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ORIGINAL ARTICLE **OPEN ACCESS**

An Innovative Approach to Measure 3D Airway Space In OSMF Patients By CBCT- An Institutional Study

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ABSTRACT
Oral submucous fibrosis is a PMD a condition that affects both the oral cavity and surrounding structures like airway space, pharynx, larynx and eustachian tube. Thus we hypothesized that it can affect the pharyngeal airway also. To measure airway space, Cone Beam Computed Tomography is a perfect approach for the three dimensional airway space. In this study we have measured the same. To analyse the three dimensional airway space in OSMF subjects Oral submucous fibrosis and having indications for a full FOV CBCT scan for other dental purposes were chosen for study. It was observed that airway space volume was reduced in OSMF subjects with a significant p value of <0.05. It was found that the habit of areca nut chewing affects both the oral cavity and surrounding associated structures thus reducing the volume of airway space in oral submucous fibrosis subjects. With the current study as a platform, findings of airway volume changes on CBCT in OSMF patients may suggest an impending OSA.Harmful effects of tobacco chewing will not only affect the oral cavity but complete oropharyngeal airway space causing difficulty in speech, eating and breathing which are the most important functions of daily routine.
Keywords: *OSMF; Airway space, CBCT.*

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INTRODUCTION

The tissues of the oral cavity are impacted by the potentially cancerous condition known as oral submucous fibrosis (OSMF). Oral submucous fibrosis was first named "Atrophiaidiopathica mucosae oris" by Schwartz in 1952, and it was later described as a "insidious, chronic disease that affects any portion of the mouth and occasionally the pharynx" by Jens J. Pindborg in 1966. A juxta epithelial inflammatory reaction, followed by fibroelastic alteration of the lamina propria and epithelial atrophy, which results in stiffness of the oral mucosa, produces trismus, and makes it impossible to chew, although the creation of vesicles may occasionally precede or be connected to it.[1,2] The primary cause of this condition is thought to be chewing areca nuts in any form, despite the fact that there are other contributing variables. Depapillation of the tongue, increasing reduction in mouth opening, restricted movement, blanching, leathery texture of the oral mucosa, and shrinking uvula are further features of 2OSMF. 3,4 The frequent correlation between oral submucous fibrosis and leukoplakia and oral cancer has led some to hypothesise that it is a precancerous condition. 5 Limited mouth opening and fibrosis of the upper digestive tract's mucosa, which affects the oral cavity, oropharynx [OP], and frequently the upper third of the oesophagus, are the prominent symptoms of OSMF. The Nasopharynx's [NP] fibrosis has an impact on the Eustachian tube's operations.[5]So it can be suggested that by intake of areca nut juices inside the aerodigestive tract can affect the adjacent structures and may lead to constriction of the oropharyngeal structures thus affecting the airway.

Also, Cone Beam Computed Tomography gives the privilege of three dimensional airway assessment and thus a volume of the associated airway can be measured accurately with the help of CBCT.

MATERIALS AND METHODS

The study was performed by taking institutional ethical committee approval from October 2018 to November 2020 CBCT scans of OSMF patients were analyzed. OSMF patients reporting to the Dept. OPD within the age range of 20 –50 yrs were selected for the study. Only OSMF patients who required full mouth scan or cone beam computed tomography radiographs for endodontic, orthodontic, ENT or oral surgery purpose and who gave consent for the study were included in the study. Patients without oral

submucous fibrosis, with generalized degenerative joint disease or with other pathologies like clefts, associated malignancy, with parafunctional habits and pregnant women were excluded from the study.
CBCT volume scans of all subjects were obtained by using the Planmeca Pro Max 3D dental imaging system with a 18-19 seconds scan time, 10mA and 90 kV the imaging protocol was used. The mandible was positioned in central relation and the lips were relaxed. The parameters were measured using Romexis Programs software. The parameters were measured as follows: All length measurements were done in millimeters (mm) and the volume was measured in cubic centimeter (cm^3).

