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Original Article

A Radiographic Assessment of Morphological Diversity of Soft Palate in Darbhanga (Bihar) Population: An Original Research

Abhijeet Alok[1], Shivani Singh[2], Mallika Kishore[3], Kumar Piyush[4], Anjani Kumar Shukla[5]

[1]Reader, Department of Oral Medicine and Radiology, Sarjug Dental College and Hospital, Darbhanga, Bihar, India, [2]Senior Lecturer, Department of Public Health Dentistry, Dr. B. R. Ambedkar Institute of Dental Sciences and Hospital, Patna, Bihar, India, [3]Senior Lecturer, Department of Oral Medicine and Radiology, Inderprastha Dental College and Hospital, Ghaziabad, Uttar Pradesh, India, [4]Senior Lecturer, Department of Conservative Dentistry and Endodontics, Sarjug Dental College and Hospital, Darbhanga, Bihar, India, [5]Tutor, Department of Oral Medicine and Radiology, Dental Institute, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

Abstract

Introduction: Soft palate (velar) plays an important function in head and neck region. Its diverse morphology is implicated in various diseases.

Aims and Objectives: The aim of this study was to evaluate the morphological variants of soft palate in each group of normal, oral submucous fibrosis, and obstructive sleep apnea (OSA) patients. The objective of this study was to evaluate the morphologic variations of velar using digital lateral cephalogram.

Materials and Methods: This study was conducted in the department of oral medicine and radiology and department of public health dentistry. Three groups were made, each of 50 patients. The soft palate morphology was evaluated according to the classification given by You *et al*.

Statistical Analysis: The collected data were subsequently processed and analyzed using the SPSS statistical package version 17.

Results: We found that most common soft palate morphology in Group I was rat-tail, whereas in Group II and Group III, the most common morphology was leaf shape.

Conclusion: Soft palate has different morphology. It may help in successful functional and structural repair in cleft palate cases and shed some light toward the cause of OSA and related disorders.

Key words: Lateral cephalogram, Morphology, Obstructive sleep apnea, Oral submucous fibrosis, Soft palate

INTRODUCTION

Soft palate (velar) is a fibromuscular portion situated posterior to the hard palate. Soft palate separates nasopharynx from the oropharynx.[1] Soft palate is derived from three palatal processes (two palatal processes and one frontonasal process). Later, mesoderm undergoes intramembranous ossification to form hard palate. Ossification does not extend to most posterior portion, which, in turn, remains soft, hence soft palate. Soft palate plays an important role in velopharyngeal closure and thus helps in sucking, deglutition, respiration, pronunciation, and phonation too. Clinical visualization of soft palate becomes inadequate due to limited accessibility of the velopharyngeal region. Hence, it becomes very important to use other diagnostic methods to access the morphology of soft palate.

The morphology of soft palate plays an important role in normal functional anatomy of upper airway and velopharyngeal incompetence. Short soft palate has been considered as one of the etiological factors of

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Corresponding Author: Dr. Shivani Singh, C/O Dr. I. D. Singh, H/O Mr. R. K. Safi, Road No. 2 East, Ayachigram Colony, Near Bank of India, Near Bairia Bus Stand, Paigambarpur Kolhua, Muzaffarpur - 843 108, Bihar, India.

velopharyngeal incompetence.[2] Patients diagnosed with enlarged adenoids, obstructive sleep apnea (OSA), and oral submucous fibrosis (OSMF) have shown palatopharyngeal deficit.[3,4] Change in the morphology of soft palate has been seen in patients suffering from OSMF. Various stages of OSMF show different morphology of soft palate than seen in normal individuals.

OSA is a sleeping disorder characterized by cessation of breathing during due to collapse of the upper airways. This leads to partial or complete pause in breathing for a minimum period of 10 s. Velopharyngeal incompetence occurs due to failure of separation of two cavities by velum and lateral and posterior pharyngeal wall. This incompetence may lead to OSA.[5]

Many studies have been done to check the dimensions of soft palate and its correlation with OSA and OSMF patients. Very few researches are there which emphasize on the morphology of soft palate.[5] Hence, this study was planned to check for soft palate morphology in Darbhanga (Bihar) population using lateral cephalogram.

