

Morphological Variants Of Soft Palate In Normal Individuals: A Digital Cephalometric Study

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ABSTRACT

Objectives: The literature describes the morphology of the soft palate as being of only one kind and ignores its diversity, but in our clinical work we discovered that the morphology of the soft palate has a variable presentation on lateral cephalometry. The aim of our study was to investigate the variation of the velar morphology.

Methods: In this study, the sample comprised 100 normal subjects whose ages ranged from 15–35 years. The morphology of the soft palate on lateral cephalometry were examined and classified into six types. The variation of the soft palate between

gender groups were also studied.

Results: The morphology of the soft palate were classified into six types. There was a significant difference in the morphology of soft palate and also between male and female groups in proportion to velar type.

Conclusion: The soft palate has variable radiographic appearances on lateral cephalometry. The classification system and proportional findings here may help the research of velopharyngeal closure in cleft palate individuals, and aetiological study of obstructive sleep apnea syndrome and other conditions.

Key Words: Soft palate, lateral cephalograms, shapes.

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 of the oral functions, especially in velopharyngeal closure which is related to the normal functions of sucking, swallowing and pronunciation[2]. The palate is formed by the fusion of three components; they are two palatal processes and the primitive palate is formed from the frontonasal process. At a later stage, the mesoderm in the palate undergoes intramembraneous ossification to form the hard palate. However, the ossification does not extend into the most posterior portion which remains as the soft palate. Early references concerning the objective measurements of the soft palate have been contributed by investigators who were interested in the speech, function and the upper airway structures[3-10,14]. 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 was 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 found the “hooked” appearance of the soft palate in patients who were awake, which indicated a high risk for the obstructive sleep apnoea syndrome (OSAS)[12]. The hooked appearance of the soft palate was also observed in our current study and it was described as “S-shaped” in our classification. However, in our current study, we also found all the six types of velar morphologies as was observed by M You Li, W Wang et al [1]. The purpose of the present study was to investigate the variation of the soft palate morphology. The proportional differences of the soft palate between the gender groups were studied as well. This study can be helpful for understanding the various morphologies of the soft

palate in the median sagittal plane on lateral cephalograms. It has been hoped that these findings may be used not only as references for the normal soft palate, but also for cleft reconstruction and the aetiological research of obstructive sleep apnea syndrome (OSAS) and other conditions.

MATERIALS AND METHODS

100 digital lateral cephalograms of normal subjects (46 men and 54 women, with ages ranging from 15–35 years) were taken from the Department of Oral Medicine and Radiology and the Department of Orthodontia, Meenakshi Ammal Dental College, Chennai. All the subjects had normal speech function and none had any history of cleft palate, syndromes or diseases or fracture of the head and neck.

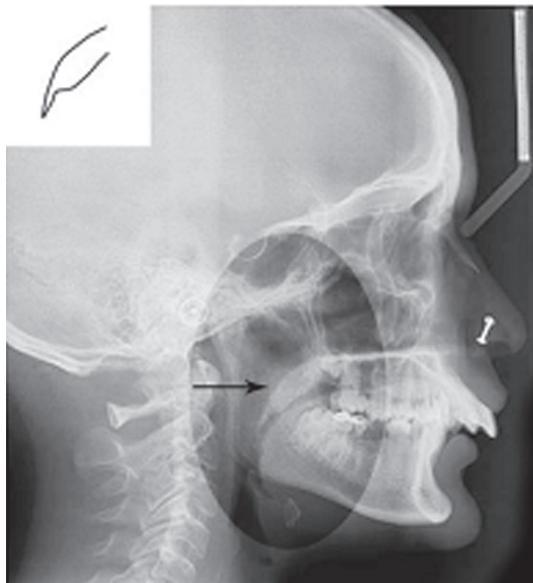
All the lateral cephalograms were taken by using DIMAX 3 CEPH (PLAN MECA PROMAX). The tube potential was adjusted to optimize the contrast of both the hard and soft tissues (85 kV). The digital radiographs were processed and viewed by using PICASA PHOTO VIEWER software [13].

All of the radiographs were observed and categorized into six types. Since there was no difference in their classification, their reliability was considered to be more than adequate for the purpose of this study.

