evaluated by kappa statistics and found to be 0.86. The above interpretation for kappa statistics is a good agreement.

Correlation analysis of bone changes between groups 1 and 2 is depicted in Table 1. Group 1 had a flattening change of 27.3 percent in both joints, whereas Group 2 had a flattening change of 18.2 percent in both joints. Almost 3% of participants in group 1 had osteophyte alterations in both joints, compared to 15.2% in group 2 subjects. 33.3 percent of the participants in group 1 had sclerosis changes in both joints, whereas 24.2 percent of the subjects in group 2 had sclerosis changes. Group 2 reported 18.2% surface erosion changes in both joints, however group 1 did not report any changes in either joint. Group 2 participants are more likely to have surface erosion and osteophyte alterations than group 1 patients, according to this table. Statistical significance was defined as a P-value of 0.05 or less. P-value 0.05 was found for osteophyte and surface erosion changes, indicating a statistically significant difference, while p-value >0.05 was found for flattening and sclerosis changes, indicating a statistically insignificant difference between the study groups during the correlation analysis of the osseous changes.

The correlation analysis of tooth wear index among group 1 and group 2 on both anterior and posterior teeth were statistically significant. (Table 2 and table 3).

A look at the distribution of osseous changes amongst group 1 patients is shown in Graph 1. Osteophyte osseous change was found to be absent from 66.7 percent of subjects in group 1, flattening osseous change was found in 42.4 percent of subjects, sclerosis osseous change was found in 54.5 percent of subjects, surface erosion osseous change was found to be absent in the majority of subjects (75.8 percent).

Graph 2 depicts the percentage of patients in group 2 with osseous alterations. There was no evidence of flattening osseous change, osteophyte osseous change, or sclerosis osseous change among the majority of participants in the second research group (48.5 percent). Surface erosion was also found to be absent in the majority of subjects (45.5 percent) in the second study group (48.5 percent).

The percentage distribution of the tooth wear index score among group 1 is shown in graph 3. In the anterior area, score 3 was found to be greater (63.6 percent) while score 2 was found to be higher (48.5 percent). Within the back region.

Graph 4 shows the percentage distribution of tooth wear index score among group 2. In the anterior region, score 3 was found to be higher (66.7%) and in the posterior region, score 2 was found to be higher which was 54.5%.

Discussion:

Many people suffer from orofacial pain, which is very debilitating and common in the general population. The overall population of the United States was found to suffer from some sort of face discomfort once every six months, omitting the source of dental pain, according to one study[15]. Pain is the most prevalent reason for seeking medical attention. Major concepts that explain pain development include the pain adaptation model and the vicious pain hypothesis [16]. Somniac bruxism (SB) causes pain, which in turn causes muscle spasm, which causes further pain in the orofacial area, according to the "vicious pain theory." This was the time at which sleep bruxism became more severe in patients who were already experiencing symptoms of TMD. Based on the self-reported diagnosis of bruxism, there is a substantial correlation between TMD and bruxism[17.] Non-instrumental approach, which relies on self-report questionnaires and clinical examinations to make the diagnosis of bruxism and instrumental approach, which includes electromyographic(EMG) recordings for assessing awake bruxism and polysomnographic studies for diagnosing sleep-related bruxism, remain the gold standard for bruxism diagnosis[18]. However, despite the fact that self-reported bruxism evaluation has limited agreement with instrumental approaches, it is highly trustworthy for diagnostic purposes [19,20,21].

Our study reveals that flattening(42.4%),osteophyte(30%),sclerosis(54.5) and surface erosion(24.2) was observed osseous changes at least in one joint in group 1(graph1), whereas in group 2 flattening(33.3%),osteophyte(45.5%),sclerosis (30.3) and surface erosion(33.3) was observed in at least one joint group 2(graph 2). The correlation analysis was positive for osteophyte and surface erosion in group 2. Number of studies shown that CBCT can play a role in the imaging of the TMJ. The most significant benefit of TMJ CBCT imaging is the accuracy with which the volume and surface changes in the condyle can be measured. High-quality images with strong diagnostic utility in the examination of osseous changes in the condyle[22] may be obtained with a relatively low amount of radiation exposure when compared to Computed tomography. CBCT imaging does not have a single imaging methodology; several characteristics have impacted the CBCT pictures, including x-ray beam factors, FOV size, detector size, and the size of reconstructed voxels. Most CBCT scanners allow for this adjustment, although the specifics will depend on the vendor. To reduce unwanted exposure to nearby anatomical structures, these parameters have a significant benefit in producing the best possible 3-dimensional pictures for the given diagnostic job. For example, the CBCT pictures may be collimated to 5X5 as tiny as feasible by restricting the field of vision, and the images can be captured at a voxel size as small as 78µm. Anatomical coverage of TMJ[23] is provided by this value, resulting in CBCT pictures that are acceptable. A growing body of evidence shows that narrowing the range of vision improves the accuracy of diagnosing osseous alterations such surface erosion[24].

