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Morphologic Variety of Soft Palate in Normal Individuals – A Clinical and Digital Lateral Cephalometric Study

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Abstract:

- ***Aim:***

To view morphologic variety of soft palate using clinical assessment and Cephalometric radiography for normal individuals.

- ***Materials and Methods:***

The study group comprised of 200 subjects in the age group of 20-25 years which included 100 males and 100 females drawn from OPD of K. D. Dental College and Hospital, Mathura who were subjected to clinical assessment and Lateral Cephalometric views

- ***Results:***

A total of 200 subjects were evaluated for Mallampati classification and soft palate morphology. Leaf-shaped soft palate was the predominant morphology (66%), followed by rat-tail type (19%). Mallampati Class I was the most frequently observed airway pattern (39.5%). A significant association was found between gender and soft palate morphology, with leaf type being more common in males and rat-tail type predominating in females ($p<0.001$). No statistically significant correlation was observed between Mallampati classification and soft palate morphology ($p=0.474$). Soft palate length did not show significant variation among different soft palate types or Mallampati classes. However, soft palate width demonstrated a significant association with soft palate morphology ($p<0.001$), with greater width observed in butt and crook types. Superior, middle, and inferior velopharyngeal spaces also showed significant variation among soft palate morphologies, whereas no significant relationship was noted between velopharyngeal spaces and Mallampati classes. These findings suggest that soft palate morphology is associated with specific morphometric airway characteristics but is independent of Mallampati classification.

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I. INTRODUCTION

The soft palate is the posterior fibromuscular 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 soft palate is a dynamic separator of the oral cavity and nasal cavity.[3] During respiration, an individual either inspires or expires through the nose or mouth but never both simultaneously. During expiration, air passes through the lungs, through the pharynx, and then through the oropharynx. During inspiration, the air passes in the opposite direction, through either the nasal cavity or the oral cavity.[3]

The soft palate elevates in the middle third to separate the oropharynx and nasopharynx during speech, respiration and swallowing. The soft pa late musculature extends from the pharynx at the level of palate, inferiorly to the tonsillar area. The right and left muscles of the soft palate attach to the distal aspect of hard palate and then intermingle on the entire midline length of soft palate, forming an aponeurosis. Simultaneous contraction of these bilateral muscles causes midline elevation of soft palate.As a result, the soft palate elevates, the pharyngeal wall moves anteriorly and medially

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at the level of soft palate elevation, which is in the line with plane of hard palate and atlas of C1.[3]

The sphincter formed by the soft palate and pharyngeal wall tightly closes and prevents any passage of liquid or food into the nasopharynx during deglutition. During phonation, the soft palate also elevates, and the pharyngeal wall moves anteriorly and medially, but movement of these structures is usually less dramatic than the sphincter movement that occurs in swallowing. The failure of soft palate to elevate during speech results in air leak.[4] These functional movements of soft palate and pharyngeal walls during speech and swallowing is called "velopharyngeal closure".[3]

Velopharyngeal closure refers to the normal apposition of the soft palate, or velum, with the posterior and lateral pharyngeal walls. It is primarily a sphincteric mechanism consisting of a velar component and a pharyngeal component. The upward and backward movement of the velum, coupled with the mesial movement of the lateral pharyngeal walls and the slight anterior movement of the posterior pharyngeal walls, separates the oral cavity from the nasal cavity during deglutition and speech. 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 deglutition.[5]

The definitive palate (or secondary palate) develops in the human foetus between the sixth and eighth week of intra-uterine life. By the sixth week of development, the primitive nasal cavities are separated by a primary nasal septum and are partitioned from the primitive oral cavity by a primary palate. During the eighth week of development, the stomodeum enlarges, the tongue 'drops' and the vertically-inclined palatal shelves become horizontal. On becoming horizontal, the palatal shelves contact each other (and the secondary nasal septum) in the midline to form the definitive or secondary palate. The shelves contact the primary palate anteriorly so that the oronasal cavity becomes subdivided into its constituent oral and nasal cavities. After contact, the medial edge epithelia of the two shelves fuse to form a "midline epithelial seam" (MES). Subsequently, this degenerates so that mesenchymal continuity is established across the now intact, and horizontal, secondary palate. Fusion of the palatal processes is complete by the twelfth week of development. Behind the secondary nasal septum, the palatal shelves fuse to form the soft palate and uvula.[6]

Soft palate dysfunctions are frequently seen in cleft lip and palate patients. They may also be observed in some syndromic patients or even in normal individuals and occasionally may contribute to hypernasal speech and misarticulation. Soft palate dysfunctions can be classified as morphologically incompetent (absolute) where the soft palate length (SPL) is not adequate for velopharyngeal closure and functional incompetence (relative), and where the soft palate dimensions are normal but dysfunction occurs as a result of insufficient muscular activity, particularly of the levator veli palatini. As a consequence of this muscle action, the soft palate plays a considerable role in regulating the size of the orifice of the velopharynx.[7]

Assessment of difficult airway in patients begins with comprehensive history and physical examination. Specific tests for assessment anatomical criteria relative to tongue/pharyngeal size is Mallampati test.[7]

Soft palate function and development can be monitored and recorded using a nasopharyngeal fiberscope and magnetic resonance imaging (MRI) methods. On the other hand, Cephalometry is easy to use, economical, and can provide definite and quantitative information about the soft palate and nasopharynx.[8] The lateral view is by far the most valuable view for evaluation of the soft palate as there is extensive bone and soft tissue overlap on other views. The AP view, however, is useful in evaluation of the lateral pharyngeal walls and uvular deviation. With the head in extension in the AP view, the soft palate is projected above the hard palate.[9]

This study aims to view morphologic variety of soft palate using clinical assessment and Cephalometric radiography for normal individuals.

II. MATERIAL AND METHODS

This study was conducted in the Department of Oral Medicine and Radiology, Kanti Devi Dental College & Research Centre, Mathura, Uttar Pradesh after obtaining approval from ethical committee. The study group comprised of 200 subjects in the age group of 20-25 years which included 100 males and 100 females drawn from OPD of K. D. Dental College and Hospital, Mathura who were subjected to clinical assessment and Lateral Cephalometric views, the study subjects were considered based on the following inclusion and exclusion criteria.

