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Temporomandibular Joint Changes in the Setting of Oral Submucous Fibrosis – A Prospective, Case Control Study

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Research article

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Abstract

Purpose: The aim of the study was to assess the changes occurring in the bony components of Temporomandibular joint as a sequelae of trismus due to Oral Submucous fibrosis.

Patient & Method: The study population was divided into two groups – Group A – 26 patients who were diagnosed with OSMF and classified according to Aziz et al and Group B – 26 patients who had come for prosthetic rehabilitation and had no restriction of mouth opening. DVT scans of bilateral TM Joint were obtained and the anterior, posterior and superior joint space as well as the articular eminence angle was assessed. The collected data was then subject to statistical analysis using.

Results: There was significant reduction in the total joint space in the Group A as compared to Group B. A steeper angle of articular eminence was noted in the Group A.

Conclusion: The present study revealed statistically high significant reduction in the Temporomandibular joint space of patients suffering from Oral Submucous fibrosis with varying degrees of restriction of mouth opening when compared with subjects who had no restriction of mouth opening. There was also a steeper angle of articular eminence noted which was suggestive of the onset of degenerative changes of the joint.

Keywords: *Temporomandibular Joint; Oral Submucous Fibrosis;, Digital Volumetric Tomography*

Abbreviations: AEA: Articular Eminence Angulation; OPG: Orthopentamograph; MRI: Magnetic Resonance Imaging; CT: Computed TomographY; CBCT: Cone Beam Computed Tomography; TMD: Temporomandibular disorders.

Introduction

The human temporomandibular joint can produce a variety of movements due to its architecture and tissue concentration. It is a ginglymodiarthroidal joint that allows both rotatory and translatory movements [1]. It consists of articulating surfaces, intervening disk, fibrous capsule, synovial fluid, membranes, and ligaments, except that it is covered with fibrocartilage rather than hyaline cartilage, like the other synovial joints [2]. A physical stimulus is important for the maintenance of its functional and structural integrity [3].

Prolonged immobilization of the TM Joint causes a lack of harmony between its components leading to its disuse and damage of the components, which brings about changes in the morphology of the bony, soft tissue components and the joint spaces. This leads to the development of Temporomandibular disorders (TMD's),which present clinically as pain in the TM joint and/ears, headache, muscle tenderness, stiffness of the joint, clicking of the joint, locking, deviation of the joint and reduced range of motion [4,5].

Joint immobilization as a result of Oral submucous fibrosis is a common finding in the Indian subcontinent that leads to disuse atrophy of the TM Joint which may result in joint changes [6,7]. With this in view, the present study was carried out to assess the morphometric changes occurring in TM Joint in patients who had Oral submucous fibrosis. The objective of the present study was to assess and compare the DVT findings of TM Joint in patients with OSMF with that of healthy subjects and to find if any correlation exists between the restriction of mouth opening and changes in the TM Joint hard tissue components.

Material and Method

The present prospective, observational, single-blind study was conducted on 52 patients (104 TM Joints) in the Department of Oral & Maxillofacial Surgery, Sharad Pawar Dental College & Hospital and Acharya Vinoba Bhave Rural Hospital Sawangi (Meghe), Wardha from August 2017 to May 2019. The study was conducted in accordance with the Helsinki declaration and its later amendments or comparable ethical standards and after getting the clearance from the Institutional ethical committee Group of Datta Meghe Institute of Medical Sciences (Ref.No. DMIMS(DU)/IEC/2017-18/6696).

A total of 52 patients (104 TM Joints) who met the inclusion criteria (Table 1) were divided into 2 groups – Group A - 26 patients clinically diagnosed with Group 3 or Group 4a OSMF according to Aziz et al classification, 2008 and the remaining 26 patients in Group B requiring Prosthodontic rehabilitation with no restriction of mouth opening [8].