It is common for the TMJ's anatomic structure to be remodelled in response to the stress it is subjected to. Joint shape and the occlusal connection are balanced by this typical physiologic reaction. The anatomical shape and form of the condyle and glenoid fossa will be altered by excessive stresses acting on the TMJ, resulting in osseous changes such as flattening, surface erosion, sclerosis, and osteophytes. Both the condylar and articular surfaces may be altered by these modifications [25]. A person's TMJ remodelling is only considered abnormal if they show symptoms or if radiographic evidence of osseous abnormalities is found[26].

Age-related osteoarthritis of the TMJ affects a greater number of women than males. Proteolytic enzymes and proteoglycans are deposited in synovial fluid during this process. TMJ cartilage loss leads to secondary inflammatory response and additional joint component degeneration[27]. Microtrauma from bruxism and other habits such as biomechanical overloading, loss of molar support from wear, and attrition all had a role in the development of TMJ osteoarthritis [33].

Flattening, osteophyte, sclerosis, and surface erosion were easier to detect with CBCT than changes in condyle size[28].TMD and osteoarthritis of the temporomandibular joint might show early symptoms of osseous changes on the condylar surface (TMJ-OA). It's possible that flattening and osteophyte are signs of more procedures relating with the TMJ, whereas surface erosion may point to more minor issues. Joint sclerosis and flattening might be a sign of the healing stage of bones[29].

In our study results suggested that flattening(42.4%) and sclerosis(54.5%) were two osseous changes observed in at least one of the joints in group 1, which was similar to findings of Nah et al[30] who reported sclerosis(30.2%) and surface erosion(29.3%). Osteophyte(45.55) and surface erosion(33.3%) were osseous changes that were observed in at least one of the joints in group 2.

According to a research by Satheeshwara Kumar and colleagues in 2018[31], they used panoramic radiological images to examine the changes in mandibular surface area in bruxers and found that the coronoid and condylar processes' surface area shrank significantly in the bruxers group. An important finding from this study is that bruxism activity alters the coronoid process and the condylar surface through the use of a 2-dimensional imaging modality that was used to measure surface area changes. This study has a limitation of using a 2-dimensional imaging modality to assess the surface area changes and it has given a key, due to bruxism activity there is an osseous alteration in the coronoid process and in the condylar surface.

Anterior and posterior parts of the dentition were shown to have attrition during oral parafunctional activity like bruxism. During deglutination and clenching, it is possible to suffer from incisal and occlusal attrition. Bruxism exacerbated this attrition, as shown by increased wear on the enamel and dentin, as well as occlusal wear and cusp or repair fractures. Even though it doesn't show any symptoms, it can be critical when it contributes to tooth wear and pain increasing [71]. Similar to the findings of Nikolaos et al.[32,33], we discovered a correlation between bruxism and dental attrition in both groups.

Although there is various possible causes in the development of TMD, Excessive occlusal pressures in the condyle of the TMJ, which can reflect in anatomical components of the TMJ, may contribute to early remodeling of osseous components and may precipitate to TMD.

The limitation in our study was bruxism assessment was done by a non-instrumental approach questionnaire, which was subjective. To overcome this, a complimentary clinical examination was done. By this way, we can assess both possible and probable bruxism which was sufficient for research purposes.

CONCLUSION

The present study was conducted to assess the correlation of condylar osseous changes in bruxism patients with and without TMJ pain. Though condylar remodeling was an age-related process, whereas, with the association of parafunctional habits like bruxism, the osseous component of the condyle may deteriorate at younger age. This results in degenerative osseous changes in the condyle, which may act as one of the possible reasons for TMD. By using CBCT it helps in timely management and aids in detecting those osseous changes earlier, which may help in controlling the further progression of the disease.

