Original Article

Morphological Variations Of Soft Palate: A Digital Cephalometric Study

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Abstract

Background: The morphology of soft palate in different individuals can have range of variability. The variable soft palatal morphology is significant during soft palatal surgeries and treatment planning in cases of velopharyngeal incompetence. Cephalometric analysis offers cost effective radiographic technique in assessment of the same.

Aim and Objective: The aim of the present study is to investigate the variable radiographic morphologic appearances of soft palate by digital lateral cephalometry and to see the differences in the morphological variety in different gender groups.

Materials and Methods: Radiographs of 300 subjects were taken by random selection from patients visiting radiographic diagnostic set-up. The individuals were subjected to digital cephalometry, and the images are processed with Kodak dry view laser printer. All digital cephalometric films were subjected to cephalometric tracing. The radiographs were evaluated to observe for the morphological variations of the soft palate

Results: Of 300 subjects, Six different types of soft palate were observed. Type 1 (52%) and Type 2 (25%) were found to be the most common types of soft palates followed by Type 4 (9.3%), Type 6 (7.3%), Type 3 (3.3%) and Type 5 (3%) respectively.

Conclusion: The soft palate can be broadly classified into six different types. This classification can further assist us in better understanding of the velar morphology in the median sagittal plane and these can be used as reference for research of velopharyngeal closure in cleft palate individuals, obstructive sleep apnea and other conditions. We also conclude that the cephalometric analysis is one of the most accepted and cost-effective techniques to evaluate upper airway and craniofacial morphology and for evaluation of the soft palate.

Keywords: Soft Palate, Digital Cephalometry, Velopharyngeal Closure

INTRODUCTION

The soft palate is the posterior fibro muscular part of the palate that is attached to the posterior edge of the hard palate. It participates in most oral functions, especially velopharyngeal closure which is related to normal functions of sucking, swallowing and pronunciation.[1,2]

Variable factors such as cleft lip and palate, increase in the size of adenoids, OSAS, snoring, craniofacial malocclusion and even improper maintenance of maxillary dentures can lead to dysfunction of the soft palate.[3]

Several factors that contribute to velopharyngeal function includes the length, function and posture of the soft palate. The depth, width of the nasopharynx including the activity of the posterior and lateral pharyngeal walls also play a role in its function and in velopharyngeal closure.

Velopharyngeal closure refers to the normal apposition of the soft palate, or velum, with the posterior and lateral pharyngeal walls. Velopharyngeal incompetence occurs when the velum and lateral and posterior pharyngeal walls fail to separate the oral cavity from the nasal cavity during speech and deglutination. [1]

Various studies during morphometric analysis of soft palate and surrounding structures noted variation in velar morphology.[1,4]

M.You et.al in 2008 classified the morphological variations of the soft palate in their clinical work by digital cephalometry.[1] The hooked appearance of soft palate in awake patients indicated a high risk for obstructive sleep apnea syndrome. [1,4]

Cephalometric analysis is one of the more accepted techniques to evaluate upper airway and craniofacial morphology and is also commonly accepted for evaluating the soft palate in both normal individuals and those with cleft palate.

Cephalometry is a relatively inexpensive method for diagnostic purpose and treatment and co-relates with other more sophisticated and expensive techniques such as computer tomography or somnofluroscopy and permits a good assessment of the soft tissue elements that define the soft palate and its surrounding structures.[4,5,6,7]
The variable soft palatal morphology is of significant importance during soft palatal surgeries[4]
This article is an effort to investigate and classify the variations of soft palate morphology by digital cephalometry in normal individuals in Indian population which can further help in the research of velopharyngeal closure in cleft palate individuals obstructive sleep apnoea syndrome and other conditions.

MATERIALS AND METHODS:

The study was conducted in the outpatient of a radiographic diagnostic setup where randomly selected 300 subjects were taken. Detailed case history was taken for each subject and then subjected to Digital lateral cephalometric radiographs. Before radiography, written consent was taken from each individual.

