



Morphological Variations of Soft Palate in OSMF Subjects: A 3D Radiographic Observational Study

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ABSTRACT

OSMF affects both the oral cavity and surrounding structures. As OSMF also affects the uvula or soft palate leading to alterations in its shapes, we have conducted this study to measure the length width of the soft palate and also made an attempt to measure the volume of the same as CBCT gives us the privilege to measure the structure three dimensionally. To evaluate soft palate morphology and dimensions in various stages of OSMF CBCT scans of subjects having Oral submucous fibrosis and having indications for CBCT scans for other dental purposes were chosen for this study and measurements of soft palate (length, vertical length, width and volume) were done. It was observed that length, vertical length was significantly reduced in osmf subjects while width and volume of soft palate was found to be significantly increased among OSMF cases 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 length and increasing the width and volume of the soft palate in oral submucous fibrosis subjects.

Keywords: OSMF; soft palate, CBCT.

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INTRODUCTION

(The oral cavity, which includes the buccal mucosa, tongue, lips, anterior faucial pillars, soft palate, and oropharynx, is affected by OSMF, a chronic, scarring condition. Soft palate morphological changes may start even before the disease manifests clinically. These modifications can cause sleep apnea, speech, swallowing, and breathing issues. To evaluate the soft palate and any changes in morphology, various radiographs are a valuable diagnostic tool. So, in this investigation, the dimensions of the soft palate were measured using CBCT [9].

MATERIAL AND METHODS

This was aradiographic observational study designed to analyze changes in soft palate in OSMF patients compared to normal controls as assessed by CBCT. 26 patients were selected after screening. Clinical examination of patients was done to diagnose OSMF following the Khanna JN and Andrade NN classification and subjects were included according to the inclusion and exclusion criteria. Age range was 20 -55 years. Control group of non OSMF subjects was selected from database. Both males and females were part of the study. Pregnant women and volunteers less than 20 yrs and more than 55 years old were excluded from the study.

For radiographic examination, Cone beam computed tomography machine Planmeca Promax 3D model with Field Of View upto 20×17 cm-more than 14 selectable FOVs, scanning time 18-26 seconds, voxel size 100-600 micrometers and a reconstruction time of 15 seconds was used. The sensor was flat panel type with available panoramic, 3D and cephalometric, 3D camera integrated programs with many modules. 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. A 20×17 mm field of view to include the entire craniofacial anatomy and a resolution of 200µm voxels was used. The voxels were isotropic. The Dose Area product (DAP) was 3610 mGy×cm². The patients were instructed to make an inspiration and hold their breath at the end of exhalation and remain still during the scanning period, not to swallow, keep their jaws at maximum intercuspation, place their tongue against the incisor teeth and not to move their heads or tongues their head. The parameters were measured using Romexis Programs software.

All length measurements were done in millimeters (mm) and the volume was measured in cubic centimeter (cm³).

For soft palate measurements, a slice thickness of 0.600mm was used. The section at which the largest visible length and width of the soft palate was used.

Length: For this two straight horizontal lines were drawn through the PNS and the tip of the soft palate and the distance was measured by drawing line from the PNS to the tip of soft palate.

Vertical length (VL): vertical distance between the two horizontal lines was measured.

Width: The linear measurement at thickest portion of soft palate and perpendicular to its length with thickest portion visible superoinferiorly and mediolaterally on the sagittal and coronal section, respectively was measured.

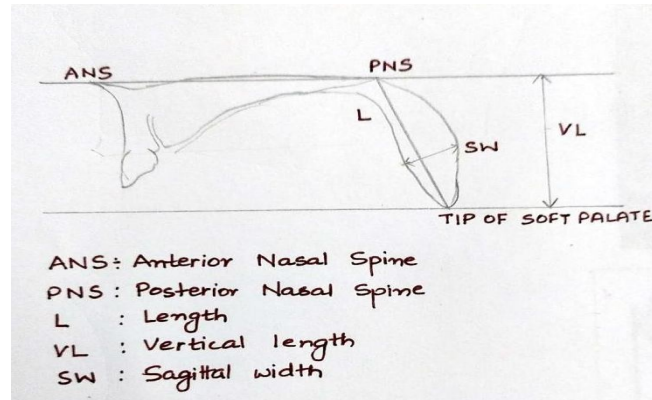


Figure 1: Measurements of soft palate on sagittal section

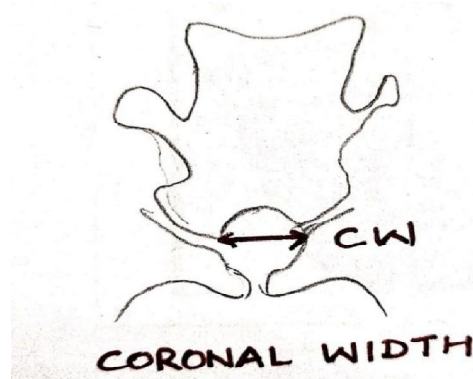


Figure 2: Measurement of width on coronal section.