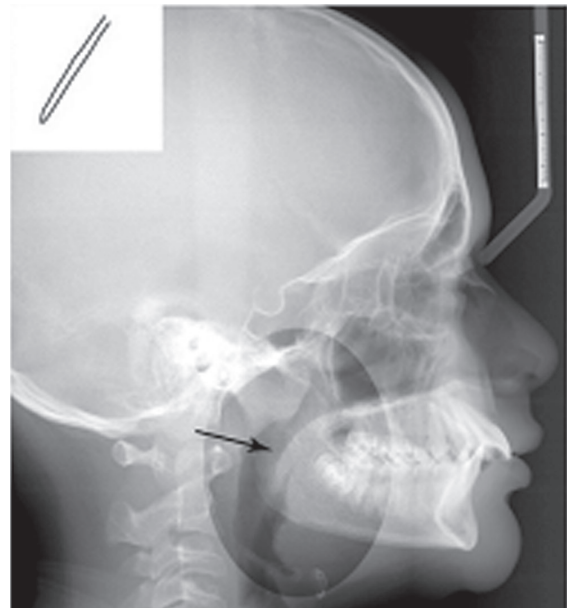
RESULTS

By observing the images of the vela on the lateral cephalograms, we classified them into six types on the basis of the various radiographical appearances. The image and line drawing of each are given in [Table/Fig 1-6]. All the 100 subjects were categorized according to the radiographical features in the above mentioned figures.

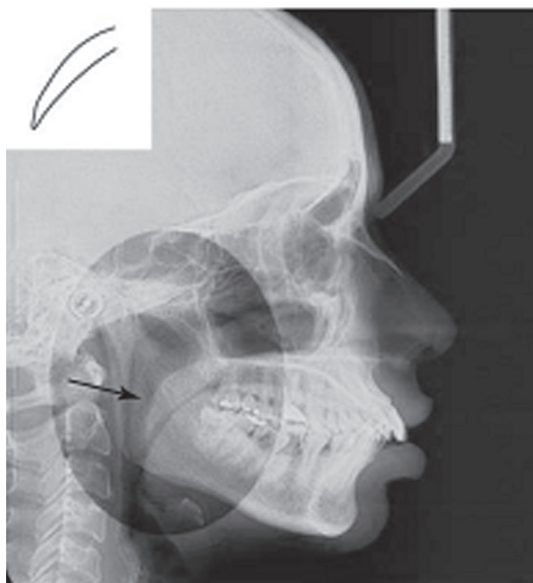
Type 1: “leaf shape”, which was lanceolate, indicated that the



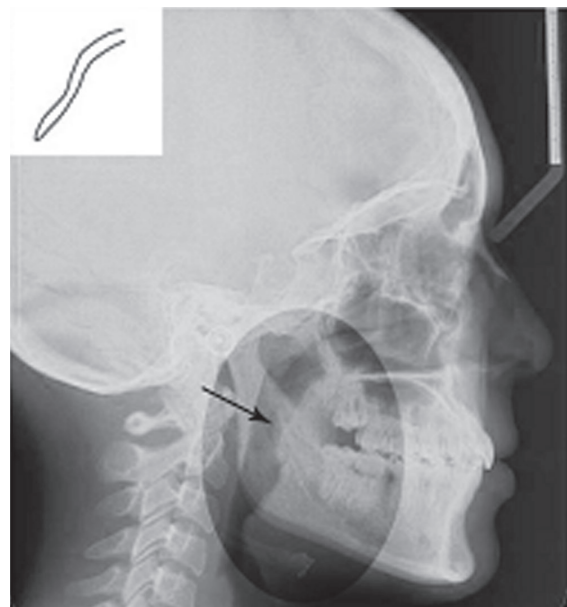
[Table/Fig-1]: 'leaf shaped (lanceolate)' the middle portion of the soft palate is elevated to both the naso-and oro-side.