Inclusion Criteria	Exclusion Criteria
Individuals between 20 to 55 years	Patients with systemic, rheumatic, endocrine, congenital and immune/autoimmune diseases affecting the Temporomandibular joint and the jaws.
Group 3 and Group 4a OSMF according to Aziz et al classification [8]	Patient with superimposed precancerous or cancerous lesions.
	Patients with traumatic injuries and/or history of trauma to the jaws.
	Patients who have been operated in the past for OSMF and/or TMJ disorders.
	Patient not giving consent for the study.

The purpose of the study was explained to the patient and written consent was obtained from all the participants. A detailed case history of the patient was recorded and a thorough clinical examination was carried out. Interincisal opening, presence of blanching, presence of fibrous bands, ulcerations, the shape of uvula and tongue movements were recorded. Maximum interincisal mouth opening (MIO) was measured using a digital Vernier caliper from the incisal edge of maxillary incisors to the incisal edge of mandibular incisors (Figures 1,2). The Patients in Group A were further divided into subgroups based on the interincisal mouth opening: Group 1 (MIO > 35 mm), Group 2 (MIO 26-35 mm), Group 3 (MIO 15 – 25 mm), Group 4a (MIO < 15mm), Group 4b (Malignant and premalignant lesions noted) [8]. A detailed clinical examination of the Temporomandibular joint was done using a structured questionnaire.

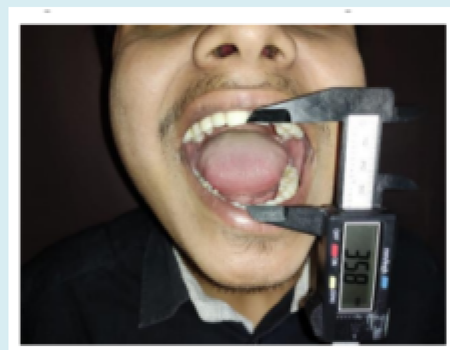


Figure 1: Mouth opening measured using Vernier calliper in Group A patient.

Figure 2: Mouth opening measured using Vernier calliper in Group B patient.

The patients' were then referred to Department of Radiodiagnosis for 3 Dimensional Digital Volumetric Tomographic (3D DVT) Scans of the bilateral Temporomandibular joints using Phillips AlluraXper FD20 3D RA, Digital subtraction Angiography unit(Netherlands) with exposure parameters of 80kVp, 10mA, and 4-5sec with Field of View- 12” 270° rotation. The imaging was done in a closed mouth fashion with the mandible in a relaxed position without clenching [4].

One senior staff member who was blinded to the study protocol and was not further involved in the statistical analysis was then recruited in the study in the capacity of an independent observer to evaluate the Temporomandibular joint morphometric dimensions on both sides to avoid observer bias.

The following components of the TM Joint were then evaluated, and the parameters analyzed

A) **Joint Space of the TM Joint** (Figures 3-5) [9]

a. Anterior Joint Space
b. Posterior Joint Space
c. Superior Joint Space(Depth of Glenoid Fossa)

For the calculation of the joint space, 2 points were initially marked, SC- The superior most convex point on the condylar head

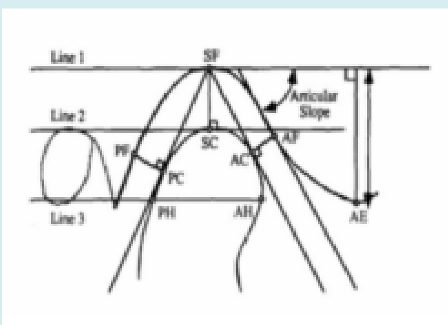


Figure 3: Schematic representation of the measurement done on DVT scans (Joint Space).

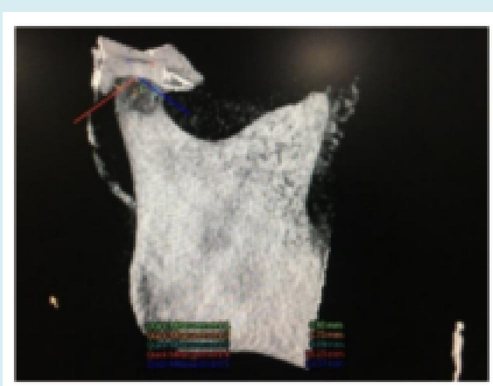


Figure 4: DVT scan showing measurements of joint Space in Group A patient.