➢ *Inclusion Criterion:*

- Individuals giving their consent.
- Systemically healthy individuals.
- Subjects above 20 years of age.

➢ *Exclusion Criterion:*

On the basis of clinical examination:

- Pregnancy
- Individuals giving history of trauma or any surgery of skull or soft tissues.
- Systemic diseases, bone diseases or any nutritional disorder.
- Individuals having any developmental anomaly of head and neck.

➢ *On the Basis of Digital Radiographic Examination:*

- Radiographs in which soft palate cannot be seen.
- Radiographs of poor quality for interpretation.
- Radiographs with faults.

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➢ *Materials for Clinical Examination of the Patient:*

- Physiological dental chair with provision of artificial illumination.
- A pair of sterile gloves.
- Mouth mask.
- One pair sterilized mouth mirror
- One sterilized straight probe
- One sterilized tweezer
- One sterilized kidney tray
- Sterilized gauze piece
- Sterilized cotton
- Disposable plastic glass
- 0.2% chlorhexidine gluconate mouth rinse.

➢ *Materials Required for Taking Digital Lateral Cephalogram Radiograph:*

Promax II Digital X-ray unit (Planmeca, Helsinki, Finland) with Toshiba D-054SB-P X-ray tube, focal spot size 0.5mm x 0.5mm according to IEC 336, total filtration 2.5mm Aluminium, anode voltage 54-84 kV ± 5 %, anode current 1-16 mA ± 10%.

➢ *Sensor Details:*

CCD active surface area – 9 x 136 mm;

CCD pixel size: 33µm

- HCL computer with Pentium D CPU 2.66 GHz 512 MB RAM and monitor.
- Planmeca Dimaxis Pro 4.1.4 software
- Lead apron
- *Materials required for measuring length, width of soft palate and pharyngeal space*
- Planmeca Dimaxis Pro 4.1.4 software

III. METHODOLOGY

The approval for the study was taken from the ethical committee of the institution. The informed consent was taken from the patients who participated in the study.

➢ *Clinical Examination:*

The subjects were made to sit comfortably in the physiological dental chair with artificial illumination. Then diluted 0.2% chlorhexidine gluconate mouth wash was given to rinse the oral cavity. Wearing the hand gloves and mouth mask, subjects were examined under the artificial illumination. Detailed clinical examination were carried out on all patients enrolled for study to rule out any pathology or the diseased state.

➢ *Mallampatti Test:*

The Mallampati classification correlates tongue size to pharyngeal size. This test is performed with the patient in the sitting position, head in a neutral position, the mouth wide open and the tongue protruding to its maximum. Patient should not be actively encouraged to phonate as it can result in contraction and elevation of the soft palate leading to a spurious picture. Classification is assigned according to the extent the base of tongue is able to mask the visibility of pharyngeal structures into four classes:

- Class I: Visualization of the soft palate, fauces; uvula, anterior and the posterior pillars.
- Class II: Visualization of the soft palate, fauces and uvula.
- Class III: Visualization of soft palate and base of uvula.
- Class IV: Only hard palate is visible. Soft palate is not visible at all.[31]

➢ *Digital Lateral Cephalogram View Radiographic Examination:*

The entire procedure was explained to the patient and was positioned properly in the digital X-ray machine as described by White S & Pharoah M (2009).[32]

The subject demographic data was fed into the computer software. Subjects were instructed to remove ear rings, necklaces, hairpins, and any other metallic objects in the head and neck region. The patient was made to wear a protective lead apron. The subject was made to stand under the X-ray machine and the machine was adjusted by pressing the adjusting buttons. Press the release lever and slide the ear posts out and also slide the nasal pointer out. Position the patient between the two ear posts so that the patient is facing the nasal positioned. Press the release level & very carefully slide the positioning cones into the patient's ears then slide the nasal positioner towards the patient until it touches the patient's nasion & then by sliding the nasal positioned up or down, adjust the angle of the patient's head until the Frankfort plane is horizontal. Patient is positioned with his/her midsagittal plane parallel to plane of sensor. In Lateral Cephalometric view, the patient is placed with the midsagittal plane parallel to plane of sensor. The Frankfurt Horizontal plane of the patient is parallel to the floor. The central beam is perpendicular to midsagittal plane of the patient. The exposure parameters were set at 68 kVp, 5mA and 18 seconds and was used throughout the study. The obtained image was displayed on the computer screen with the aid of software.

The final selection of 200 patients were done after evaluation of Lateral Cephalogram radiographs out of which 100 males and 100 females were selected.

➢ *Interpretation of Lateral Cephalometric View*

The interpretation of Digital Lateral Cephalogram was done using Planmeca Dimaxis Classic 4.1.4 version software. Different enchancement tools were used, such as magnification, brightness, contrast, sharpening as well as softening filter provided by the software of the system, to modify the images to increase the resolution upto the observer's optimum visible perception thus to minimize the bias with measurements. Using the digital ruler, the variables (height and width) were determined and measured directly on the computer screen.

The soft palate morphology will be identified. The following measurements will be taken: soft palate length, soft palate width, superior pharyngeal airway space, middle

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pharyngeal airway space and inferior pharyngeal airway space.

All the proformas were filled after obtaining record of identification, measurements & calculations of above mentioned parameters for each sample.

IV. RESULTS

In the present study, 200 subjects were evaluated clinically for anatomic tongue pharyngeal airway (Table 1)

Table 1 Distribution and Proportion of Mallampati Class Types

	Mallampati Classes Types				Total
	Class I	Class II	Class III	Class IV	
n	79	69	34	18	200
Proportion (%)	39.5	34.5	17.0	9.0	100

