Original Article

Correlation of soft palate shape with skeletal malocclusion

ABSTRACT

Introduction: Soft palate is a fibromuscular organ essential for phonation, deglutition, respiration, and velopharyngeal competence. It exists in various shapes including rat tail type, leaf type, butt type, straight line, crooked type, and S shaped. There have been studies in the literature that has compared the morphological variation of soft palate in genders and subjects of different age groups. However, the literature is limited regarding the correlation of soft palate shape with different skeletal patterns. Hence, this study was undertaken.

Aims: To study various shape of soft palate on lateral cephalogram in patients with skeletal Class I, Class II, and Class III malocclusions.

Settings and Design: A retrospective study.

Subjects and Methods: Total 90 lateral cephalograms of skeletal Class I (30), Class II (30), and Class III (30) were classified on the basis of W angle into skeletal pattern as Class I, Class II, and Class III. Their soft palates were traced and compared for the shape variation.

Statistical Analysis Used: Pearson's Chi-square test.

Results: The result showed that crooked shape soft palate is more frequent type among the population. In skeletal Class I malocclusion, crooked was most frequent shape of palate followed by leaf shape. In skeletal Class II malocclusion, crooked was most common followed by rat tail type and in Class III malocclusion, butt shape was most common followed by leaf type.

Conclusions: Significant correlation exists between the variants of soft palate and skeletal malocclusion

Keywords: Skeletal pattern, soft palate variants, W angle

INTRODUCTION

The roof of the mouth anatomically separates the nasal cavity from the oral cavity and structurally is composed of anterior bony component, i.e., hard palate and posterior fibromuscular component, i.e., soft palate (also known as velum).[1]

The soft palate is a mobile flap suspended from the posterior border of the hard palate, sloping down and back between the oral and nasal parts of the pharynx. It is a thick fold of mucosa enclosing an aponeurosis, muscular tissue, vessels, nerves, lymphoid tissue, and mucus glands. It participates in most of the oral functions, especially velopharyngeal closure which is related to the normal functions of sucking, swallowing, blowing, and pronunciation. Soft palate dysfunctions are frequently seen in cleft lip and palate patients, enlarged adenoids, obstructive sleep apnea syndrome (OSAS), snoring, poorly retained maxillary denture, and skeletal craniofacial malocclusion.

The palate is formed by the fusion of three components – two palatal processes and the frontonasal process. In the later stage, the mesoderm in the palate undergoes intramembranous ossification to form the hard palate whereas the posterior part does not undergo ossification and remains as soft palate. The hard and soft palate is easily palpable and identified by change in color. The most important muscle for velopharyngeal closure is the levator

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veli palatini. Often, the normal anatomy and any other anomaly of soft palate help in the diagnosis and successful treatment of many intricate cases.[2]

Numerous studies have been done in past toward the dimensional analysis of soft palate and its surrounding structures, but little attention has been paid toward the morphological variants of soft palate and configuration. You *et al*. classified the soft palate into six morphological types by observing the image of soft palate on lateral cephalograms:

- Type 1: Leaf shaped/lanceolate shaped
- Type 2: Rat tail shaped
- Type 3: Butt-like shaped
- Type 4: Straight line shaped
- Type 5: S-shaped/distorted soft palate; and
- Type 6: Crooked shaped.[3]

Pépin *et al*. observed that the "hooked or S shaped" appearance of the soft palate in awake patients indicated a high risk of OSAS.[4]

Table 1: Categorization of samples into groups using W angle

Samples	Malocclusion	W angle
Group 1 (30)	Class I malocclusion	51-56
Group 2 (30)	Class II malocclusion	<51
Group 3 (30)	Class III malocclusion	>56

Table 2: Correlation of shape of soft palate with different skeletal malocclusion

Soft palate type	Group			Total
	1	2	3	
Crooked				
Count	11	13	5	29
Percent	37.9	44.8	17.2	100.0
Butt type				
Count	3	1	12	16
Percent	18.8	6.3	75.0	100.0
Rat tail type				
Count	6	10	2	18
Percent	33.3	55.6	11.1	100.0
Leaf type				
Count	9	6	9	24
Percent	37.5	25.0	37.5	100.0
Straight				
Count	1	0	2	3
Percent	33.3	0.0	66.7	100.0
Total				
Count	30	30	30	90
Percent	33.3	33.3	33.3	100.0

Table 3: Pearsons's Chi-square test

	Value	df	*P*	Result
Pearson χ^2	24.545[a]	8	0.002	Significant

Level of significance set at $P<0.05$.