Inclusion criteria:

- Age ranges from ten to eighty years

Exclusion criteria:

- Patient with cleft palate and previous surgery of cleft palate
- Fracture of head and neck region

Image acquisition:

The subjects were instructed to stand in an erect position with Frankfort Horizontal plane parallel to the floor. The ear rods on the cephalostat were adjusted on the machine. The distance between the x-ray source and the mid sagittal plane was 5 feet or 60 inches. Subjects were instructed to keep their teeth in occlusion and relax facial musculature.
The films used in the study were from FUJIFILM(Fuji medical x-ray film) .Film size 20.3cm X 25.4cm (8in X 10in)

Exposure parameters: The cephalometric machine on which the individuals were subjected to digital cephalometry were from ADVAPEX (OPG-TMJ-CEPH X-RAY System , AERB India approved)

X ray film: Fuji medical dry imaging film DI- HL (blue base). DI-HL is a daylight loading, blue polyester based film.Fuji Dry Silver technology with new rapid thermal development capability speeds the delivery of films with superior image quality and stability. Gradation reproduction is equivalent to conventional silver halide film. And there's no chemical or solid waste.
On one side glazed acetate paper of 0.03in thickness was attached using cellotape.
All digital cephalometric films were subjected to cephalometric tracing .

Viewing condition: The viewing conditions were standardized for each observer in a quiet room free from distractions. For radiographs, the observers used an illuminated view box (Medi-X view) in which extraneous light was masked. Tracing was the carried out using 4H pencil with the help of trans illuminated view box followed by examination in an subdued ambient light were the variations in morphology of the soft palate was observed.
The radiographs were examined and the shape of the soft palate were found out by comparing the standard pictures from the study done by You M *et.al*(2008)[1] where he categorized the morphology of the soft palate into 6 types based on radiographic appearances .(Fig : 1-6)
Type 1: Leaf shaped/Lanceolate shaped
Type 2: Rat-tail shaped
Type 3: Butt-like
Type 4: Straight line
Type 5: S-shaped/distorted soft palate.
Type 6: Crooked appearance

Fig 1 : Type 1- ‘‘Leaf-shaped’’ (lanceolate); the middle portion of the soft palate is elevated to both the naso- and oro-side

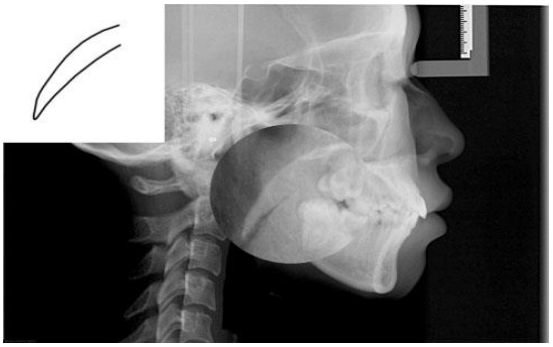


Fig. 2: Type 2- ‘‘Rat-tail shaped’’; the anterior portion is inflated and the free margin has an obvious coarctation

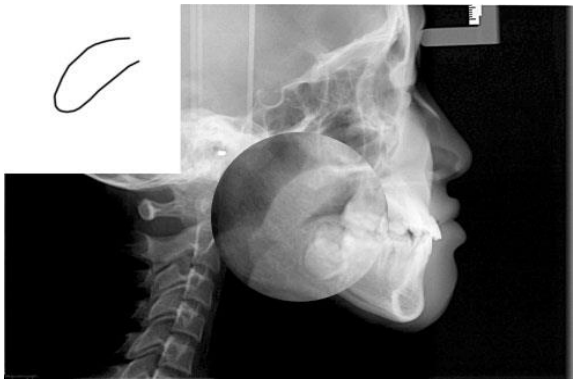


Fig. 3 : Type 3- A ‘‘Butt-like shape’’; the length of the soft palate in this type is about a third to three-quarters of that of the leaf shape.The width has almost no distinct difference from the anterior portion to the free margin

