Digital cephalometric study of the soft palate to observe its morphological variations.

[1]Dr.Anuraj Singh Kochhar, BDS, MDS, WFO fellow Orthodontics & Dentofacial Orthopedics Private Practionner

[2]Dr.Ritasha Bhasin, Idapp student Faculty of Dentistry University of Toronto Canada

[3]Dr.Gulsheen Kaur Kochhar, BDS, MDS, Reader, Pediatric & Preventive Dentistry National Dental College & Hospital Dera Bassi, Punjab.

[4]Dr. Vishu Midha, BDS, MDS, Pediatric & Preventive Dentistry Private Practionner

[5]Dr. Preetinder Singh, BDS, MDS, Professor, Periodontology and Oral Implantology, Swami Devi Dyal Hospital & Dental College Barwala, Panchkula, Haryana.

[6]Dr. Annupriya Sikri, BDS, MDS, Reader, Pediatric & Preventive Dentistry, National Dental College & Hospital, Dera Bassi,Punjab.

Correspondence Author: Dr. Gulsheen Kaur Kochhar, BDS, MDS, Pediatric & Preventive Dentistry Reader, National Dental College & Hospital Dera Bassi, Punjab.

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Abstract

The soft palate participates in most oral functions. Continued efforts toward the dimensional analysis of the soft palate and its surrounding structures have been made little attention has been paid to the variety of soft palate morphology and configuration. Aim of the study was to investigate the variation of soft palate morphology in normal individuals who came to the department for orthodontic consultation/ treatment. This study can be helpful for understanding the various morphologies of the soft palate in the median sagittal plane on lateral cephalogram. 182lateral cephalograms of normal north Indian subjects (95 men and 87 women, with age ranging 13–30 years) were gathered from O P D of Orthodontics and Dentofacial Orthopaedics department. All lateral cephalograms were taken using a PLANMECA DIGI ProMax (PLANMECA USA) in a natural head position. In conclusion, the morphology of the soft palate can be divided into seven types according to their features on lateral cephalometry. This classification can help us better understand the diversity of the velar morphology in the median sagittal plane. These findings can be used as references for the research of velopharyngeal closure in cleft palate individuals and for aetiological research of OSAS and other conditions.

Keywords: Soft Palate, Lateral Cephalometry, PLANMECA DIGI Pro-max

Introduction

The soft palate is the posterior fibro-muscular part of the palate that is attached to the posterior edge of the hard palate.[1] It participates in most oral functions, especially velopharyngeal closure which is related to the normal functions of sucking, swallowing and pronunciation.[2] Early references concerning the objective measurements of the soft palate have been contributed by investigators interested in speech function and upper airway structures.[3-8]

Although these continued efforts toward the dimensional analysis of the soft palate and its surrounding structures have been made, little attention has been paid to the variety of soft palate morphology and configuration. By observing the image of the soft palate on lateral cephalometry, we noticed that the configuration of the soft palate presented variously in normal individuals.

It was irrational to describe the morphology of the soft palate as only one kind in the published literature. Pepin et al[9] found the ''hooked'' appearance of the soft palate in awake patients, which indicated a high risk for obstructive sleep apnoea syndrome (OSAS).The hooked appearance of the soft palate has also been observed in our current study and was described as ''S-shaped'' in our classification. However, in our review of the literature we did not find that the other types that we observed were described by other investigators.

Aim of the study was to investigate the variation of soft palate morphology in normal individuals who came to the department for orthodontic consultation/ treatment.

This study can be helpful for understanding the various morphologies of the soft palate in the median sagittal plane on lateral cephalogram. It is hoped that these findings may be used not only as references for normal soft palate, but for cleft reconstruction and the aetiological research of OSAS and other conditions.

Materials and methods

182 lateral cephalograms of normal north Indian subjects (95 men and 87 women, with age ranging 13–30 years) were collected.(figure 1) All subjects had normal speech function and none had any history of cleft palate or systemic diseases, nor diseases or fracture of the head and neck. All lateral cephalograms were taken using a PLANMECA DIGI ProMax (PLANMECA USA) in a natural head position.

The tube potential was adjusted to optimize the contrast of both hard and soft tissues (68-72 kV depending on patients age).(figure 2)

Digital radiographs were processed by the Planmeca Romexis Viewer software and studied. (figure 3) All of the radiographs were observed and categorized into seven types by two observers who did the assignment separately. Since there was no difference in their classification, reliability was considered to be more than adequate for the purpose of this study.

Results

By observing the image of the velum on lateral cephalograms, the soft palate was classified into seven types on the basis of the various radiographic appearances. The image and line drawing of each type are given in Figures 4–10. All 182 subjects were categorized according to the radiographic features in the above mentioned figures.