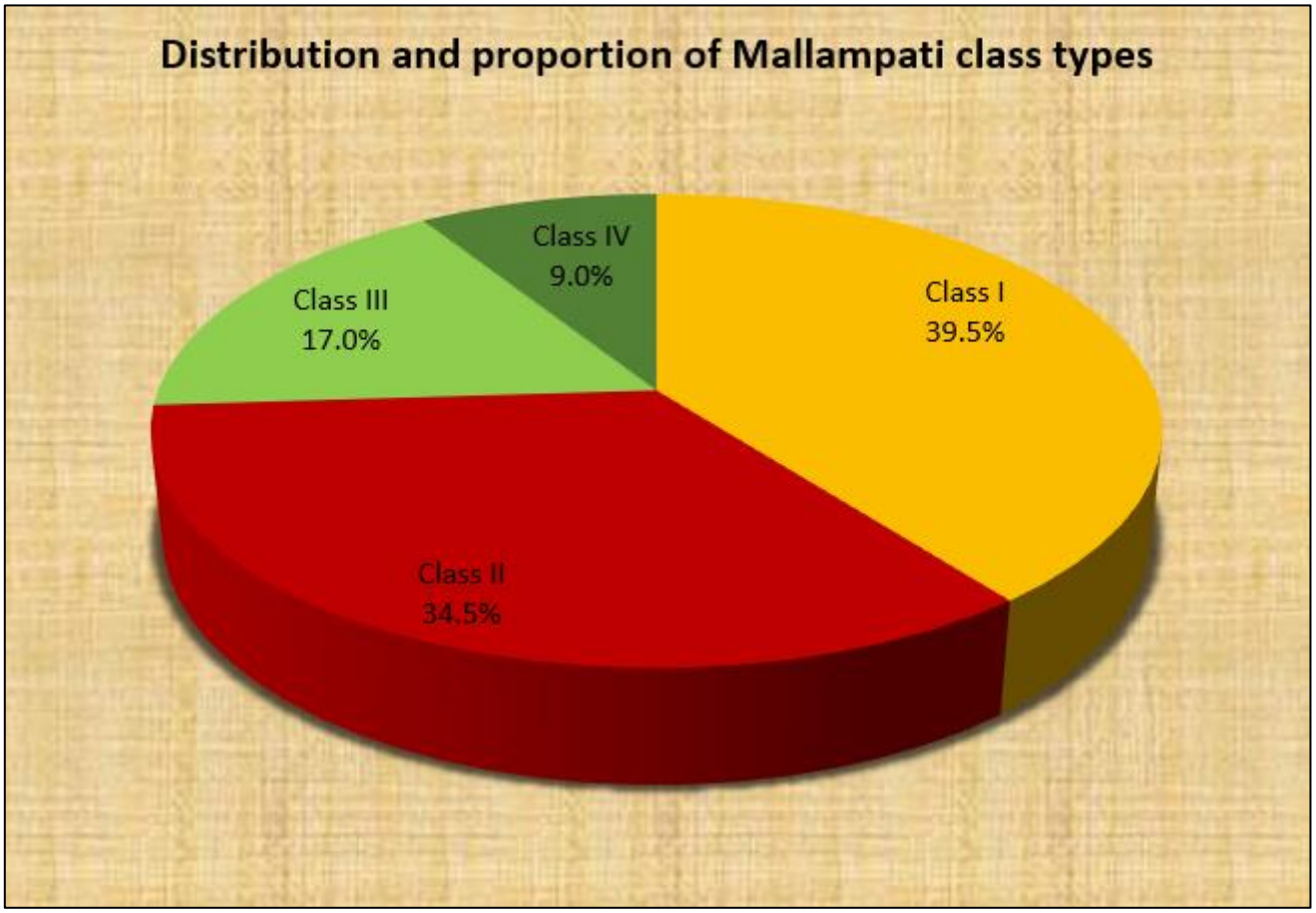

Fig 1 Distribution and Proportion of Mallampati Class Types

➢ *Observations:*

- Among 200 subjects, 79/200 (39.5%) showed Class I, 69/200 (34.5%) showed Class II Mallampati class.
- 34/200 (17.0%) showed Mallampati Class III and 18/200 (9.0%) Class IV.

➢ *Inference:*

- In normal individuals, Mallampati Class I has the highest frequency.

The soft palate morphology radiographically was classified according to M You et al (2008)

Table 2 Distribution and Proportion of Soft Palate Morphology Types

	Soft palate types						Total
	Leaf	Butt-shape	Crook	Rat-tail	S-shape	Straight-line	
n	132	9	10	38	5	6	200
Proportion (%)	66.0	4.5	5.0	19.0	2.5	3.0	100.0

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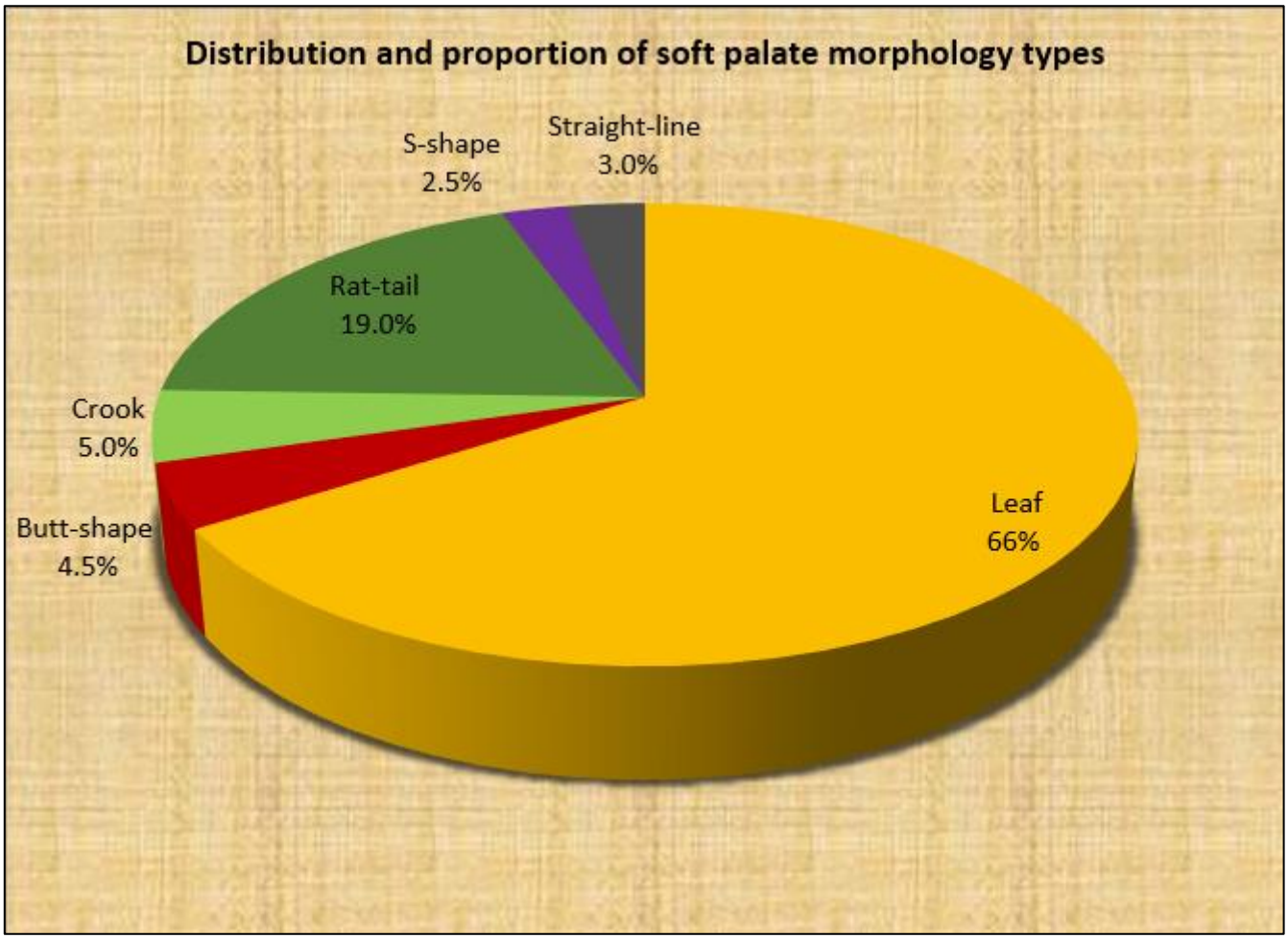