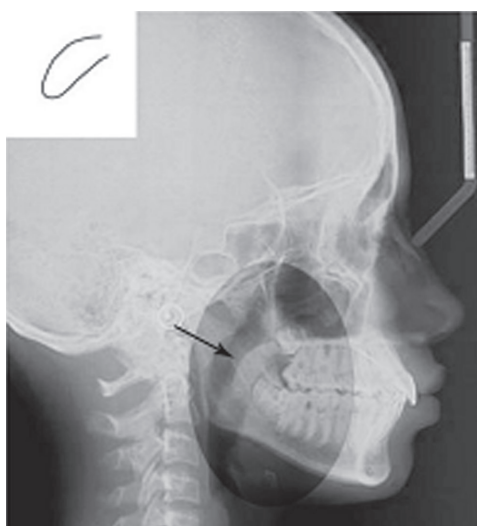
[Table/Fig-4]: Straight line



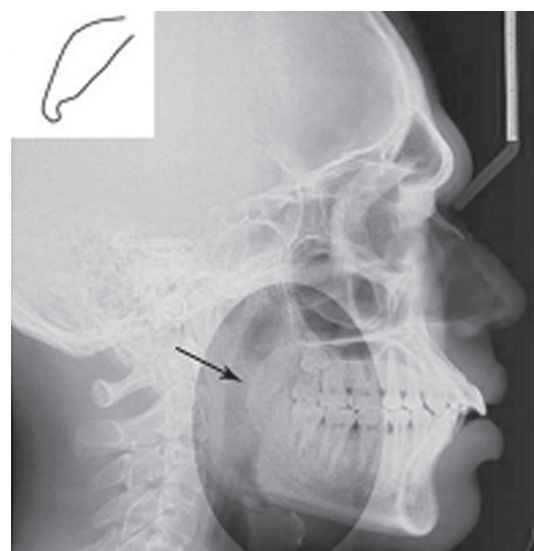
[Table/Fig-2]: 'rat tail shaped' the anterior portion is inflated and the free margin has an obvious coarctation.



[Table/Fig-5]: Distorted soft palate which presents the "S".



[Table/Fig-3]: 'A bult like shape' 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.



[Table/Fig-6]: 'Crook-shaped appearance' of the soft palate in which the posterior portion of the soft palate crooks anterosuperior.

middle portion of the soft palate elevated to both the naso and the oro-side in 40 (40%) cases. Type 2: when the soft palate showed that the anterior portion was inflated and that the free margin had an obvious coarctation, the radiographical appearance was described as having a “rat-tail shape” in 28(28%) cases. Type 3: a “butt-like” soft palate showed a shorter and fatter velum appearance, and the width showed almost no distinct difference from the anterior portion to the free margin in 15 (15%) cases. Type 4 indicated that the image of the soft palate presented a “straight line shape” in 12 (12%) cases. Type 5: The distorted soft palate presented the S-shape in 2 (2%) cases. Type 6 revealed a “crook” appearance of the soft palate, in which the posterior portion of the soft palate crooked anteriosuperiorly in 3 (3%) cases. The distribution and the proportion of these types are presented in Table 1.

DISCUSSION

Cephalometric analysis is one of the most commonly accepted techniques for evaluating the soft palate both in normal individuals and in those with a cleft palate. Cephalometry is a relatively inexpensive method and it permits a good assessment of the soft tissue elements that define the soft palate and its surrounding structures[7]. The morphometric assessment of the nasopharynx or the configuration of adjacent structures can be defined in terms of their depth and height in the median sagittal plane on the lateral cephalograms. 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 was ignored in the past, is logically responsible for the significantly different dimensions on the soft palate, such as the velar length and width.

The digital radiographic technique which was 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 to adjust and optimize the contrast and the gradation with the professional PICASA PHOTO VIEWER software. Therefore, the soft palate appearance and the diagnostic information can be enhanced and elicited, which benefits the investigation and assesment [13].

In our study, the leaf-shaped soft palate was the most frequent type [in 40 (40%) cases], which was an expected finding, since this type was previously described as a classic velar morphology in the literature. The S-shape which was described as a hooked appearance of the soft palate by Pepin et al, was found in 2 (2%) 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[12]. 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 the upper airway resistance and the transpharyngeal pressure gradient. Pepin et al therefore concluded that hooking of the soft palate in patients indicated a high risk for obstructive sleep apnea syndrome (OSAS).