Volume: The volume of the soft palate was defined as the product of the length, coronal width and sagittal width.

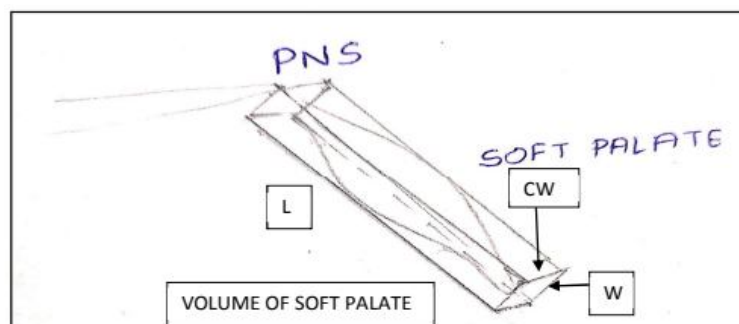


Figure 3: Measurement of volume of soft palate

RESULTS

Normality distribution was tested using the Shapiro-Wilk W test (p-value was more than 0.05) for mouth opening and soft palate. Independent t-test (2 groups) was used for unpaired groups. One way ANOVA was used for comparison of more than two groups. Post hoc Bonferroni test was used. Mann Whitney U test was used of unpaired data. Chi square test was used for categorical variables. A level of $p < 0.05$ was considered statistically significant.

In cases (osmf patients) (N=26) 22 were males and 4 were females whereas in control group (N=26) 20 were males and 6 were females.

Among the OSMF cases, the mean age of male was 35.45 ± 6.696 years and female was $33.25 \pm .957$ years. The comparison was done using independent t test and was not found to be significant ($p=0.524$). Among the controls, the mean age in male: 33.50 ± 7.970 years and female was 37.83 ± 11.873 years. The comparison was done using independent t test and was not found to be significant ($p=0.307$).

Mean mouth opening was compared for the cases across various grades of OSMF using one way ANOVA test. It was found to be significant. Mean Mouth opening of cases was 26.142 ± 7.605 mm.

On pair wise (post hoc Bonferroni) comparison, significant differences were seen among all the four grades. The mouth opening reduced with increase in grades. The difference between each group was statistically significant. Mean mouth opening of OSMF patients was less than normal mouth opening. The mouth opening reduced with increase in grades.

The length, vertical length, sagittal width, coronal width and volume of soft palate were measured for both OSMF cases and controls and the means were compared.

TABLE 1: COMPARISON OF SOFT PALATE AMONG OSMF CASES AND CONTROL:

	CASES		CONTROL		P VALUE
	MEAN	SD	MEAN	SD	
LENGTH	33.114	6.113	37.000	5.193	0.017*, SIG
VERTICAL LENGTH	27.262	5.971	32.185	4.829	0.002*, SIG
SAGITTAL WIDTH	9.296	1.607	9.142	1.215	0.699, NS
CORONAL WIDTH	14.604	4.143	10.235	2.887	0.001*, SIG
VOLUME(cm) ³	4.479	1.673	3.415	1.044	0.008*, SIG

INDEPENDENT T TEST^b, MANN WHITNEY U TEST^c, LEVEL OF SIGNIFICANCE SET AT $P < 0.05$
NS: NON SIGNIFICANT, SIG: SIGNIFICANT