Fig 2 Distribution and Proportion of Soft Palate Morphology Types

➢ *Observations:*

- Out of 200 subjects, 132 (66%) had leaf type, 38(19.0%) had Rat-tail type soft palate morphology.
- 10(5%) had Crook type, 9(4.5%) had Butt type, 6(3%) had Straight line and 5(2.5%) had S-shape soft palate morphology.

➢ *Inference:*

- Leaf type soft palate morphology is the most common type followed by Rat-tail type.

The soft palate type and the distribution in males and females was evaluated (Table 3)

Table 3 Comparison of Soft Palate Type and Gender Distribution

Gender	**Soft palate**	**Total**					
	Leaf	**Butt-shape**	**Crook**	**Rat-tail**	**S-shape**	**Straight-line**	
F	52	4	5	34	2	3	100
M	80	5	5	4	3	3	100
Total	132	9	10	38	5	6	200
Result: Chi-square value= 29.935; P = 0.000; Significant							

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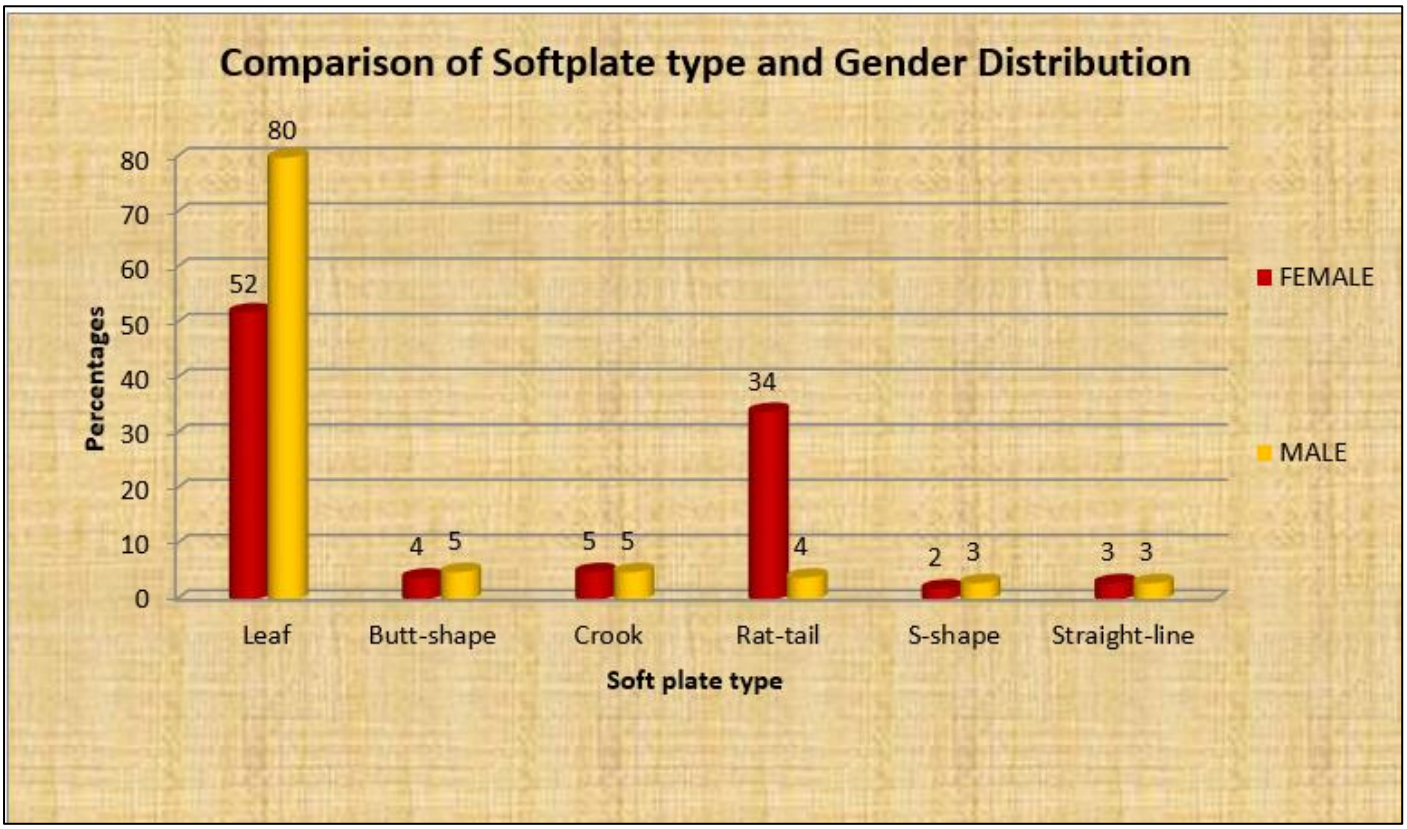

Fig 3 Comparison of Softplate Type and Gender Distribution

➢ *Observations:*

- In males, 80/100 showed Leaf type soft palate morphology and 5/100 Butt and Crook type with only 3/100 both S-shape and Straight line.
- In females, 34/100 showed Rat-tail type soft palate morphology and 52/100 Leaf type.