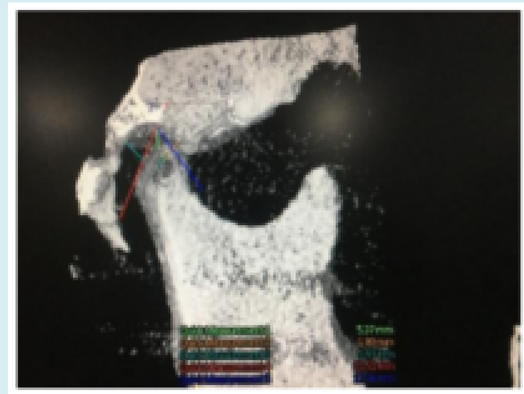


Figure 5: DVT scan showing measurements of joint Space in Group B patient.

SF – The deepest point in the Glenoid fossa
Two tangents were drawn from the deepest point ‘SF’ on the anterior and posterior surface of the condylar head

Two points, AC and PC were marked on the condylar head
AC- The most convex point on the anterior surface of the condylar head PC- The most convex point on the posterior surface of the condylar head

Perpendiculars were drawn from these points were drawn on the articular surfaces

SC-SF- This denoted the distance between the most convex point on the superior surface of the condyle to the deepest point in the Glenoid fossa, the Superior Joint Space (Depth of Glenoid fossa)

AC-AF – This line denoted the distance between the anterior surface of the condyle and the tangent point of the articular slope, the Anterior Joint Space

PC-PF – This line denoted the distance between the posterior surface of the condyle and the tangent point of the articular slope, the Posterior Joint Space

B) **Articular Eminence Angulation** (AEA) (Figures 6-8) [10]

Two lines were marked

Line 1 – Formed by connecting the points at Articular Eminence Vertex (AEV) and the Mandibular Fossa Vertex (MFV)

Line 2 – A line parallel to the Palatine plane (PP) through AEV
The angle formed by the two lines was measured and recorded as Articular eminence angulation (AEA)

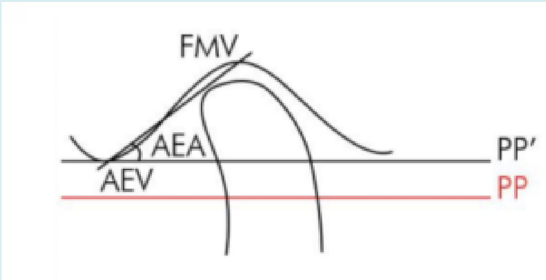


Figure 6: Schematic representation of the measurements done on DVT scans (Angle of articular eminence).

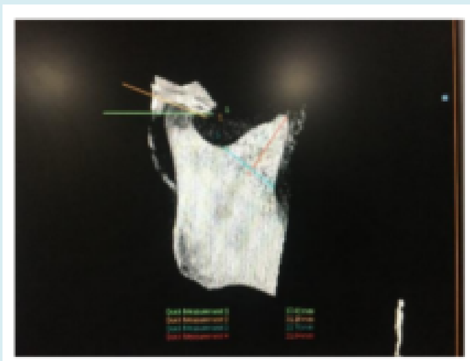


Figure 7: DVT scan showing measurement of Angle of articular eminence in Group A patient.

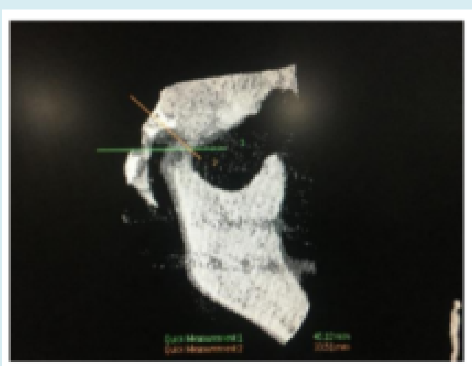


Figure 8: DVT scan showing measurement of Angle of articular eminence in Group B patient.