Type 1 ''leaf shape'', which was lanceolate, indicated that the middle portion of the soft palate elevated to both the naso- and the oro-side.

Type 2 when the soft palate showed that the anterior portion was inflated and the free margin had an obvious coarctation , the radiographic appearance was described as having a ''rat-tail shape''

Type 3 ''butt-like'' soft palate showed a shorter and fatter velum appearance, and the width had almost no distinct difference from the anterior portion to the free margin. The length of the soft palate in this type is about a third to three-quarters of that of the leaf shape. The width has almost no distinct difference from the anterior portion to the free margin

Type 4 indicated that the image of the soft palate presented a ''straight line shape''

Type 5 the distorted soft palate, presented the S-shape

Type 6 revealed a ''crook'' appearance of the soft palate, in which the posterior portion of the soft palate crooks anterio-superiorly.

Type 7 indicated soft palate morphology that could not be grouped under any other. (Miscellaneous)

The data was collected and analyzed.(table 1)

Morphology of soft palate							
	Type 1 Leaf Like	Type 2 Rat Tail	Type 3 Butt like	Type 4 Straight line	Type 5 S shape	Type 6 Crook shape	Type 7 Miscellaneous
N	82	30	20	14	12	10	14
Proportions(%)	45.6%	16.4%	10.9%	7.6%	6.5%	5.4%	7.6%

Table 1: Distribution and proportion of different types of soft palate

Discussion

Cephalometric analysis is one of the most commonly accepted techniques for evaluating the soft palate in both normal individuals and those with cleft palate. Cephalometry is a relatively inexpensive method and permits a good assessment of the soft tissue elements that define the soft palate and its surrounding structures. [7]

Morphometric assessment of the nasopharynx or the configuration of adjacent structures can be defined interims of depth and height in the median sagittal plane on lateral cephalogram. The dimensional analysis of the soft palate and its surrounding structures, especially the velar length and width, has been studied by many investigators.

However, the variety of velar morphology, which has been ignored in the past, is logically responsible for the significantly different dimensions on soft palate, such as velar length and width. The digital radiographic technique, used in the current study, is based on the principle of slit radiography. We were able to take the image scanning from posterior to anterior in the sagittal plane, and adjust and optimize the contrast and the gradation with professional software. Therefore, the soft palate appearance and diagnostic information can be enhanced and elicited, which benefits the investigation and measurement.[10]

In our study, the leaf-shaped soft palate was the most frequent type 1 (82 cases) which is an expected finding since this type was previously described as a classic velar morphology in the literature. While the crook shape was seen in only (10 cases) cases and was not found in the adult group, it can be supposed that the number of subjects in the investigation was not large enough. The S-shape, which was described as a hooked appearance of the soft palate by Pepin et al,[9] was found in (12 cases)cases in our study. Hooking of the soft palate was defined in their study as an angulation of about 30°between the distal part of the uvula and the longitudinal axis of the soft palate.[9] They hypothesized that soft palate hooking plays a key role in pharyngeal collapse, since hooking results in a sudden and major reduction in the oropharyngeal dimensions, which therefore dramatically increases upper airway resistance and the transpharyngeal pressure gradient. Pepin et al[9] therefore concluded that hooking of the soft palate in awake patients indicates a high risk for OSAS.

Much of the former research that studied the soft palate and its surrounding structures was aimed at providing some information on diagnosis, prediction and treatment in individuals with cleft palate. The soft palate plays a large role in velopharyngeal closure, which refers to the normal apposition of the soft palate with the posterior and lateral pharyngeal walls. It is primarily a sphincteric mechanism consisting of velar and pharyngeal components. The movement separates the oral cavity from the nasal cavity during deglutition and speech. When the velum and lateral and posterior pharyngeal walls fail to separate the two cavities, velopharyngeal incompetence(VPI) occurs. A short soft palate is absolutely one of the important aetiologies of VPI.[2]

According to Cohen et al even after closure of the softtissue defect in patients with cleft palates, normal function of the soft palate is frequently not achieved.[11]The variation of the soft palate morphology may be anew explanation for surgical failure and the soft palate should be repaired in various patterns.

Conclusion

In conclusion, the morphology of the soft palate can be divided into seven types according to their features on lateral cephalometry. This classification can help us better understand the diversity of the velar morphology in the median sagittal plane. These findings can be used as references for the research of velopharyngeal closure in cleft palate individuals and for aetiological research of OSAS and other conditions.