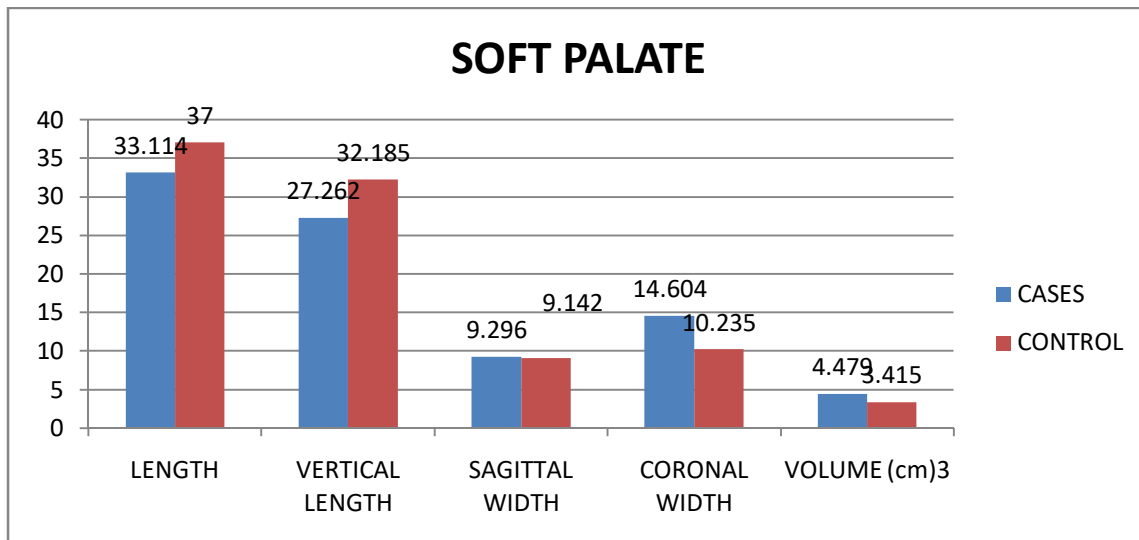
The length was compared among OSMF cases and controls using independent t test. It was found to be significantly higher among controls (mean±SD: 37 ± 5.193) as compared to OSMF cases (mean±SD: 33.114 ± 6.113) with p value 0.017.

The vertical length was compared among OSMF cases and controls using independent t test. It was found to be significantly higher among controls (mean±SD: 32.185 ± 4.829) as compared to OSMF cases (mean±SD: 27.262 ± 5.971) with p value of 0.002.

The coronal width was compared among OSMF cases and controls using independent t test. It was found to be significantly lower among controls (mean±SD: 10.235 ± 2.887) as compared to OSMF cases (mean±SD: 14.604 ± 4.143) with p value 0.001.

The volume was compared among OSMF cases and controls using Mann whitney U t test. It was found to be significantly lower among controls (mean±SD: 3.415 ± 1.044) as compared to OSMF cases (mean±SD: 4.479 ± 1.673) with p value 0.008.

Observation: The size measurements of soft palate were significantly altered in OSMF patients. The length and vertical length were reduced significantly whereas the coronal width and volume were significantly higher in OSMF cases than controls. However, the width values on sagittal sections of OSMF cases remained same as that of controls.



Graph I : Comparison of soft palate among osmf cases and controls

Also the values for measurements of soft palate were compared among grades of OSMF. The length of soft palate was found to decrease with increase in grades with a significant p value of 0.042. However the vertical length was also observed to decrease with increasing grade but the values were not statistically significant.

Other parameters like sagittal and coronal width and volume of soft palate did not show any consistent changes in their values.

TABLE 2: COMPARISON OF SOFT PALATE AMONG VARIOUS GRADES OF OSMF:

SOFT PALATE	OSMF GRADES	N	Mean	SD	P value
Length	GRADE I	2.00	40.20	4.24	0.042*, SIG
	GRADE II	10.00	35.69	5.17	NA
	GRADE III	12.00	30.50	5.88	
	GRADE 1V	2.00	28.84	3.16	
Vertical length	GRADE I	2.00	32.60	6.79	.087, NS
	GRADE II	10.00	29.74	4.47	
	GRADE III	12.00	25.18	6.31	
	GRADE 1V	2.00	22.00	1.41	
Sagittal width	GRADE I	2.00	8.05	1.06	0.531, NS
	GRADE II	10.00	9.46	1.87	
	GRADE III	12.00	9.53	1.49	
	GRADE 1V	2.00	8.30	1.27	
Coronal width	GRADE I	2.00	11.50	6.93	.625, NS
	GRADE II	10.00	15.67	4.75	
	GRADE III	12.00	14.33	3.30	
	GRADE 1V	2.00	14.00	5.09	
Volume	GRADE I	2.00	3725.04	2324.49	0.338
	GRADE II	10.00	5184.28	1676.84	
	GRADE III	12.00	4215.03	1606.40	
	GRADE 1V	2.00	3295.82	1061.70	

DISCUSSION

This is one of the few studies to report changes in soft palate (length, width and volume) on CBCT in OSMF patients.