MATERIALS AND METHODS

This study was conducted in the department of oral medicine and radiology and department of public health dentistry. Three groups were made. Group I comprised normal individuals who visited dental outpatient department (OPD) for one or other dental treatment. Group II comprised OSMF patients and Group III had patients diagnosed with OSA. 50 subjects were considered in each group. Hence, a total of 150 sample sizes were studied in this study. Informed consent was taken from each and every patient. This study was approved by the ethical committee of the institute. All lateral cephalogram radiographs were obtained from Genoray Papaya Plus Extor-C digital panoramic system using standard exposure parameters as recommended by the manufacturer. All images were taken by same radiologist following a standardized protocol for patient positioning and exposure parameter settings. All radiographs were analyzed by the same radiologist. No intraobserver variability was assessed. Assessment of radiographs was made digitally. No alteration of image was done digitally to facilitate better visibility. Morphology of soft palate was classified according to the classification given by You *et al*.[3] The classification of soft palate is as follows [Figure 1]:

- Type 1: Leaf/lanceolate shaped: The middle portion of the soft palate elevated to both nasal and oral sides
- Type 2: Rat-tail shaped (RAT): The soft palate showing inflated anterior portion and free margin with an obvious coarctation
- Type 3: Butt like: The soft palate showing a shorter and fatter velum appearance with no distinct difference of width of the anterior portion to the free margin
- Type 4: Straight line shaped
- Type 5: S-shaped/distorted soft palate
- Type 6: Crooked appearance: The soft palate with posterior portion crooks anterosuperiorly.

The morphology of soft palate was seen on lateral cephalogram. OSMF patients were diagnosed according to the classification given by Nagesh and Bailoor on clinical features.[6]

The collected data were subsequently processed and analyzed using the SPSS statistical package version 17. Chi-square test was applied to test the significance of the study. $P < 0.05$ is considered to statistically significant. In our study, we observed $P < 0.001$ which showed the study was highly statistically significant.

RESULTS

The result of the present study showed that in Group I (normal individuals) had rat-tail shape of soft palate in maximum subjects (18, 36%). Rat-tail shape of soft palate was followed by leaf- or lanceolate-shaped soft palate (12, 24%), butt shape (8, 16%), straight shape (6, 12%), crooked shape (4, 8%), and S shaped (2, 4%). In group II, most common morphology was leaf type (16, 32%). Leaf-type

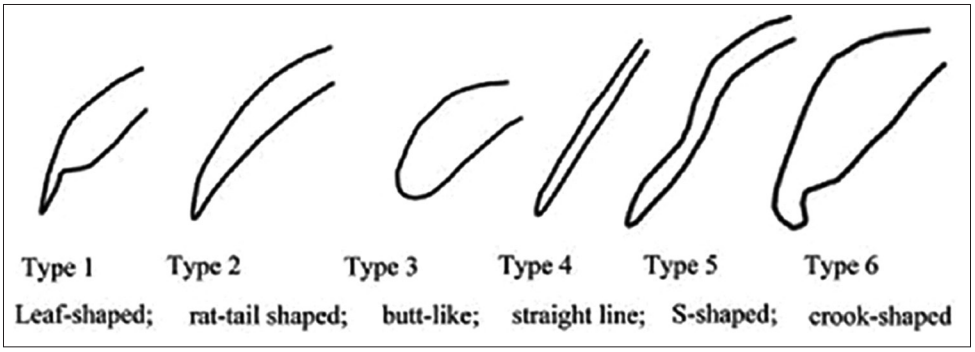


Figure 1: Morphology of various soft palate

morphology was followed by butt shape (14, 28%), crooked shape (9, 18%), rat-tail shape (6, 12%), S shape (4, 8%), and straight shape (1, 2%). In Group III, the most common morphology of soft palate observed was of leaf-type soft palate (28, 56%), followed by crooked shape (10, 20%), butt shape (5, 10%), rat-tail shape (4, 8%), S shape (2, 4%), and straight shape (1, 2%). Overall, of 150 subjects, the most common soft palate morphology observed was of leaf type followed by rat-tail shape, butt shape, crooked shape, straight shape, and S shape [Table 1].

Gender comparison showed that males were more in number in all three groups. In Group I, 30 males were present. In Group II, 31 males were present, and in Group III, 36 males and 14 females were present. In males, in Group I, the most common morphology of soft palate was RAT, followed by leaf shape, butt shape, straight shape, crooked shape, and S shape. In Group II, the most common soft palate morphology in males was of Type 1 followed by Type 3, Type 2, Type 6, and then Type 5. No Type 4 morphology was seen in Group II male patients. In females, the most common morphology was of Type 3. In Group III, the most common velar morphology was of leaf shape (Type 1), followed by crooked-shaped soft palate (Type 6), butt shape (Type 3), rat shaped (Type 2), S shaped (Type 5), and straight shape (Type 4) [Graph 1 and Table 2].