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Figure Legends

Figure 1: Cephalogram taken in natural head position

Figure 2: Tube potential according to different parameters

	Type 1 Leaf Like	Type 2 Rat Tail	Type 3 Butt like	Type 4 Straight line	Type 5 S shape	Type 6 Crook shape	Type 7 Miscellaneous
							Morphology of soft palate
N	82	30	20	14	12	10	14
Proportions(%)	45.6%	16.4%	10.9%	7.6%	6.5%	5.4%	7.6%

Figure 3: Digital radiographs processed by the Planmeca Romexis Viewer software
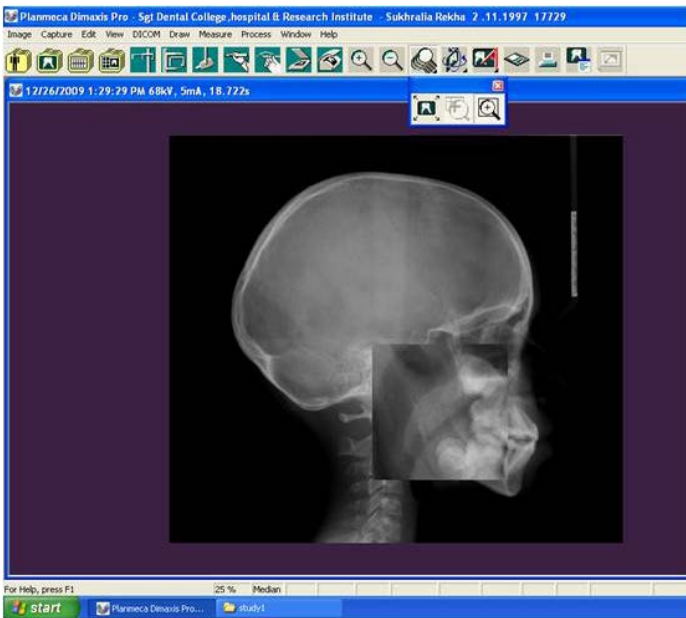
Figure 4: Type 1-leaf shape
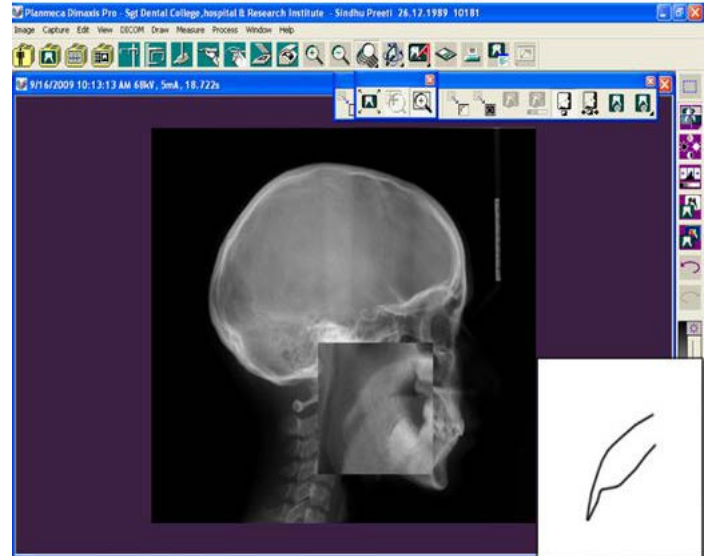
Figure 5: Type2 -rat tail shaped
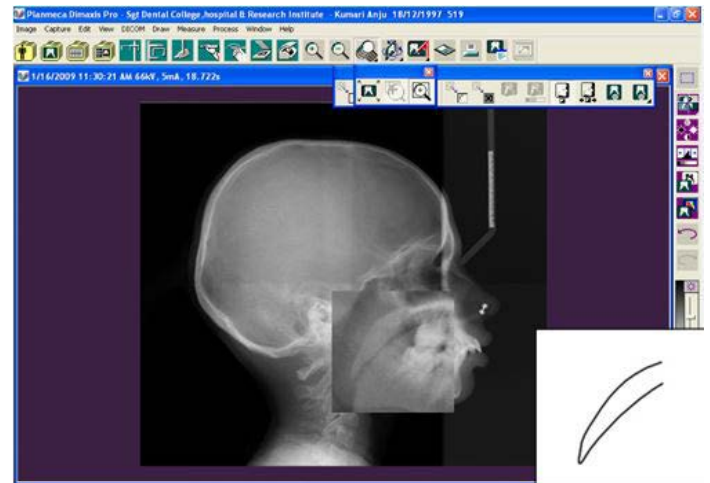
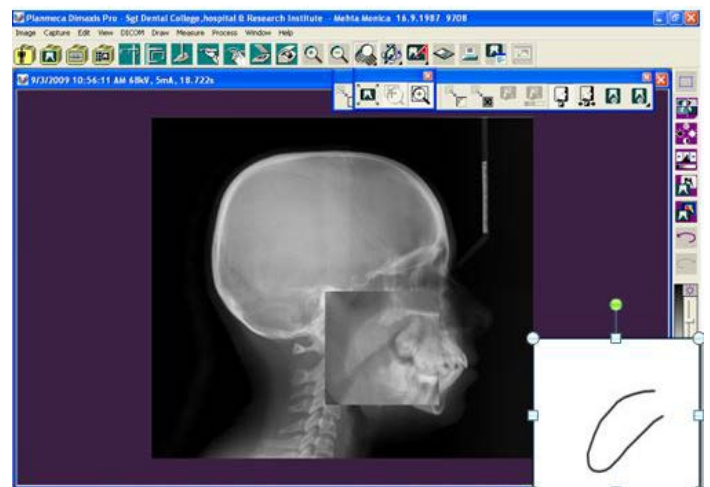Figure 6: Type 3 - butt-like