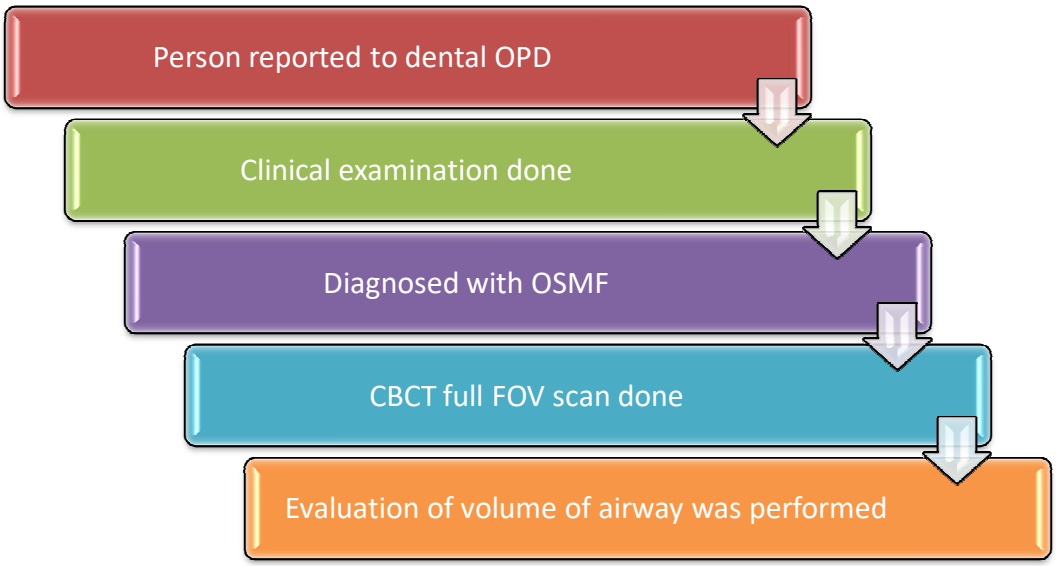


Figure 1: Stepwise procedure of methodology.

Evaluation of changes in airway

Airway space volume was measured as per El and Palomo (2011) method. For measurement a slice thickness of 0.600mm was used. The sagittal section at which both ANS-PNS plane and the anterosuperior tip of third cervical vertebrae was visible was used. The Frankfort plane was oriented in a straight horizontal line. One horizontal line was drawn through the ANS-PNS plane and another horizontal line was drawn parallel to this line at the anterosuperior tip of third cervical vertebrae. The airway tool was selected. Starting at the centre of airway on palatal line, guidance points were drawn through the length of the airway space between the two horizontal parallel lines drawn and the selected airway tool calculated the volume of the selected area.

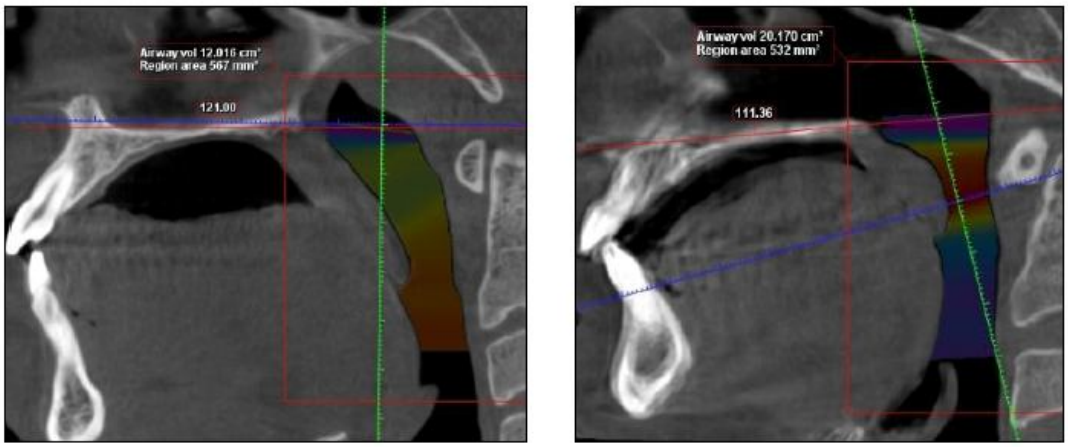


Figure 2: Airway space volume of OSMF subject and non OSMF subject assessed on CBCT