As variation in morphology of soft palate plays an important role in the assessment of velopharyngeal closure and in diagnosing obstructive sleep apnea individuals. There have been studies in the literature that has compared the morphological variation of soft palate in genders and subjects of different age groups. However, the literature search to study the variation of soft palate morphology in the subjects with different skeletal patterns was found to be insufficient. The purpose of our study was to investigate correlation between various shape of soft palate with skeletal Class I, Class II, and Class III malocclusions using lateral cephalograms of patient seeking orthodontic treatment.

SUBJECTS AND METHODS

A retrospective study was conducted on patients seeking orthodontic treatment. A total of 90 lateral cephalograms of patients that visited to the Department of Orthodontics and Dentofacial Orthopaedics, Aurangabad, Maharashtra, India, were collected. All the lateral cephalograms were taken with the patients standing upright in a natural head position, and they were instructed to occlude their molars and breathe through their nose, so as to allow the same observation of the mobile sites of the soft palate and the upper airway. This was done using the same digital radiographic machine for all patients [Table 1]. The selected 90 cephalograms were categorized into 3 groups using the W angle.

Their soft palates were traced and compared for the shape variations as given by You *et al*. [Figures 1-6].[3]

RESULTS

Statistical analysis

All the data were collected and analyzed, and a crosstab was composed by dividing the subjects based on the type

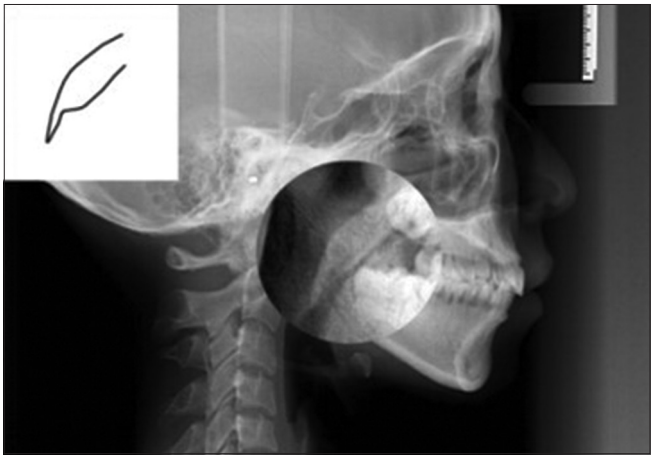


Figure 1: Type I: "leaf shaped" (lanceolate); the middle portion of soft palate is elevated to both naso- and oro-side

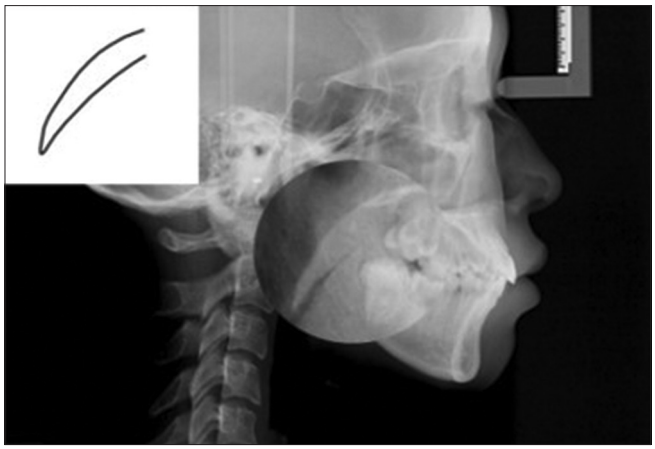


Figure 2: Type 2: "rat tail shaped;" anterior portion is inflated and free margins have obvious coarctation