Mean values of length, vertical length, sagittal and coronal width in OSMF cases were 33.114±6.113mm, 27.262±5.971mm, 9.296±1.607mm, 14.60±4.14mm and in control group were 37.00±5.193mm, 32.185±4.829mm, 9.142±1.215mm and 10.23±2.887mm respectively. In OSMF cases the length and vertical length decreased and coronal width increased significantly as compared to controls. There was a decreasing trend in length and vertical length of soft palate with increase in grades of OSMF (length in accordance with increase in grades: 40.20<35.69<30.50<28.84mm, vertical length: 32.6<29.7<25.1<22

mm). Our results were in accordance with Shankar VN et al [1] (mean length in Case group: Type 1-31.85 mm, Type 2-35mm, Type 3-26.86 mm, Type 4-24 mm and Type 6-30.25 mm and in control group for Type 1-36.72 mm, Type 2- 36.44 mm, Type 3-30.22 mm, Type 4-35.72 mm, Type 5-33.1 and Type 6-32.83 mm and mean width- study group 10.38 mm for type 1 , 7.50 mm for type 2, 12.43 mm for type 3 and 9 mm for type 4 soft palate. Type 6 soft palate had 10.75 mm and for Control group was 9.62 mm, 8.10 mm, 11.59 mm, 5.58 mm, 8.03 mm and 9.45 mm for Type 1, 2, 3, 4, 5, and 6 soft palates respectively), Tekchandani V et al [2] (mean length in Type 1 soft palate was 28.05 mm in OSMF group and 35.51 mm in control group, Type 2 was only measured in control group and it was 36mm in dimensions, Type 3 measured 24.29 mm in OSMF and 31.25 in control group, Type 4 measured 25mm in OSMF and 35mm in control group, Type 5 was 26mm in dimension in OSMF and 31mm in control group and Type 6 was 23.33mm in dimension in OSMF subjects and 34mm in control group, values for width in Type 1 soft palate were 11.77 mm in OSMF group and 11.01mm in control group, Type 2 was only measured in control group and it was 8.5mm in dimensions, Type 3 measured 12.29 mm in OSMF and 11.5 in control group, Type 4 measured 13 mm in OSMF and 7 mm in control group, Type 5 was 11 mm in dimension in OSMF and 9.5 mm in control group and Type 6 was 10.88 mm in dimension in OSMF subjects and 10 mm in control group).

The following studies also showed decrease in length, increase in width values Deshmukh RA et al [3] (mean length in OSMF group was 32.7 ± 4.02 mm and in normal group it was 34.4 ± 4.65 mm and width in OSMF group was 10.9 ± 1.54 and in normal group was 8 ± 0.96 mm), Khare P et al [4] and in contrast with the values found by Nerkar A et al [5] (mean length in OSMF group was 22.43mm and 24.47mm in control group and width was 23.91 and 21.96 in OSMF and control groups) and Pradhan L et al [6] (mean length was 26.82 ± 4.77 in OSMF group whereas in the subjects without OSMF the mean score was 33.62 ± 2.67 and width was 7.80 ± 1.77 in OSMF subjects whereas in the subjects without OSMF the mean score was 9.34 ± 1.42).

For the first time we are reporting coronal width measurements in OSMF as well as normal subjects. The volume of soft palate was calculated using length, sagittal width and coronal width (product of the three values). It was found to increase in OSMF cases (4.479 ± 1.673 cm³) compared to control group subjects (3.415 ± 1.044 cm³). However there is no reported literature on volume of OSMF.

Celiker FB et al [7] have reported volume of soft palate in mild and severe OSAS patients compared with normal subjects. They used Multi-Planar Reformat (MPR) Roy free measurement technique to measure the volume of soft palate on MRI⁷ while our study measured the volume using product of three measurements which can give a rough estimate of the volume which may be evaluated with precise 3D volume measurements in the future. Disappearance of the uvula can be attributed to extensive fibrosis leading to retraction which may be one of the reasons for changes in linear and volume measurements in our study [8]. Also an increase in coronal width found in our study would have also influenced the increase in volume. The length and width were affected so also the volume in our study. The shape type distribution was compared using chi square test among cases and controls. It was not found to be significant. OSMF case group consisted of 7(26.9%) Type 1, 7 (26.9%) Type 2, 6 (23.1%) Type 3, 1 Type 4 (3.8%), 3 Type 5 (11.5%) and 2 (7.7%) in Type 6.

Control group consisted of 9(34.6%) Type 1, 8 (30.8%) Type 2, 3 (11.5%) Type 3, 2 Type 4 (7.7%), 3 Type 5 (11.5%) and 1 (3.8%) in Type 6.

CONCLUSION

Our study highlighted the various morphological occurrences and dimensions of soft palate using CBCT. Thus, we can conclude that oral submucous fibrosis affects the morphology and dimensions of soft palate thus reducing its length and increasing the width of the same. An increase in volume was observed in OSMF cases.

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