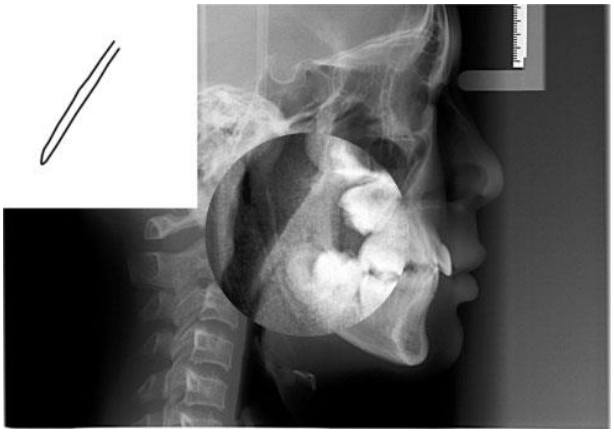


Fig. 4 : Type 4- ‘‘Straight line’’

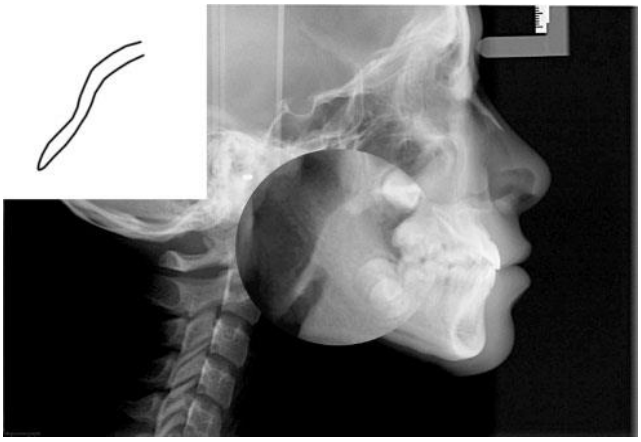


Fig. 5 : Type 5-Distorted soft palate, which presents the ‘‘S-shape’’

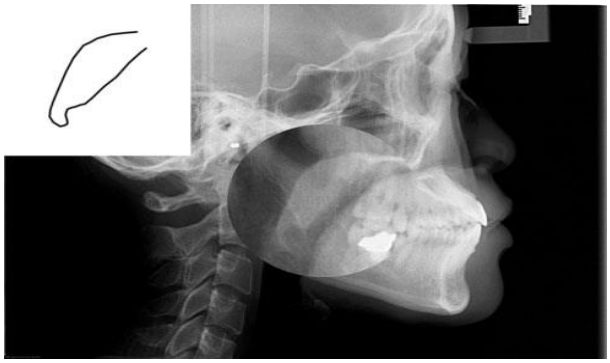


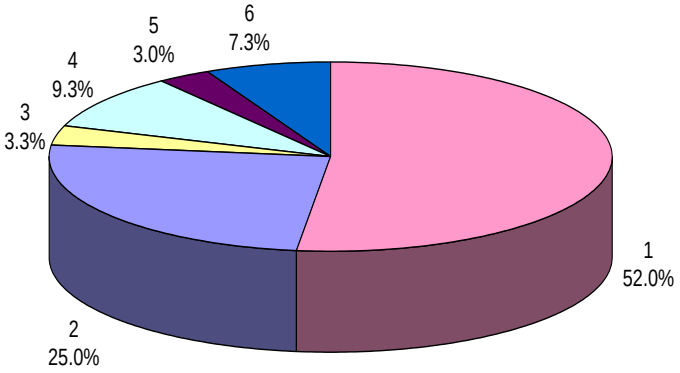
Fig. 6: Type 6- ‘‘Crook-shaped’’ appearance of the soft palate, in which the posterior portion of the soft palate crooks antero-superiorly

RESULTS:

Type 1 (52%) and Type 2 (25%) were found to be the most common types of soft palates followed by Type 4 (9.3%), Type 6 (7.3%), Type 3 (3.3%) and Type 5 (3%) respectively (Table 1, Graph 1).