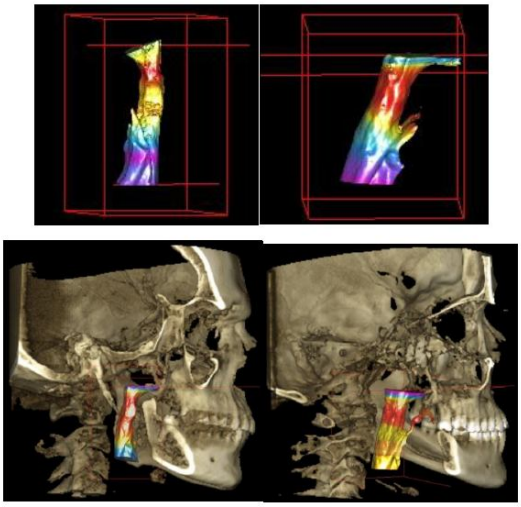


Figure 3: 3D segmentation of the assessed airway volume

RESULTS:

OSMF cases and age and sex matched control group was selected and analysed on CBCT. Data was analyzed (SPSS) version 21, IBM Inc. Descriptive data was reported for each variable. Summarized data was presented using Tables and Graphs. Normality distribution was tested using the Shaperio Wilk W test. Independent t-test (2 groups) was used for unpaired groups. Chi square test was used for categorical variables. A level of $p<0.05$ was considered statistically significant.

Demographic details of the patients

Age and Sex: In OSMF patients (N=26) 22 were males and 4 were females whereas in non OSMF cases (N=26) 20 were males and 6 were females. Among the OSMF cases, the mean age of males was 35.45± 6.696 years and female was 33.25± 0.957 years. Among the non OSMF, the mean age in male population was: 33.50±7.970 years and female was 37.83± 11.873 years. The mean age of OSMF and non-OSMF cases were not significantly different.

Mouth Opening: Mean mouth opening was compared across various grades of OSMF using one way ANOVA test. It was found to be significant.

Mean Mouth opening of OSMF cases was 26.142±2.785mm and that of non OMSF cases was 41mm. On pair wise (post hoc Bonferroni) comparison, significant differences were seen among all the four grades. The mouth opening reduced with increase in grades of OSMF. The difference between each grade was statistically significant. It was observed that the mean mouth opening of OSMF subjects was less than non OSMF subjects. The mouth opening reduced with increase in grades.

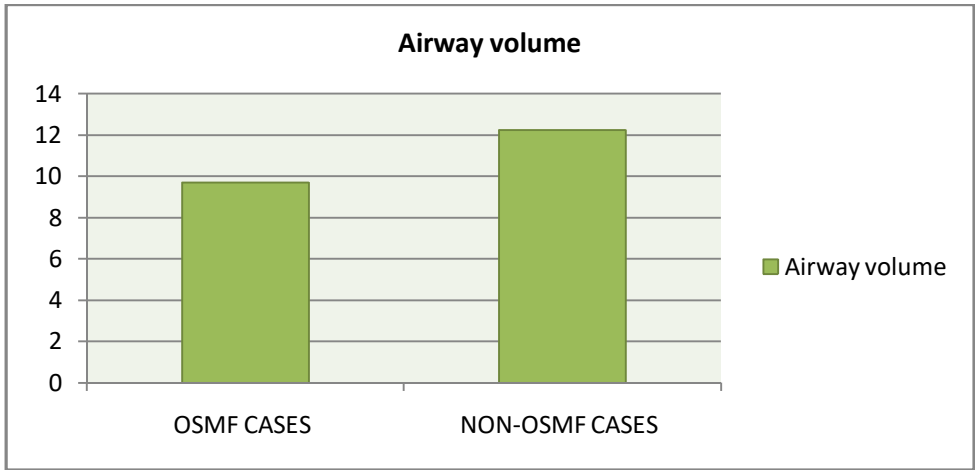
To analyse airway space in OSMF patients

Comparison of airway space among OSMF and non OSMF subjects:

	OSMF SUBJECTS		NON-OSMF SUBJECTS		P VALUE
	MEAN	SD	MEAN	SD	
Airway volume	9.7019	3.97067	12.2215	4.23352	0.028*, SIG

Table 1: Comparison of Airway space volume among OSMF and non OSMF subjects.