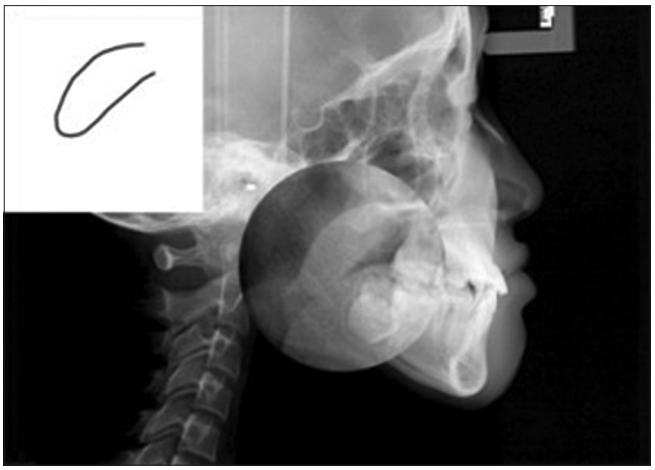


Figure 3: Type 3: "butt-like shape;" the length of soft palate in this type is about a third to three quarter of that of leaf shape. The width has almost no distinct difference from anterior portion to free margin

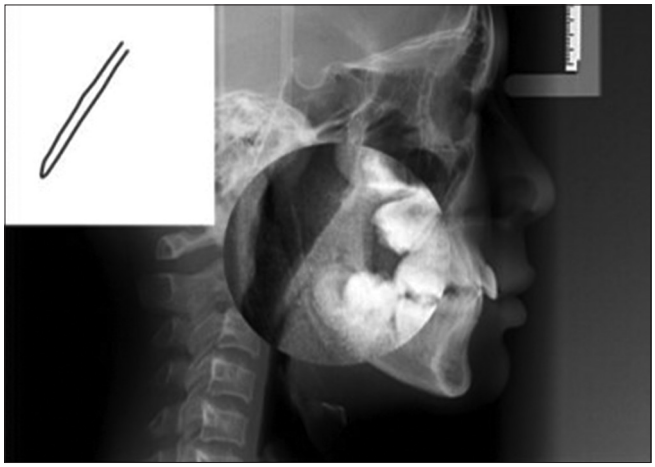


Figure 4: Type 4: "straight line"

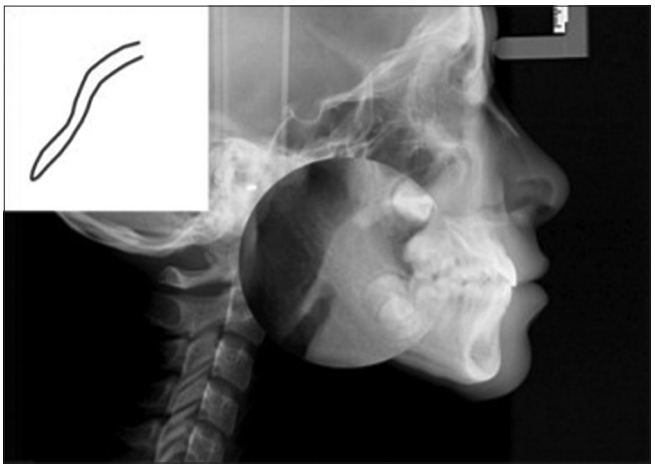


Figure 5: Type 5: distorted soft palate, which presents "S shape"

of malocclusion and the shape of soft palate, to compare the correlation between various shapes of soft palate and types of malocclusion [Table 2]. Pearson's Chi-square test was used to evaluate the relationship among variables in the crosstabs [Table 3].