Table 1: Distribution of various types of soft palate in three groups

Type	Group I, *n* (%)	Group II, *n* (%)	Group III, *n* (%)	Total
Leaf	12 (24.0)	16 (32.0)	28 (56.0)	56
Rat	18 (36.0)	6 (12.0)	4 (8.0)	28
Butt	8 (16.0)	14 (28.0)	5 (10.0)	27
Straight	6 (12.0)	1 (2.0)	1 (2.0)	8
S shaped	2 (4.0)	4 (8.0)	2 (4.0)	8
Crooked	4 (8.0)	9 (18.0)	10 (20.0)	23
Total	50 (100.0)	50 (100.0)	50 (100.0)	150

χ^2=34.327; df=10; *P*<0.001; highly significant. Group I versus II: χ^2=14.369; df=5; *P*=0.013; significant, Group I versus III: χ^2=22.144; df=5; *P*<0.001; highly significant, Group II versus III: χ^2=8.655; df=5; *P*=0.124; not significant

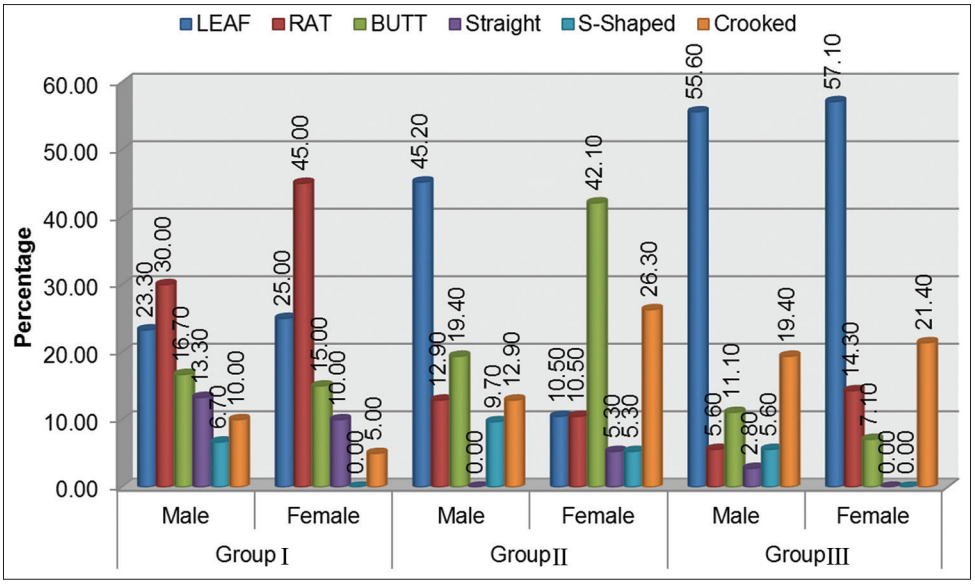
In females, the most common morphology of soft palate was rat-tail shape in Group I, butt shape in Group II, and leaf shape in Group III. No S-shaped morphology of soft palate was observed in females of Group I. Straight shape and S shape of soft palate was not present in any females [Graph 1].

Among the age group, the most common age group seen in Group I was <30 years of the age group where 44 subjects were present. In Group II, the most common age group was of 31–40 years, whereas in Group III, the most common age group was of individuals more than 40 years.

In Group I, the most common soft palate morphology seen in the age group of ≤30 years was rat-tail followed by leaf shape, butt shape, straight shape, crooked shape, and S shape. In Group II, the most common morphology seen in the most common age group was butt shape, then leaf shape, crooked shape, S shape, rat-tail shape, and straight shape. In Group III, the most common morphology noted was leaf shape, followed by rat-tail shape, crooked shape, butt shape, S shape, and straight shape [Graph 2 and Table 3].