➢ *Inference:*

- In males, Leaf type is the commonest type of soft palate.
- In females, Rat-tail is more seen.
- There is definite co-relation between soft palate type and gender distribution of soft palate morphology type.

The comparison of clinical assessment (Mallampati test) and radiographic Soft palate types was done (Table 4)

Table 4 Comparison Between Mallampati Class and Soft Palate Type

Mallampati test class	Soft palate						Total
	Leaf	Butt-shape	Crook	Rat-tail	S-shape	Straight-line	
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Class I	50 (63.3)	5 (6.3)	5 (6.3)	16 (20.3)	2 (2.5)	1 (1.3)	79 (100.0)
Class II	42 (60.9)	3 (4.3)	4 (5.8)	16 (23.2)	2 (2.9)	2 (2.9)	69 (100.0)
Class III	25 (73.5)	0 (0.0)	1 (2.9)	5 (14.7)	0 (0.0)	3 (8.8)	34 (100.0)
Class IV	15 (83.3)	1 (5.6)	0 (0.0)	1 (5.6)	1 (5.6)	0 (0.0)	18 (100.0)
Total	132 (66.0)	9 (4.5)	10 (5.0)	38 (19.0)	5 (2.5)	6 (3.0)	200 (100.0)
Result: Chi-square value= 14.684; P = 0.474; Not Significant							

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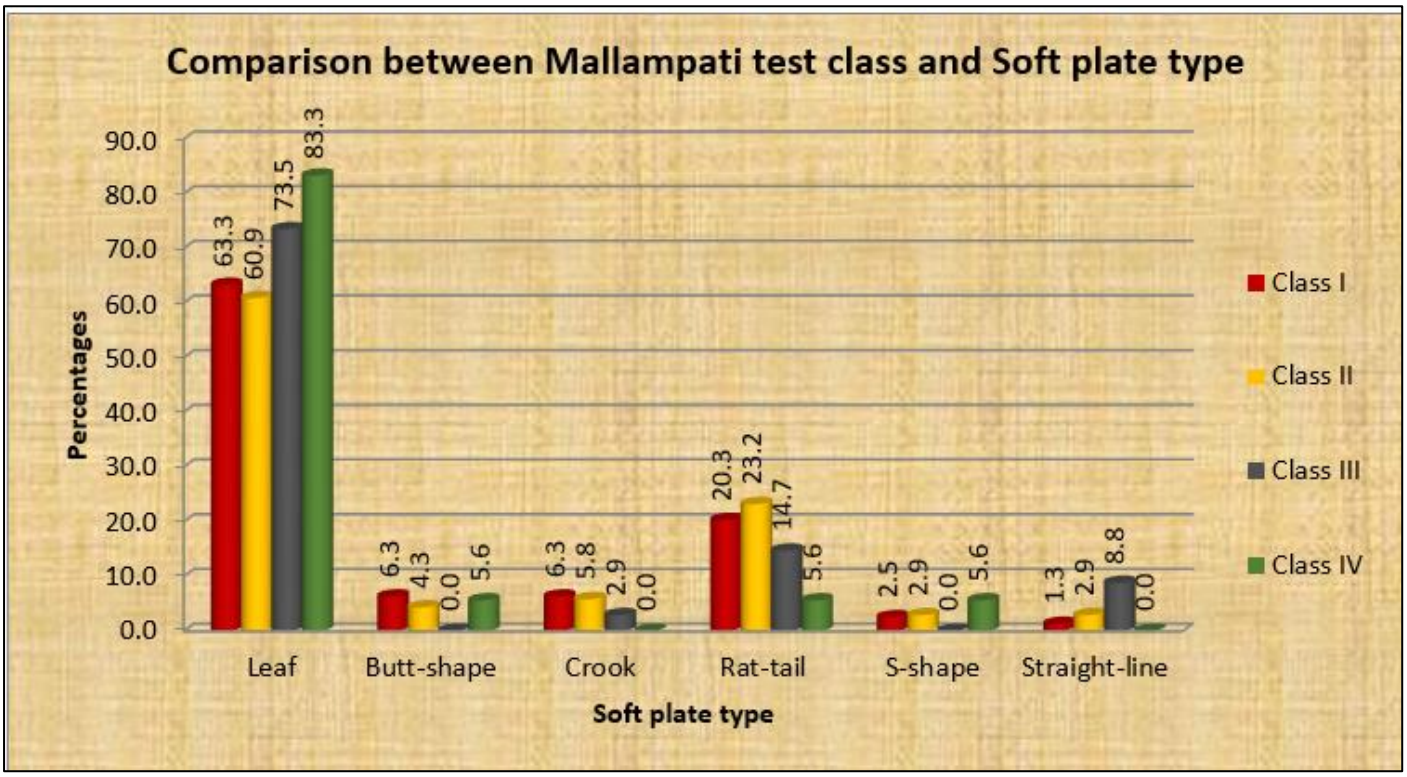

Fig 4 Comparison Between Mallampati Test Class and Soft Plate Type

➢ *Observations:*

- Out of 200 subjects, 50/79 (63.3%) of Class I showed Leaf type, 42/69 (60.9%) showed Leaf type of Class II, 25/34 (73.5%) of Class III showed Leaf type and 15/18 (83.3%) of Class IV showed Leaf type.
- The same observations pertain to other soft palate types.

➢ *Inference:*

- There is no significant co-relation between clinical Mallampati class and soft palate types.