The result of this study showed that crooked shape soft palate is more frequent type among the Marathwada population [Tables 4 and 5]. In skeletal Class I malocclusion, it was observed that crooked was most frequent shape of palate followed by leaf shape. In skeletal Class II malocclusion, crooked was most common followed by rat tail type and in Class III malocclusion, butt shaped was most common followed by leaf type.

DISCUSSION

The lateral cephalogram is the most common diagnostic radiograph used in orthodontics. Cephalometric analysis is a commonly accepted technique for the evaluation of soft palate because of its easy availability, cost effectiveness, and relatively good assessment of soft tissue. The dimensional analysis of the soft palate and its surrounding structures, especially velar length and width, has been discussed in various studies, nevertheless the variation of velar morphology which is the most logic cause of different dimensions of soft palate.

The W angle, which is most commonly used in the determination of anteroposterior dentofacial discrepancy, was used to classify the individuals according to their skeletal configuration. Sharma *et al*. reported that it is reliable for determining the anteroposterior relationship of the jaws.[5]

In our study, Type VI shaped soft palate was the most frequent type while a previous study by You M. *et al*.[3] described leaf-shaped soft palate to be the classic velar morphology. This variation may be due to the fact that most of our study cases had malocclusion requiring orthodontic treatment.

Table 4: Distribution of frequency of soft palate shape in various skeletal malocclusion

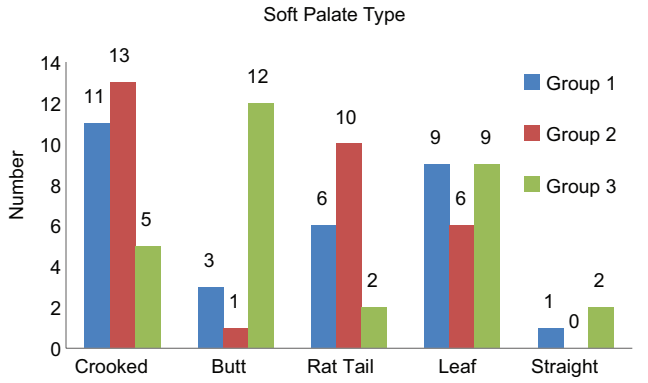
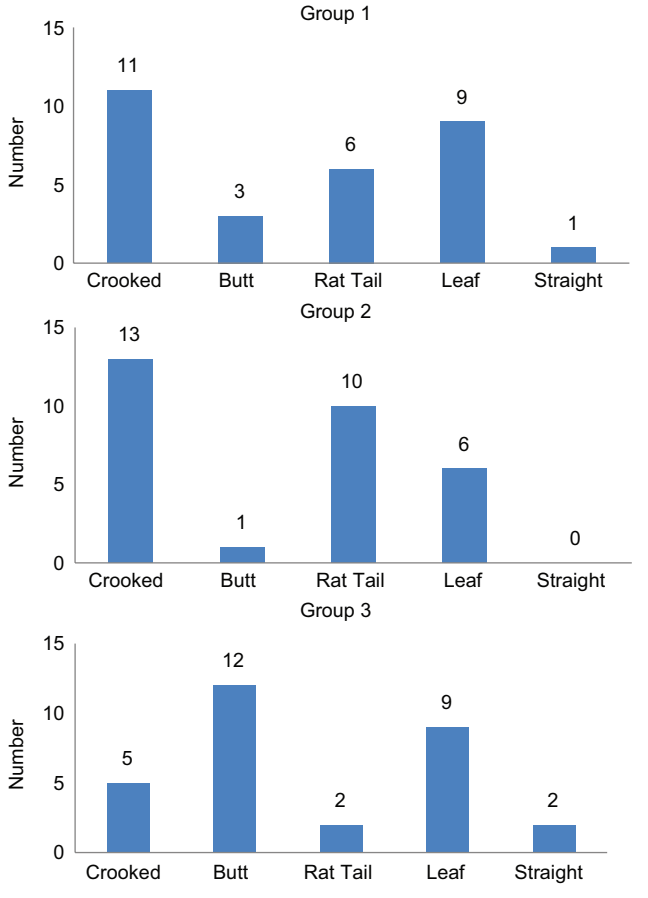


Table 5: Distribution frequency of soft palate variation in skeletal Class I, Class II, and Class III



In some studies, the most common type of morphological variant of soft palate was reported to be butt shaped and S shaped,[6,7] and in other studies, Type 2 rat tail shape was most frequent type.[2,8] These variations in types of soft palate could be population-related trait.