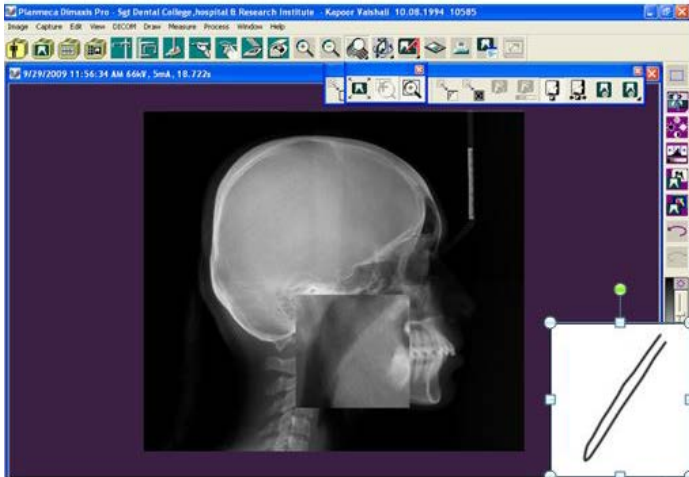Figure 7: Type 4- straight line shape
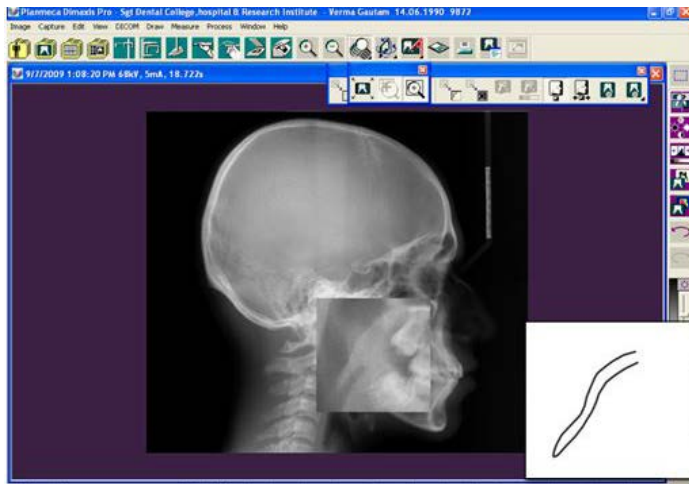

Figure 8: Type 5- S-shape
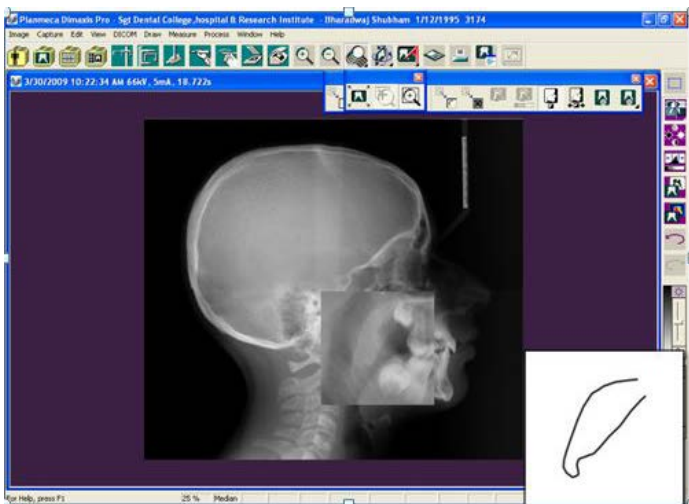

Figure 9: Type 6, 'crook appearance

Figure 10: Type 7 soft palate morphology that could not be grouped under any other. (Miscellaneous)