The comparison of mean soft palate length was done by evaluating through One way ANOVA test (Table 5)

Table 5 Mean Comparison of Soft Palate Length

Soft Plate	Length of soft palate					F VALUE	P VLAUE
	N	Mean	SD	MIN	M0AX		
Leaf	132	32.07	4.03	20.90	43.30	0.655	0.658 Not significant
Butt-shape	9	31.00	2.73	26.00	35.60		
Crook	10	30.27	3.41	25.40	36.50		
Rat-tail	38	31.32	3.63	20.60	37.80		
S-shape	5	32.26	3.04	28.70	35.60		
Straight-line	6	32.43	6.49	23.00	41.20		
Total	200	31.80	3.93	20.60	43.30		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

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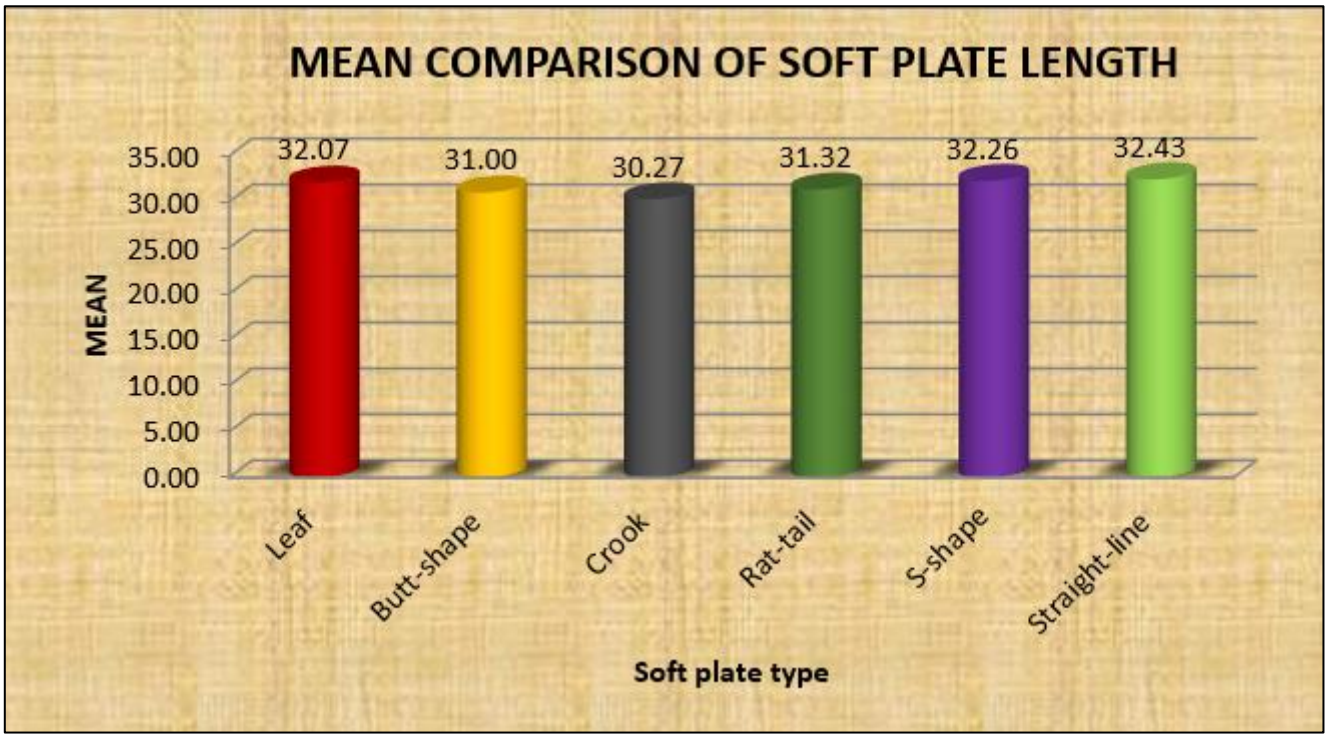

Fig 5 Mean Comparison of Soft Plate Length

➢ *Observations:*

- The Leaf type 132/200 showed maximum variation (20.90 – 43.30 mm).
- The mean length of soft palate for leaf type is 32.07mm, Crook type is 30.27mm, Rat-tail type is 31.32mm, Butt-type is 31.00mm, S shape is 32.26mm and Straight line is 32.43 mm.
- Both F value (0.655) and P value (0.658) are > 0.05.

➢ *Inference:*

- The length of soft palate does not co-relate with the soft palate morphology type.

The comparison of mean soft palate width with soft palate type was done using One way ANOVA test (Table 6)

Table 6 Mean Comparison of Soft Palate Width

Soft Plate	Width of soft palate					F VALUE	P VLAUE
	N	Mean	SD	MIN	MAX		
Leaf	132	8.30	1.75	3.40	13.70	15.504	0.000 Significant
Butt-shape	9	9.12	1.33	8.10	12.50		
Crook	10	9.13	1.78	7.10	13.20		
Rat-tail	38	6.73	1.13	3.90	9.30		
S-shape	5	6.74	1.58	4.80	8.30		
Straight-line	6	3.90	1.35	2.30	5.60		
Total	200	7.91	1.89	2.30	13.70		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