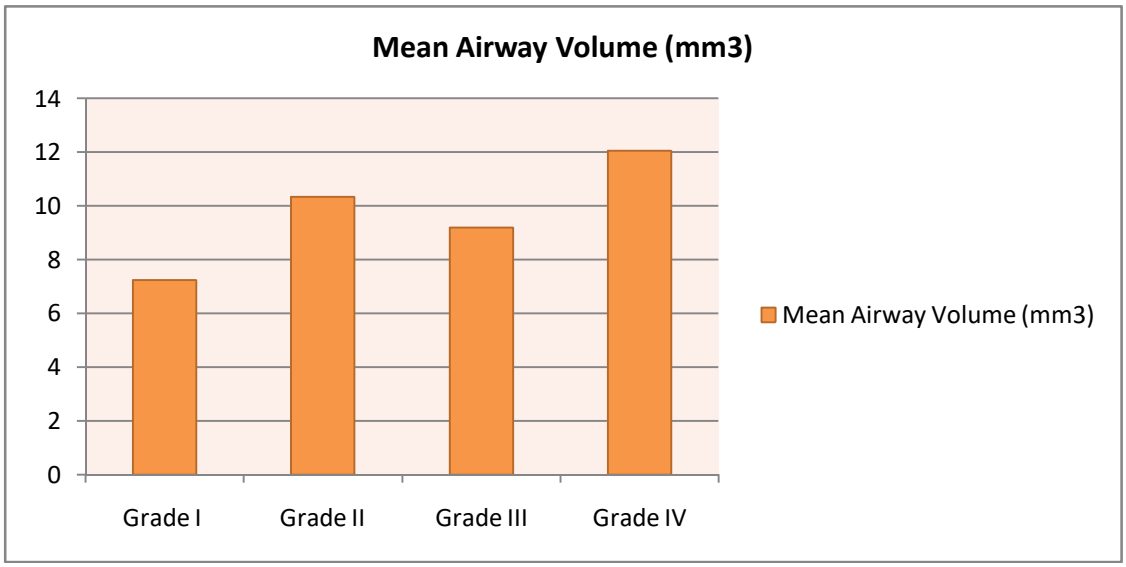
The airway space volume (cm^3) was compared among OSMF subjects (Mean±SD: 9.7019±3.97) and non OSMF subjects (Mean±SD: 12.2215±4.233) and the values were found to be significantly reduced in OSMF subjects with a p value <0.05.



Graph I: Comparison of airway space volume in OSMF and non OSMF subjects

OSMF Grades	Mean Airway Volume (mm^3)	SD	P value
Grade I	7.23	0.95	.616,NS
Grade II	10.34	3.91	
Grade III	9.20	2.76	
Grade IV	12.04	11.91	

Table 2: Grade wise comparison of Airway Space among OSMF subjects



Graph II: Comparison of mean airway space volume among various grades of OSMF

Airway volume was assessed for any consistent change with increase in grades but no significant trend was observed.

DISCUSSION

This was a radiographic observational cross sectional study. CBCT scans were performed on Planmeca Romexis 3D machine. A total of 26 OSMF cases and age and sex matched, 26 non OSMF cases CBCT scans were performed and evaluated with an objective to study the CBCT changes in airway space. The pharyngeal airway space volume was measured for each OSMF subject and compared with non-OSMF subjects. To the best of our knowledge from literature search performed we can say that this study is the first to be conducted to find changes in airway in OSMF subjects on CBCT.

Khare P et al [6] published an article in which they mentioned that OSMF is a chronic disorder and has an illustrious presentation by limited mouth opening and fibrosis of the lining mucosa of the upper digestive tract involving the oral cavity, Oropharynx [OP] and commonly the upper third of the oesophagus. The fibrosis extending into Nasopharynx [NP]affects functions of Eustachian tube. Anatomically, the division

of pharyngeal airway is demarcated by NP, OP, and laryngeal pharynx. There are numerous articles on calculating airway volume in Oral sleep apnea disorder (OSAD) and other orthodontic malocclusion cases. There is no literature available to show any variation in the volume of the complex upper airway (restricted to NP and OP) in relation with OSMF patients. An important consideration is that OSMF may have limited mouth opening and as such may pose challenges in intubation. Retrograde intubation becomes method of choice in such circumstances. Diminished volume of NP, OP may be due to airway constriction complicating intubation procedures. So they proposed that OSMF changes may lead to alterations in NP, OP volume which can be assessed by Cone Beam Computed Tomography (CBCT) accurately [6].