TABLE 1: CORRELATION ANALYSIS

DERANGEMENT		**GROUP 1**		**GROUP 2**		**P-VALUE**
		FREQUENCY	**PERCENTAGE**	**FREQUENCY**	**PERCENTAGE**	
FLATENNING	**A**	10	30.3	16	48.5	0.078
	P(1 JOINT)	14	42.4	11	33.3	
	P(BOTH JOINTS)	9	27.3	6	18.2	
OSTEOPHYTE	**A**	22	66.7	13	39.4	0.034*
	P (1 JOINT)	10	30.3	15	45.5	
	P(BOTH JOINTS)	1	3.0	5	15.2	
SCLEROSIS	**A**	4	12.1	15	45.5	0.413
	P(1 JOINT)	18	54.5	10	30.3	
	P (BOTH JOINTS)	11	33.3	8	24.2	
SURFACE EROSION	**A**	25	75.8	16	48.5	0.041*
	P(1 JOINT)	8	24.2	11	33.3	
	P (BOTH JOINTS)	0	0	6	18.2	

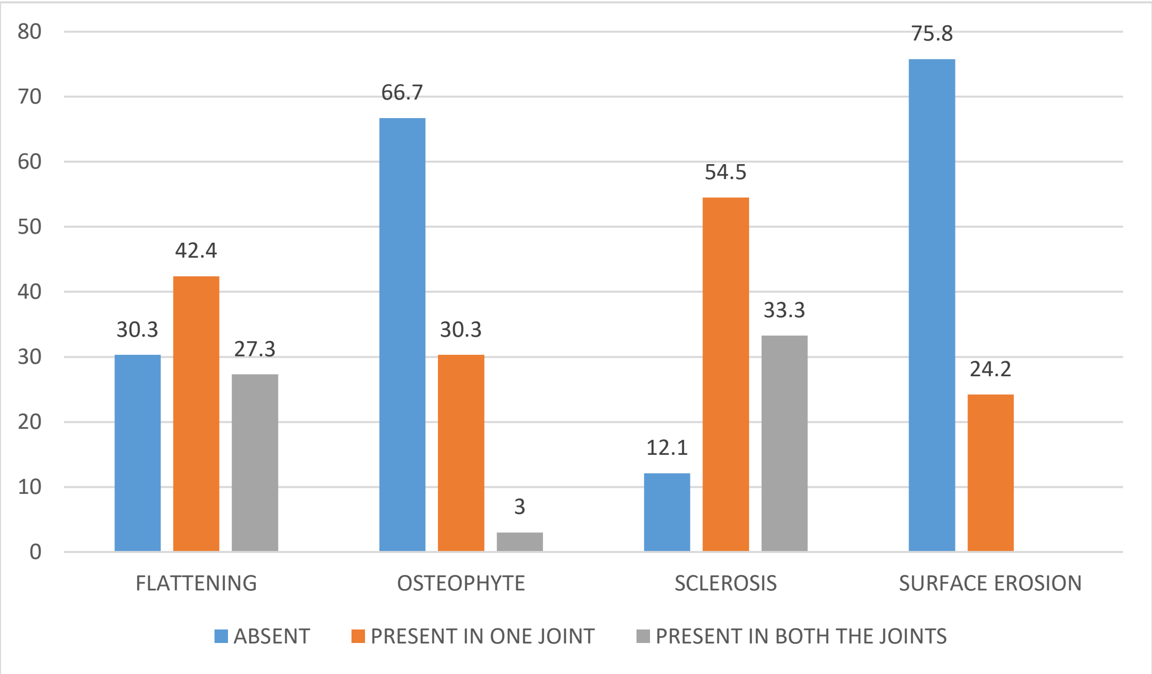
TABLE 2: TOOTH WEAR INDEX AMONG GROUP 1

TOOTH WEAR INDEX	GROUP 1				P-value
	ANTERIOR		POSTERIOR		
	N	%	N	%	
SCORE 0	0	0	0	0	0.035*
SCORE 1	0	0	15	45.5	
SCORE 2	12	36.4	16	48.5	
SCORE 3	21	63.6	2	6.1	
SCORE 4	0	0	0	0	