Therefore, it is a likely hypothesis that velopharyngeal adequacy is strongly dependent on a close coordination of the anatomic parts which are involved in the velopharyngeal closure: the soft palate

and the contiguous pharyngeal structures. Since the harmony of the velum and the surrounding pharyngeal structures seems to be indispensable for velopharyngeal closure, it is reasonable to hypothesize that the contiguous pharyngeal structures may have different characteristics to match up to the different velar morphology. The further studies should therefore be focused on whether differences exist among the pharyngeal structures of each type. Even after the closure of the soft tissue defect in patients with cleft palates, the normal function of the soft palate is frequently not achieved [15]. The variation of the soft palate morphology may be a new explanation for surgical failure and the soft palate should be repaired in various patterns.

CONCLUSION

The morphology of the soft palate can be divided into six types according to their features on lateral cephalometry. This classification can help us to understand better, 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 the aetiological research of OSAS and other conditions.

REFERENCES

- [1] You M, Li X, Wang H, Zhang J, Wu H, Liu Y, Miao J, Zhu Z. et al. Morphological variety of the soft palate in normal individuals: a digital cephalometric study. *Dentomaxillofacial Radiology* 2008; 37: 344–9.
- [2] Moore KL, Agur AMR. *Essential Clinical Anatomy* (2nd edn). Philadelphia, PA: Lippincott, Williams and Wilkins, 2002.
- [3] Johns DF, Rohrich RJ, Awada M. Velopharyngeal incompetence: a guide for clinical evaluation. *Plas Reconstr Surg* 2003; 112: 1890–8.
- [4] Subtelny JD. A cephalometric study of the growth of the soft palate. *Plast Reconstr Surg* 1957; 443–4.
- [5] Satoh K, Wada T, Tachimura T, Fukuda J, Shiba R, Sakoda S, et al. Comparison of the nasopharyngeal growth between patients with clefts (UCLP) and those with non-cleft controls by multivariate analysis. *Cleft Palate Craniofac J* 1997; 34: 405–9.
- [6] Johnston CD, Richardson A. Cephalometric changes in the adult pharyngeal morphology. *Eur J Orthod* 1999; 21: 357–62.
- [7] Taylor M, Hans MG, Strohl KP, Nelson S, Broadbent BH. Soft tissue growth of the oropharynx. *Angle Orthodontist* 1996; 66: 393–400.
- [8] Kollias I, Krogstad O. Adult craniocervical and pharyngeal changes – a longitudinal cephalometric study between 22 and 42 years of age. Part II: morphology of the uvulo glossopharyngeal changes. *Eur J Orthod* 1999; 21: 345–55.
- [9] Maltais F, Carrier G, Cormier Y, Series F. Cephalometric measurements in snorers, non-snorers, and patients with sleep apnoea. *Thorax* 1991; 46: 419–23.
- [10] Randall P, La Rossa D, McWilliams BJ, Cohen M, Solot C, Jawad AF, et al. Palate length in the cleft palate as a predictor of the speech outcome. *Plast Reconstr Surg* 2000; 106: 1254–9.
- [11] Lu Y, Shi B, Zheng Q, Xiao WL, Li S. Analysis of the velopharyngeal morphology in adults with velopharyngeal incompetence after the surgery of a cleft palate. *Annals Plast Surg* 2006; 57
- [12] Pepin JL, Veale D, Ferretti GR, Mayer P, Levy PA. Obstructive sleep apnea syndrome: hooked appearance of the soft palate in awake patients – cephalometric and CT findings. *Radiology* 1999; 210: 163–70.
- [13] Saunders Jr RS, Samei E. A method for modifying the image quality parameters of digital radiographic images. *Med Phys* 2003; 30: 3006–17.
- [14] Hoopes JE, Dellon AL, Frabrikant JI. Cineradiographic definition of the functional anatomy and the pathophysiology of the velopharynx. *Cleft Palate J* 1970; 7: 443–54.
- [15] Simpson RK, Austin AA. A cephalometric investigation on the velar stretch. *Cleft Palate J* 1972;

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