Table 1: Various Types of Soft Palate (n=300)

S.No.	Type	No. of subjects	Percentage
1.	1	156	52.0
2.	2	75	25.0
3.	3	10	3.3
4.	4	28	9.3
5.	5	9	3.0
6.	6	22	7.3

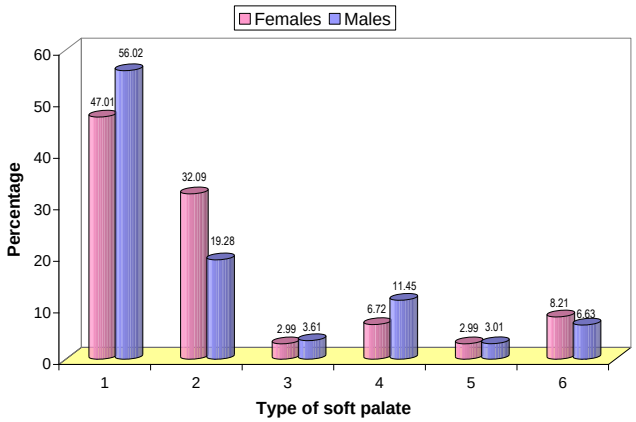


Graph 1: Various types of soft palate

It was also observed that type of soft palate and gender are not dependent on each other. Majority of females (47.01%) and males (56.02%) in the present study had type 1 soft palate (p=0.120). Type 2 soft palate was found in 32.09% in females and 19.28% in males this difference was statistically significant (p=0.011) (Table 2, Graph 2)

Table 2: Comparison of Type of Soft Palate and Gender

Type of Soft Palate	Females (n=134)		Males (n=166)		Total		Significance	
	No.	%	No.	%	No.	%	χ^2	p
1	63	47.01	93	56.02	156	52.00	2.411	0.120
2	43	32.09	32	19.28	75	25.00	6.492	0.011
3	4	2.99	6	3.61	10	3.33	0.091	0.763
4	9	6.72	19	11.45	28	9.33	1.959	0.161
5	4	2.99	5	3.01	9	3.00	0.0002	0.989
6	11	8.21	11	6.63	22	7.33	0.273	0.601



Graph 2: Comparison of type of soft palate with gender

DISCUSSION

The soft palate participates in most oral functions, especially velopharyngeal closure which is related to normal functions of sucking, swallowing and pronunciation. The functional utility of the soft palate including their contributions in speech function and upper airway structures including their velar length and pharyngeal depth has been established in literature. Although these continued efforts toward the dimensional analysis of the soft palate and its surrounding structures have been made, little attention was paid to the variety of the soft palatal morphology and configuration. You M *et al(*2008)[1] noticed while observing the soft palate morphology on lateral cephalometry that the configuration of the soft palate presented with variable morphological patterns in normal individuals. Many different methods were suggested for proper evaluation of soft palatal morphology including various clinical examinations, diagnostic cast together with variable combinations, but precise assessment of morphology of the soft palate remains elusive. Radiographic modalities offer greater advantage over others in assessing and identifying soft palatal anatomy.[3] The assessment of variation of the soft palate morphology can aid in proper treatment planning in cases of velopharyngeal incompetence.[3]

300 subjects participated in the present study (166 males and 134 females). In this study, we aimed to compare the type of soft palate and gender in normal individuals of the Indian population.