Since it is already discussed that OSMF affects the soft palate by reducing the length and increasing the width and hence changes in soft palate dimensions can affect the airway. Also the disease affects the Eustachian tube and the oesophagus. As the mucosa of the oesophagus and oral cavity are similar, so the disease may, in same way affect the pharyngeal mucosa[7] thus affecting the airway tract structures and dimensions. Review of literature shows that OSMF is not only a potentially malignant disease of oral cavity but also may cause structural changes in surrounding orofacial structures. Involvement of airway may contribute to airway disorder like OSA. However, no studies have been been reported on the affect of OSMF on airway using CBCT.

Airway space volume measurements were 9.7019±3.97cm^3 for OSMF cases which was significantly reduced compared to non OSMF cases (12.2215±4.233 cm^3). Various authors have

reported airway volume in normal subjects. Weissheimer A et al [8] (9.407 cm^3) to compare imaging softwares however their measurements were based on phantom study. The values also differed from studies reported by El H and Palomo JM [9] (mean values: D3D-7444.37±3250.08 mm^3, OD3D program (4603.06±1741.03 mm^3)), Lenza MG [10] (mean values 8620.41±2938.49 mm^3), Alves Jr M et al in 2012[11] (mean values for group I was 7588.82± 1892.75 and for group II was 5561.92 ±1778.13mm^3). Their methodology and landmarks for airway measurements were different form our study. In a study by Burkhard JP et al [12] Class I malocclusion patients showed a mean: 14858 ± 5719 mm3 which was comparable with our control group.

Ours is the first study to report the changes in airway space volume in OSMF patients which was less than controls. However there was no definite increasing or decreasing trend in airway volume measurements with increasing grades of OSMF. The present study is the first of its kind to report orofacial changes in OSMF subjects by CBCT Imaging. For the first time changes in airway in OSMF patients are reported. The reduction in airway in OSMF as found in this study, adds another dimension of concern related to the damages caused by OSMF, other than oral cavity. So with the help of parameters used in this study risk of airway related diseases in OSMF patients may be evaluated.

Limitations of the study include small sample size and unequal number of patients are distributed in various grades of OSMF due to variations in reporting of cases for treatment and practical problems of stratified sample design. Few cases had Class III and rest had Class I molar relation. Position of landmarks for measurements was challenging in class III malocclusion patients due to considerable deviation in the position of the landmarks. It was also observed that the shape and the measurement of landmarks like “ANS”,“PNS” “anteroposterior part of third cervical vertebra” varied significantly. It may sometimes be blunt or pointed hence posed problems with consistency in locating theupper and lower limits of airway.

CONCLUSION:

Oral submucous fibrosis is a premalignant condition. It is disease which affects the oral cavity and associated structures (oropharynx) and affects a fine number of Indian population. The disease is multifactorial. The various etiologies include chillies, areca nut, misri and various nutritional deficiencies and genetic predisposition is also seen. When a person chews areca nut he or she also ingests some amount of the liquid juices or exracts of areca nut into the esophagus as a part of natural swallowing mechanism, so it can be hypothesized that the pharyngeal structures may also be affected. Effects of OSMF may be seen intraorally like stiffness of oral mucosa, reduction in movement of tongue and loss of papillation of tongue, marble like appearance and leathery texture of oral mucosa, shrunken uvula, burning sensation, ulceration, dysphonia and hearing impairment as well as extraorally like Prominent hypertrophic and stiff masseter, weight loss, nasal intonation of voice.

We hypothesized that these changes in OSMF can lead to reduction in airway space volume. So, volume of pharyngeal airway space were measured in OSMF subjects using full volume CBCT scan. It was found that reduction in airway space volume was statistically significant in OSMF subjects compared to age and sex matched non OSMF subjects attributed to trismus, fibrosis of uvula and effects on pharynx. Findings of airway volume changes on CBCT in OSMF subjects may suggest an impending OSA which can further be used for education and counseling of the patient.

No conflicts of interest.

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