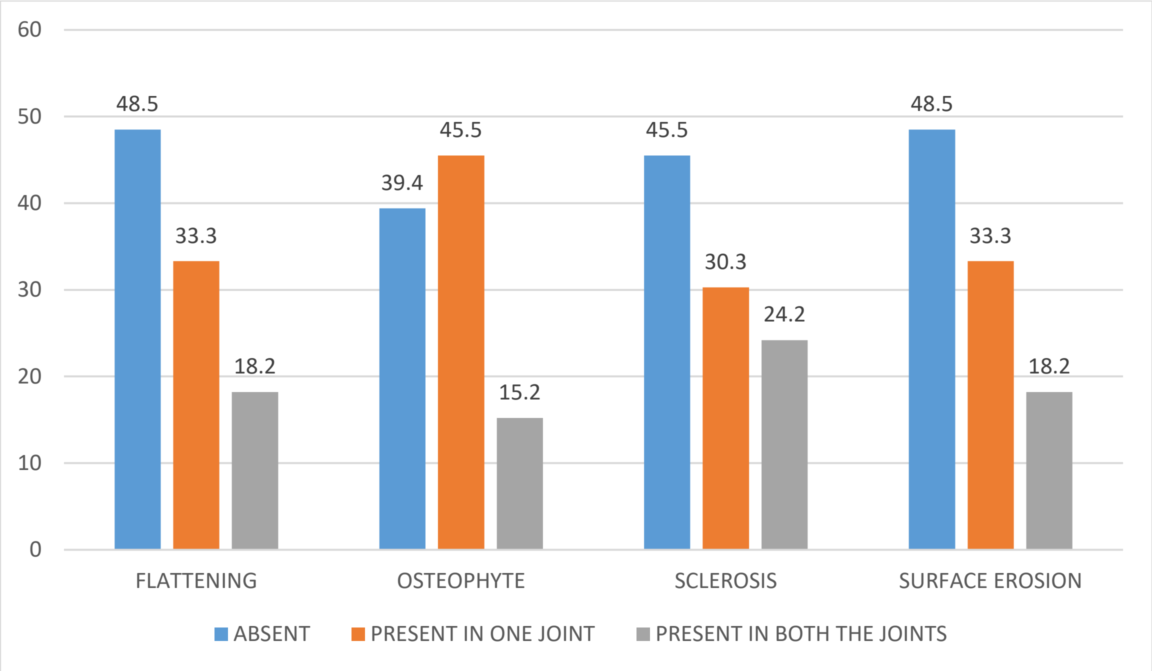
TABLE 3: TOOTH WEAR INDEX AMONG GROUP 2

TOOTH WEAR INDEX	GROUP 2				P-value
	ANTERIOR		POSTERIOR		
	N	%	N	%	
SCORE 0	0	0	0	0	0.046*
SCORE 1	3	9.1	15	45.5	
SCORE 2	8	24.2	18	54.5	
SCORE 3	22	66.7	0	0	
SCORE 4	0	0	0	0	

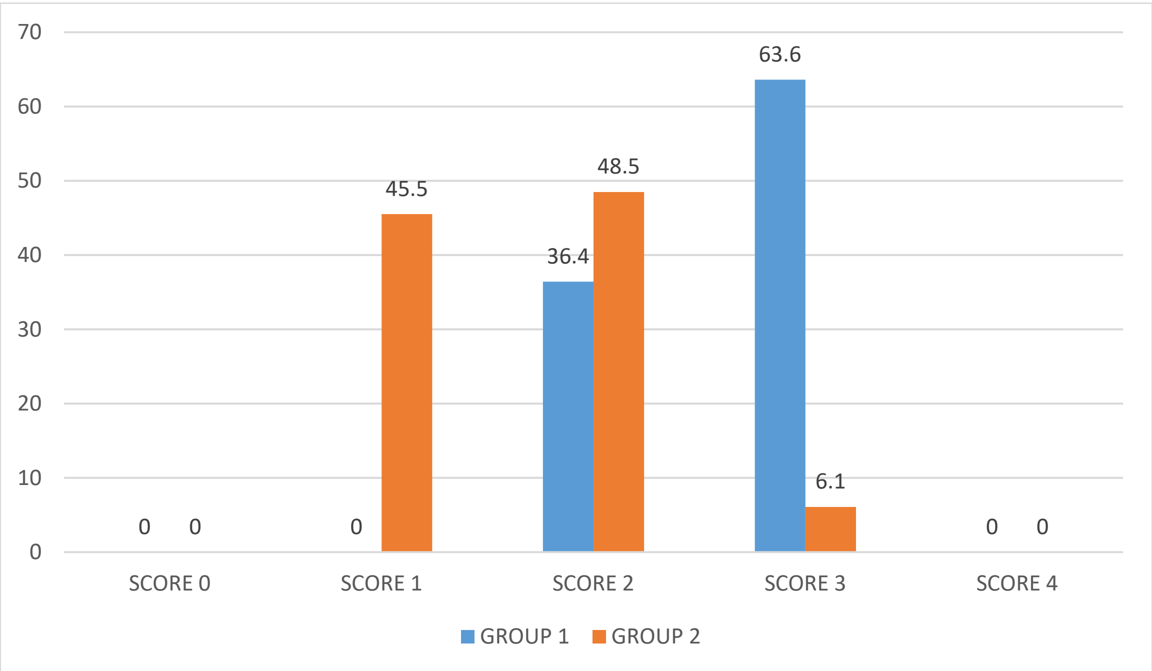
GRAPH 1: PERCENTAGE DISTRIBUTION OF OSSEOUS CHANGES IN PATIENTS AMONG GROUP 1 INDIVIDUALS