Statistical Analysis

All the data was recorded and tabulated in MS Excel Sheet (Microsoft Office 2019). Data was analyzed using SPSS 22.0 version and Graphpad Prism 7.0 version. The analysis was done using descriptive and inferential statistics using the Chi-square test and Student's unpaired t-test. Statistical significance was established at $p < 0.05$.

Results

A total of 52 patients (104 TM Joints) were included in the study and were grouped according to the presence or absence of Oral Submucous fibrosis. The study group – Patients with Oral Submucous Fibrosis- Group A was composed of 21 males and 5 females with a mean age of 33.76±8.68 years and the control group – Patients without Oral submucous fibrosis - Group B consisted of 21 males and 5 females with a mean age of 33.46±6.24 years. On comparing the mean age of Group A and B using the Chi-square test, the p-value was 0.14, which was statistically not significant, hence the controls being age and gender-matched.

The mean joint space in anterior, posterior and superior compartments was significantly reduced in Group A patients when compared to Group B controls. The depth of Glenoid fossa (Superior Joint space) on right and left side in Group A was 2.39 ± 1.12 mm 2.55 ± 1.47 mm and in Group B was 3.58 ± 1.44 mm and 3.79 ± 1.33 mm respectively. The difference between the groups was found to be statistically significant (p=0.002) (p=0.002) (Table 2).

	Group	N	Mean	Std. Deviation	t-value
Right Side	Group A	26	2.39	1.12	3.31
	Group B	26	3.58	1.44	p=0.002,**S**
Left Side	Group A	26	2.55	1.47	3.18
	Group B	26	3.79	1.33	p=0.002,**S**

Table 2: Comparison of Depth of Glenoid fossa (mm) in two groups.

The mean anterior joint space was in group A was 1.72 ± 0.92 mm and 1.54 ± 0.73 mm and in Group B was 2.60 ± 1.38 mm and 2.35 ± 1.15 mm on right and left side respectively (p = 0.009) (p = 0.004). The mean posterior joint space in Group A was 1.82 ± 0.71 mm and1.87 ± 1.22 mm and 3.77 ± 1.52 mm 3.80 ± 1.95 mm on left and right side respectively in Group B (p = 0.0001) (p = 0.0001).The difference between the two groups in Anterior Joint space and Posterior joint space was found to be statistically significant (Table 3).

	Group	N	Mean	Std. Deviation	t-value
Right Side	Group A	26	2.39	1.12	3.31
	Group B	26	3.58	1.44	p=0.002,**S**
Left Side	Group A	26	2.55	1.47	3.18
	Group B	26	3.79	1.33	p=0.002,**S**

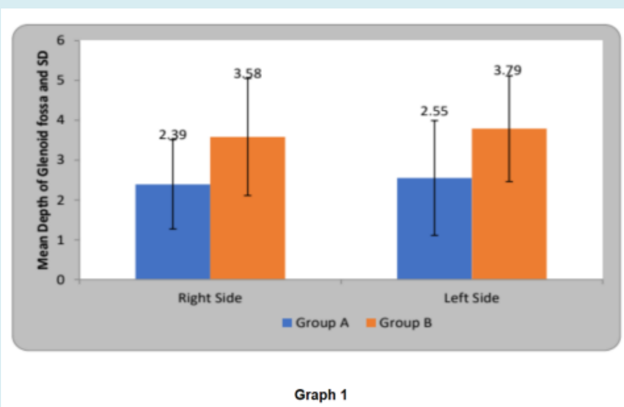
Table 3: Comparison of Joint Space (mm) in two groups.

The mean angle of articular eminence in Group A on right and left side was 28.02 ± 6.60 deg. and 28.02 ± 6.53 deg. whereas in Group B it was 31.87 ± 5.57 deg. and 32.37 ± 6.48 deg. respectively When compared, it was found to be statistically significant (p = 0.027) (p = 0.020) (Table 4).