DISCUSSION

Advanced diagnostic imaging techniques such as magnetic resonance imaging and fluoroscopy are now available



Graph 1: Association of gender with type of palate in three groups

Table 2: Association of gender with type of palate in three groups

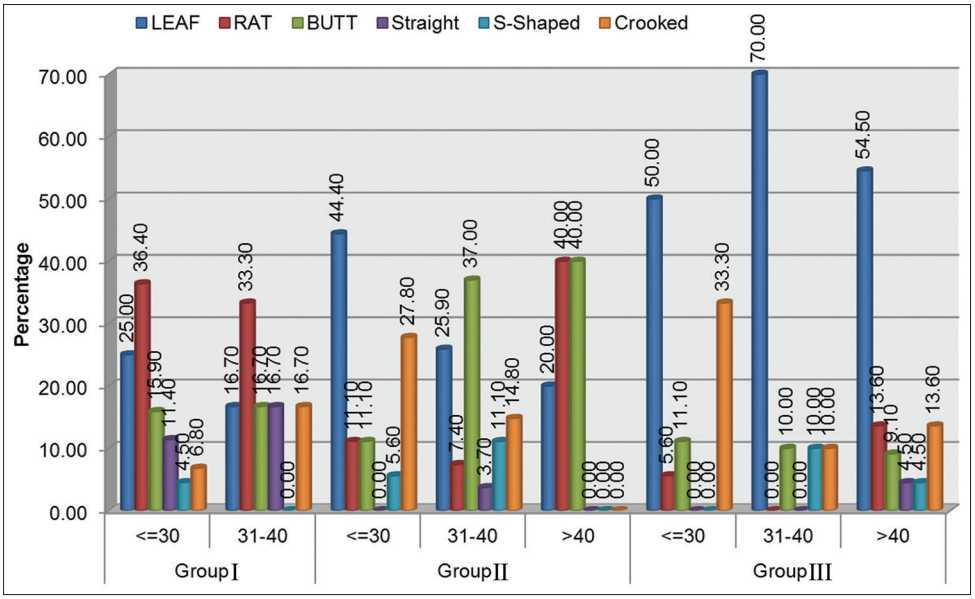
Group	Gender	Leaf	Rat	Butt	Straight	S shaped	Crooked	Total	*P*
Group I	Male, *n* (%)	7 (23.3)	9 (30.0)	5 (16.7)	4 (13.3)	2 (6.7)	3 (10.0)	30 (100.0)	0.761; NS
	Female, *n* (%)	5 (25.0)	9 (45.0)	3 (15.0)	2 (10.0)	0 (0.0)	1 (5.0)	20 (100.0)	
	Total, *n* (%)	12 (24.0)	18 (36.0)	8 (16.0)	6 (12.0)	2 (4.0)	4 (8.0)	50 (100.0)	
Group II	Male, *n* (%)	14 (45.2)	4 (12.9)	6 (19.4)	0 (0.0)	3 (9.7)	4 (12.9)	31 (100.0)	0.083; NS
	Female, *n* (%)	2 (10.5)	2 (10.5)	8 (42.1)	1 (5.3)	1 (5.3)	5 (26.3)	19 (100.0)	
	Total, *n* (%)	16 (32.0)	6 (12.0)	14 (28.0)	1 (2.0)	4 (8.0)	9 (18.0)	50 (100.0)	
Group III	Male, *n* (%)	20 (55.6)	2 (5.6)	4 (11.1)	1 (2.8)	2 (5.6)	7 (19.4)	36 (100.0)	0.805; NS
	Female, *n* (%)	8 (57.1)	2 (14.3)	1 (7.1)	0 (0.0)	0 (0.0)	3 (21.4)	14 (100.0)	
	Total, *n* (%)	28 (56.0)	4 (8.0)	5 (10.0)	1 (2.0)	2 (4.0)	10 (20.0)	50 (100.0)	