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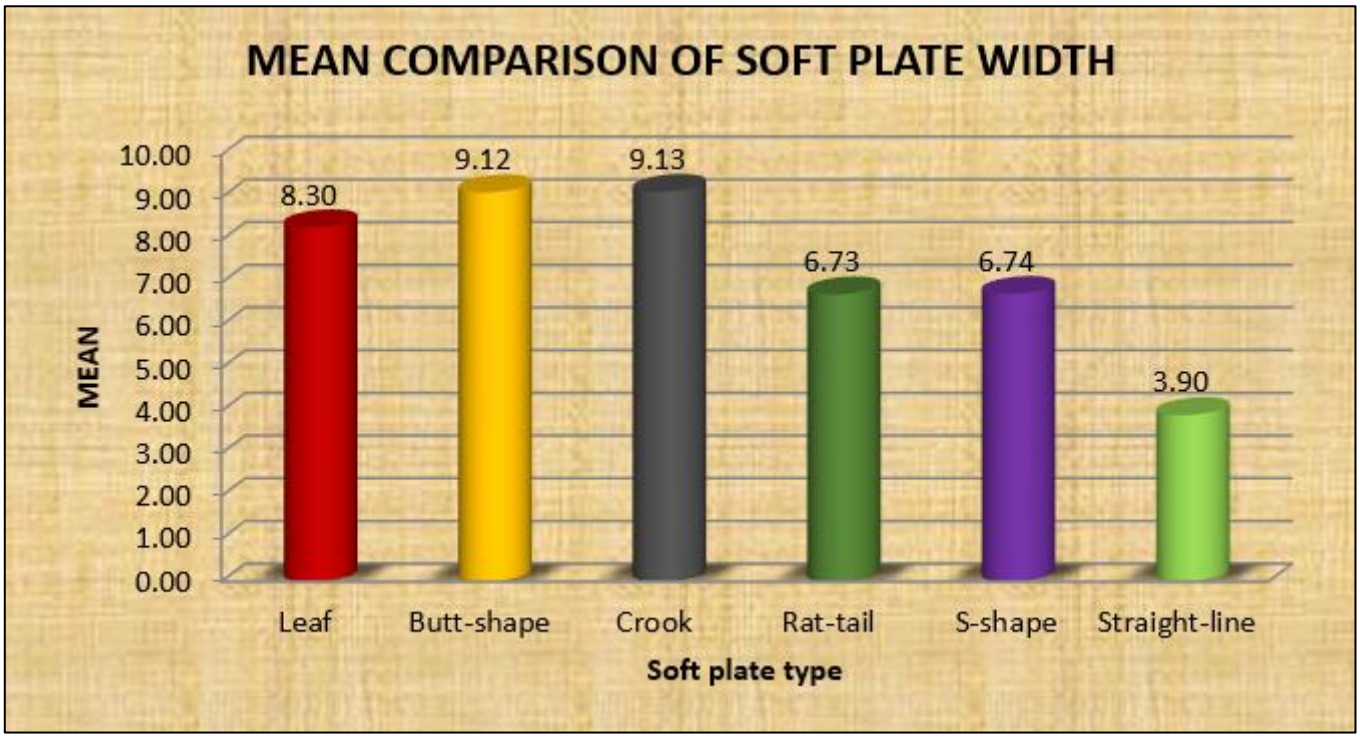

Fig 6 Mean Comparison of Soft Plate Width

➢ *Observations:*

- Out of 200 subjects, the greatest mean width of soft palate was observed in Butt-type and Crook type 9.12 and 9.13 mm respectively.
- The Leaf type showed mean width of 8.30mm.
- The Rat-tail and S-shape showed mean width of 6.73 and 6.74mm respectively.
- The least mean width of soft palate was observed in Straight line type.
- The P value is 0.000 that shows high significance.

➢ *Inference:*

- The soft palate width co-relates with the soft palate type.

The comparison of mean velopharyngeal space among different types of soft palate was evaluated using One way ANOVA test (Table 7)

Table 7 Mean Comparison of Velopharyngeal Space – Superior Among Different Types of Soft Palate

Soft Plate	Velopharyngeal Space-SUP					F VALUE	P VLAUE
	N	Mean	SD	MIN	MAX		
Leaf	132	12.28	2.73	5.00	18.60	2.537	0.030 Significant
Butt-shape	9	9.52	3.29	2.80	14.10		
Crook	10	13.07	2.65	8.90	16.90		
Rat-tail	38	12.16	2.41	6.10	19.00		
S-shape	5	12.32	1.77	10.10	14.40		
Straight-line	6	13.87	1.99	11.80	17.40		
Total	200	12.22	2.71	2.80	19.00		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

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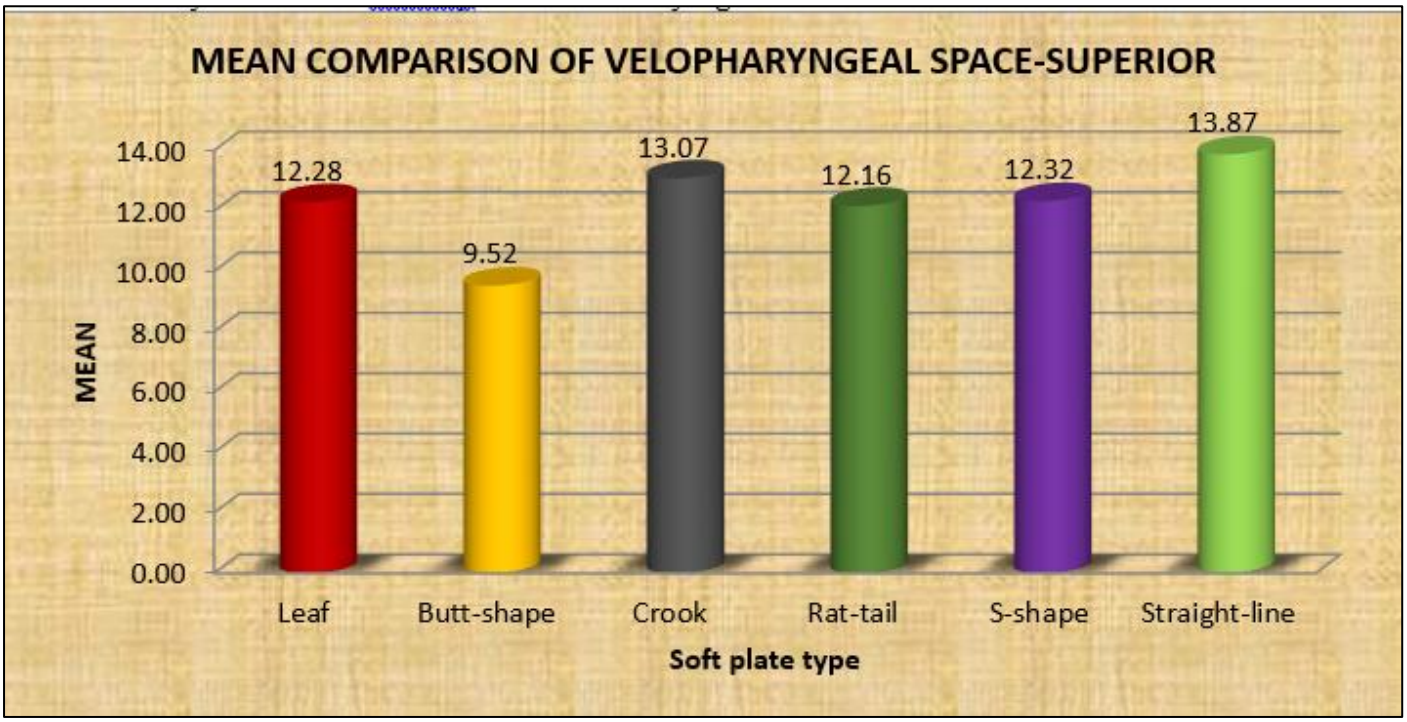