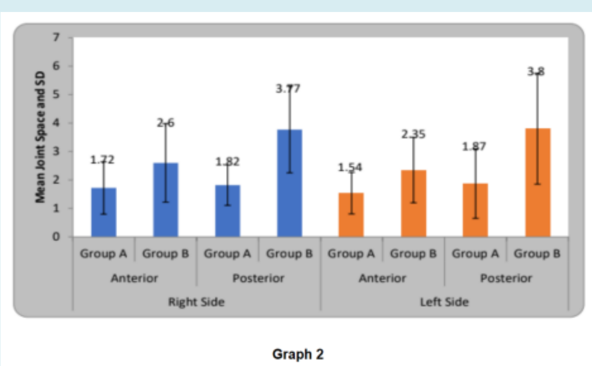
	Group	N	Mean	Std. Deviation	t-value
Right Side	Group A	26	28	6.6	2.27
	Group B	26	31.9	5.57	p=0.027,**S**
Left Side	Group A	26	28	6.53	2.4
	Group B	26	32.4	6.48	p=0.020,**S**

Table 4: Comparison of Articular eminence angulation (Degree) in two groups.

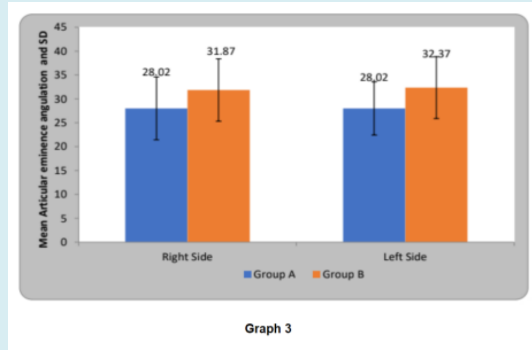
Results of the present study showed that hypomobility of the TM Joint in a setting of Oral Submucous fibrosis leads to a significant reduction in the joint space and a steeper angle of articular eminence which disposed the joint to degenerative changes and development of subsequent disorders.



Graph 1: Comparison of Depth of Glenoid fossa (mm) in two groups.



Graph 2: Comparison of Joint Space (mm) in two groups.



Graph 3: Comparison of Articular eminence (degree) in two groups.

Discussion

The temporomandibular joint is a load-bearing joint for which the stimulus plays an important role in maintaining its homeostasis. Various etiological causes like Oral Submucous Fibrosis, trauma, TM joint disorders, benign and malignant tumors lead to trismus and eventual immobilization of the joint bringing about changes in its hard and soft tissue components [11].

One of the most common causes of TM Joint immobilization in the population of the Indian subcontinent is Oral Submucous Fibrosis due to the inadvertent use of tobacco products in its varied forms. Smokeless tobacco contains high amounts of areca nuts [12]. Areca nuts contain flavonoids, alkaloids, and copper, which interfere with the homeostasis of the extracellular matrix. The Alkaloids stimulate fibroblast, at the same time, flavonoids, inhibit collagenase, stabilize the collagen fibrils and render them resistant to degradation. The constant chewing of the tobacco products results in muscle contracture, leading to overactivity of the masticatory muscles eventually causing muscle fatigue and degradation, scarring and fibrosis. All these events result in the classic presentation of OSMF as pronounced limitation of mouth opening [7,13]. This pronounced limitation of mouth opening leads to immobilization and disuse of the TM Joint causing a shift in the homeostatic mechanism of the joint and resulting in the symptoms of Temporomandibular disorders [3].

These changes in the TM Joint can be visualized and assessed by radiologically imaging the joint. Various radiological modalities are indicated for viewing the components of TM Joint such as Plain film radiographs, Orthopentamograph (OPG), Magnetic resonance imaging (MRI), Computed tomography (CT), Cone Beam Computed Tomography (CBCT) and 3 Dimensional Digital Volumetric Tomography (3D DVT) [14]. Digital volumetric scans were chosen in the study as it provides more valid and accurate data with lesser radiation exposure and being cost-effective and easily available [4,15].