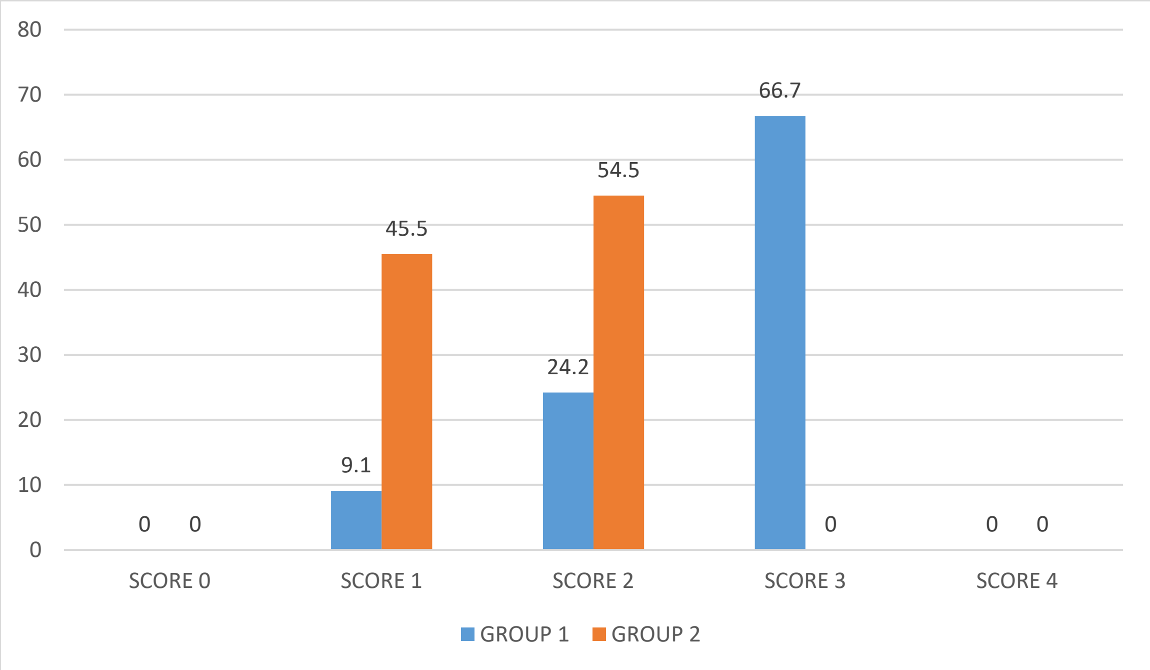
GRAPH 2: PERCENTAGE DISTRIBUTION OF OSSEOUS CHANGES IN PATIENTS AMONG GROUP 2 INDIVIDUALS



GRAPH 3: PERCENTAGE DISTRIBUTION OF TOOTH WEAR INDEX SCORE AMONG THE GROUP 1



GRAPH 4: PERCENTAGE DISTRIBUTION OF TOOTH WEAR INDEX SCORE AMONG THE GROUP 2



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