In our study we observed that Type I -52% and Type 2 -25% were the most common Type of soft palates followed by Type 4- 9.3%, Type 6 -7.3%, Type 3 -3.3% and Type 5- 3% respectively. Our study was in part accordance with a study conducted by You M *et al* [1] They conducted a study comprising of 200 normal subjects and found that Type 1 53% and Type 2 18.5% were the most common type of soft palate but they also observed that Type 6-1.5% was the least common Type of soft palate. Here our study was in variance with the study conducted by You M *et al(*2008) [1] We observed that Type 5-3% and Type 3-3.3% were the least common Type 6 soft palate was present in 7.3% of the subjects. A possible reason for this difference may be because of the large number of subjects in our study. The Type 1 or the leaf type soft palate is very common and recognized as classic velar morphology.[8,9] Verma et al reported 48.7% prevalence of type 1 that is in accordance with our study.[10]

According to Dahal et.al[3] rat-tail shape was the most common type of soft palate-44.4% (Type-2) followed with leaf like soft palate-41.1%(Type-1) in Nepali population. Further studies regarding variation of soft palate in various ethnic populations can enhance knowledge regrading normal velar morphology.
In comparison between Types of soft palate and gender, in our study we observed that in female subjects Type 1- 47.01% was the most common type of soft palate followed by Type 2- 32.09% Type 6- 8.21 % Type 4- 6.72 % and Type3 and Type 5 (2.99 %) being the least common. In male subjects we observed that Type 1- 56.02% was the most common followed by Type 2 -19.28 %, Type 4- 11.45 % and Type 6- 6.63 % respectively with Type 3-3.61 % and Type 5-3.01 % being the least common Type of soft palate. This observed value was not in accordance with the study conducted by You M *et al(*2008)[1] where they observed that Type 2 and Type 3 type of soft palate were found to be more common in males than in female.

The observed data showed that the type of soft palate and gender were not dependent on each other. But we also observed that Type 2 soft palate was found in 32.09% in females and 19.28% in males and the difference was statistically significant(p=0.011). A possible reason for the variable result can be attributed to the number of sample size(subjects) which was larger in our study when compared to the study conducted by You M *et al(*2008)[1]
Dahal et al.[3] observed rat tail type of soft palate as most prevalent in both sexes while Tripathy et al and Guttal et al have reported leaf type or type 1 soft palate as the most common in both sexes. Our study is in accordance with the findings reported by Tripathy et al. and Guttal et al. [11, 12]
Previous research in the field brought to light that prevalence of S-shaped or distorted types of soft palate in individuals may hypothetically predispose to obstructive sleep apnea.[13, 14, 15] Though least common in our study, but presence of S-

shaped soft palate in individuals should require further assessment regarding knowledge about velar incompetence. The morphology of the soft palate affects pronunciation, phonetics, speech development, and resonance disorders.[16, 17] Thus, corrective therapy of any defects in speech and phonetics would require adequate knowledge about different velar morphologies and their respective effects. In spite of advanced imaging techniques, cephalometric analysis still remains a promising modality for analysis of soft tissues in head and neck region due to its cost effectiveness.[18, 19]
Further research is needed in gender predilection with variations in soft palate morphology to evaluate whether soft palate patterns can reveal sexual dimorphism. Evaluation of larger sample size is needed to assess for any ethnic variations in soft palatal morphology.

CONCLUSION:

Based on the result of the present study, the following conclusions were drawn:

- The morphological variation of the soft palate was divided in to 6 types:

Type 1 - "Leaf Shaped"(Lanceolate), Type 2 - "Rat-Tail Shape", Type 3 - "Butt-Like Shape"
Type 4 - "Straight Line", Type 5 – "S-Shaped"(Distorted Soft Palate), Type 6 – "Crook-Shaped"

- Type 1 soft palate was the most common type of soft palate with Type 5 being the least common.
- Though the Type of soft palate and gender were not dependent on each other, Type 2 soft palate was found to be present more in females than in males.

Study and knowledge of morphological variations of soft palate helps in assessing velopharayngeal closure and in treatment planning for velopharyngeal incompetence, in repair of cleft palate and in investigation and evaluation in cases of snoring and obstructive sleep apnea syndrome.

CONFLICT OF INTEREST: None

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