Only a few studies in the literature have reported the effect of immobilization on the human TM Joint and have commented on the thickness of the articular cartilage, which has revealed significant reduction [16,17]. Few animal studies have also been performed to evaluate the effects after partial or complete immobilization of the joint [18-20]. No studies to date have evaluated the Joint space and articular eminence angulation as effects of prolonged immobilization in the setting of Oral Submucous Fibrosis.

The present study was conducted to analyze and compare the morphometric changes occurring in the Temporomandibular joint secondary to prolonged trismus caused by Oral Submucous Fibrosis.

The TM Joint space was evaluated as the superior, anterior and posterior space compartments and studied on the sagittal sections of the DVT scans. The Superior joint space or the depth of glenoid fossa is the distance from the most convex point on the condylar articulating surface to the most convex point on the temporal articulating surface. In the present study, the mean depth of glenoid fossa on right side in Group A was 2.39 ± 1.12 mm and in Group B was 3.58 ± 1.44 mm ($p = 0.002$), whereas on the left side it was 2.55 ± 1.47 mm in Group A as compared to 3.79 ± 1.33 mm in Group B ($p = 0.002$). On comparing, a reduction in the Superior joint space was noted, which was found to be significant. Results were in accordance with the study given by A. Tsuruta, K. Yamada, K. Hanada, et al. [21] who observed that the thickness of Roof of glenoid fossa was greater in joints with bony changes in the condyle. C. Nanthini, S. Sathasivasubramanian, M. Arunan also observed a total reduction in space in patients with Grade III and Grade IV OSMF [3].

The anterior and posterior joint space is the distance between the anterior and posterior-most convex points on the condylar head to the articular slopes. In the present study, we found the anterior joint space in Group A on the right side to be 1.72 ± 0.92 mm and the left side to be 1.54 ± 0.73 mm. In Group B, the anterior joint space was observed to be 1.82 ± 0.71 mm on the right side and on the left side 2.35 ± 1.15 mm. The posterior joint space in Group A was found to be 2.60 ± 1.38 mm on the right side and 1.87 ± 1.22 mm on the left side. In Group B, the posterior joint space was observed to be 3.77 ± 1.52 mm on the right side and 3.80 ± 1.95 mm on the left side. This denoted a significant reduction in anterior and posterior joint space in Group A patients as compared to Group B patients. This was in accordance with the previous study by C. Nanthini, S. Sathasivasubramanian, M. Arunan who observed a highly significant reduction in joint space of individuals with OSMF (3.00 ± 1.09 mm) when compared to healthy individuals (4.12 ± 0.87 mm) [3].

Articular eminence angulation (AEA) is the angle formed by the line joining the Articular eminence vertex and mandibular fossa vertex with the line parallel to the palatine plane. In Group A, on the right side, the angle of articular eminence was found to be 28.02 ± 6.60 deg. and in Group B it was 31.87 ± 5.57 deg. On comparing the 2, the AEA was found to be steeper in Group A ($p = 0.027$), which was statistically significant. Similarly, on the left side, the angle of articular eminence was 28.02 ± 6.53 deg. and 32.37 ± 6.48 deg. in Group A and Group B respectively. On comparing the two groups, it was noted that the AEA was steeper in Group A ($p = 0.020$), which was found to be statistically significant. Similar results were obtained in the studies conducted by S. Cruz, S.L.S Melo, D.P. de Melo, D. Q. Freitas, P.S.F. Campos [10], and M. Paknahad, S. Shahidi, M. Akhlaghian, M. Abolvardi [22] who concluded that the presence of degenerative bone diseases results in a steeper angle of articular eminence.

Conclusion

Prolonged trismus secondary to Oral Submucous fibrosis leads to immobilization of the TM Joint, which causes significant reduction of joint space and steeper angulation of articular eminence which could possibly be a reason of early intr-operative disloation of condyle following fibrotomy requiring eminectomy as a part of OSMF treatment protocol.

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