Patients with skeletal Class I malocclusion were most frequently found to be associated with crooked-like

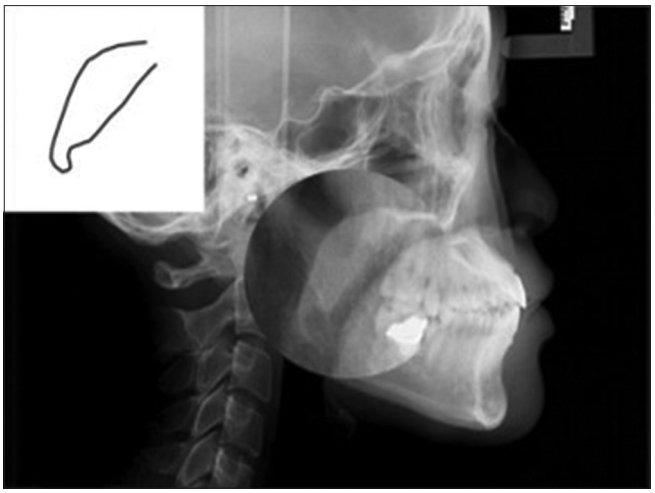


Figure 6: Type 6: "crooked shaped;" appearance of soft palate in which the posterior portion of soft palate crooks anterosuperiorly

morphology of soft palate, Class II with crooked-shaped soft palate, and Class III with butt-shaped soft palate. In a previous study conducted by Subramaniam[9] in skeletal malocclusions' sample, leaf shape was found to be the most frequent in Class I, rat tail type in Class II malocclusions, and leaf type and crooked type in Class III. This difference in result from our study may be due to ethnic variation.

Obstructive sleep apnea is characterized by the recurrent occlusion of the upper airways resulting due to the inspiratory collapse of pharyngeal walls during sleep. Subramaniam *et al*. found that "S shape" morphology of the velum, indicated a high risk for obstructive sleep apnea. The hooking of the soft palate was defined as an angulation of 30° between the distal part of the uvula and the longitudinal axis of the velum. They hypothesized that soft palate hooking results in a sudden and major reduction in oropharyngeal dimensions, thus increasing the upper airway resistance and the transpharyngeal pressure gradient resulting in a pharyngeal collapse.[9]

Our study concluded that there is a significant correlation between the variants of soft palate and type of skeletal malocclusion in Marathwada population.

The development of soft palate gets completed by the 12th week of intrauterine life[10] and muscles by 16–17th week of intrauterine life.[11] Thus, shape of soft palate is achieved in the intrauterine life itself. However, skeletal development of maxilla and mandible continues throughout the pubertal growth spurt. Moreover, the final malocclusion is established at 16–18 years of life. Our study concluded that there is a significant correlation between the variants of soft palate and type of skeletal malocclusion. Thus, at very early age of the child, we can predict the skeletal malocclusion by viewing the shape of the soft palate.

In Class II, the crooked type was most common that contributes to an abrupt and major reduction in oropharyngeal dimension while in Class III, the most common variant was butt shape type, i.e., length of soft palate was shorter when compared to Class I and Class II cases.

Hence, the soft palate dimension and their functional relationship with the surrounding structure should be examined in the diagnosis and treatment planning of various skeletal problems to avoid posttreatment speech problems. Therefore, treatment planning involving an increase in pharyngeal space should be considered. Clinician should be vigilant when using orthopedic or surgical method that may involve maxillary advancement.

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Conflicts of interest

There are no conflicts of interest.

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