NS: Not significant

Table 3: Age-wise distribution of morphology of soft palate in three groups

Group	Age (years)	Leaf	Rat	Butt	Straight	S shaped	Crooked	Total	*P*
Group I	≤30, *n* (%)	11 (25.0)	16 (36.4)	7 (15.9)	5 (11.4)	2 (4.5)	3 (6.8)	44 (100.0)	0.944; NS
	31–40, *n* (%)	1 (16.7)	2 (33.3)	1 (16.7)	1 (16.7)	0 (0.0)	1 (16.7)	6 (100.0)	
	Total, *n* (%)	12 (24.0)	18 (36.0)	8 (16.0)	6 (12.0)	2 (4.0)	4 (8.0)	50 (100.0)	
Group II	≤30, *n* (%)	8 (44.4)	2 (11.1)	2 (11.1)	0 (0.0)	1 (5.6)	5 (27.8)	18 (100.0)	0.301; NS
	31–40, *n* (%)	7 (25.9)	2 (7.4)	10 (37.0)	1 (3.7)	3 (11.1)	4 (14.8)	27 (100.0)	
	>40, *n* (%)	1 (20.0)	2 (40.0)	2 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (100.0)	
	Total, *n* (%)	16 (32.0)	6 (12.0)	14 (28.0)	1 (2.0)	4 (8.0)	9 (18.0)	50 (100.0)	
Group III	≤30, *n* (%)	9 (50.0)	1 (5.6)	2 (11.1)	0 (0.0)	0 (0.0)	6 (33.3)	18 (100.0)	0.651; NS
	31–40, *n* (%)	7 (70.0)	0 (0.0)	1 (10.0)	0 (0.0)	1 (10.0)	1 (10.0)	10 (100.0)	
	>40, *n* (%)	12 (54.5)	3 (13.6)	2 (9.1)	1 (4.5)	1 (4.5)	3 (13.6)	22 (100.0)	
	Total, *n* (%)	28 (56.0)	4 (8.0)	5 (10.0)	1 (2.0)	2 (4.0)	10 (20.0)	50 (100.0)	

NS: Not significant



Graph 2: Age-wise distribution of morphology of soft palate in three groups

worldwide for imaging of soft palate, but still, lateral cephalogram is preferred imaging technique for the analysis of soft palate. Lateral cephalogram is preferred due to its easy accessibility, economical, and relatively good assessment of soft tissue.[7] Lateral cephalogram can give quantitative assessment of the pharyngeal depth and palatal inclination in the form of velum angle, pharyngeal depth, and Need's ratio. All these features make lateral cephalogram, a preferred choice of imaging technique for soft palate.

Various studies done on different populations worldwide showed that the most common soft palate morphology was Type 2, i.e., rat morphology.[2,8] The study done on North Indian subpopulation showed leaf shape as the most common morphology.[9] In our study done on Darbhanga

(Bihar) population, overall considering all three groups, the most common morphology was leaf type, followed by rat-tail shape, butt shape, crooked shape, straight shape, and S shape. However, in Group I, rat-tail was the most common morphology, and in Group II and Group III, the most common morphology found was leaf or lanceolate type. This is the only study done till date in this region. No study on soft palate morphology has been reported in northern Bihar till now.

This study was planned to do a comparative analysis of three groups comprising normal individuals, OSMF, and OSA diagnosed patients. In Group I, most common morphology found was rat tail shape. This result of Group I coincides with the result of Garg and Kapoor and Upadhyay *et al*.[2,10] However, the study was done by You *et al*. and Elkunchwar *et al*. showed leaf morphology as most common.[6,11] This difference in result may be due to the fact that most of our study subjects in Group I had malocclusion requiring orthodontic treatment.

In our study, we did not categorize OSMF patients to various stages based on clinical features or habits. We found that the most common velar morphology in Group II was Type 1. Studies were done by Patil *et al*. and Shankar *et al*. on OSMF patients showed that the most common velar morphology was Type 6.[12,13] The difference in our result may be due to increased percentage of OSMF patients in Stages 2 and 3 in studies conducted by Patil *et al*. and Shankar *et al*. as it has been seen that as disease progresses, morphology of soft palate changes from long and narrow to short and thick.

In Group III, the most common velar morphology was Type 1, i.e., leaf type. The result of the present study on OSA patients coincides with the study conducted by Ara *et al*.[5] Pharyngeal morphology (size and shape) undergoes changes with the progression of age. This may explain increased incidence of sleep disorders like OSA in later part of life.[14] Pépin *et al*. conducted a study to observe that curving of soft palate leads to abrupt reduction in oropharyngeal dimension. This reduction leads resistance in upper airway finally culminates into airway collapse.[15]

Therefore, this study was conducted to show different type of soft palate morphology in normal individuals, OSMF patients, and OSA diagnosed patients. This is the only study done on three different categories of subjects using lateral cephalogram. However, further studies are recommended with larger sample size so that radiographic assessment of morphological diversity of soft palate can be done.

CONCLUSION

All the six types of soft palate are normal variant of soft palate which can be diagnosed on lateral cephalogram. Velar morphology is not fixed. It keeps changing with the age. Morphology of soft palate which was present during adolescent need not be present in older age group. Morphology of soft palate should be studied because morphology of soft palate is an etiologic factor in various disorders like OSA. Hence, oral and maxillofacial radiologists can play a key role in diagnosis of various disorders by evaluating velar morphology.

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