Fig 7 Mean Comparison of Velopharyngeal Space-Superior

➢ *Observations:*

- The greatest velopharyngeal space – superior is in Straight line type of soft palate. The Crook type shows mean superior velopharyngeal space 13.07 mm. The Butt-type shows the least mean superior velopharyngeal space 9.52 mm.
- The P value is 0.03 which is <0.05 showing high significance for superior velopharyngeal space among soft palate types.

➢ *Inference:*

- The Butt-type shows least superior velopharyngeal space and Straight line shows the greatest superior velopharyngeal space.
- Superior velopharyngeal space is in co-relation with soft palate types.

The mean comparison of middle velopharyngeal space among different types of soft palate was evaluated using One way ANOVA test (Table 8)

Table 8 Mean Comparison of Velopharyngeal Space – Middle Among Types of Soft Palate

Soft Palate	Velopharyngeal space-MIDDLE					F VALUE	P VLAUE
	N	Mean	SD	MIN	MAX		
Leaf	132	11.58	3.07	5.00	20.90	9.165	0.000 Significant
Butt-shape	9	10.34	3.36	6.40	17.70		
Crook	10	13.79	2.74	9.20	18.90		
Rat-tail	38	10.75	2.93	5.00	19.80		
S-shape	5	12.50	23.98	10.70	21.10		
Straight-line	6	12.13	2.87	7.90	15.90		
Total	200	12.02	7.68	5.00	111.10		

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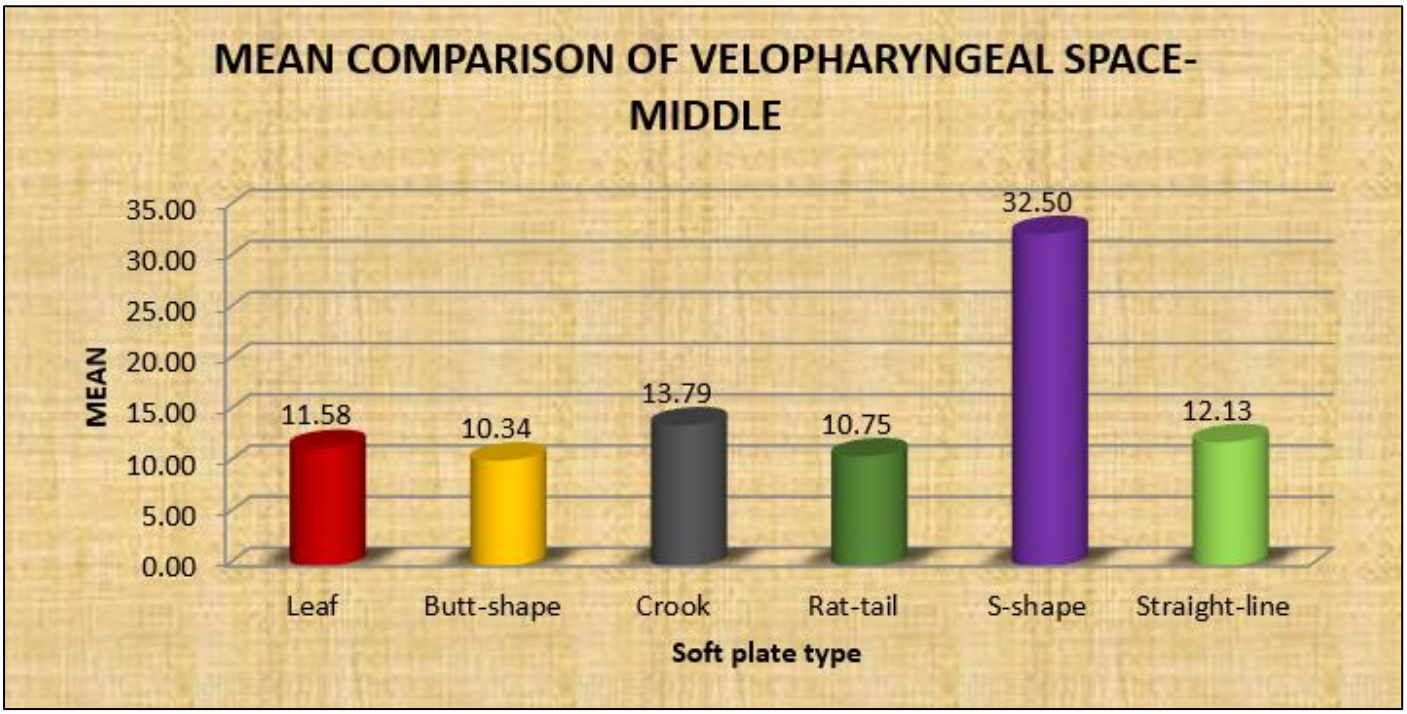

Fig 8 Mean Comparison of Velopharyngeal Space-Middle

➢ *Observations:*

- The greatest middle velopharyngeal space 13.79 mm is observed in Crook type with least middle velopharyngeal space 10.34 mm in Butt-type soft palate morphology.
- The P value is 0.00 which is < 0.05 shows high significance for middle velopharyngeal space and soft palate type.

➢ *Inference:*

- Middle velopharyngeal space is in co-relation with soft palate types with greatest in Crook type and least in Butt type.

The mean comparison of inferior velopharyngeal space among different types of soft palate was evaluated using Anova one way test (Table 9)

Table 9 Mean Comparison of Velopharyngeal Space – Inferior Among Types of Soft Palate

Soft Palate	Velopharyngeal Space-INFERIOR					F VALUE	P VLAUE
	N	Mean	SD	MIN	MAX		
Leaf	132	10.44	3.27	2.80	19.60	2.613	0.026 Significant
Butt-shape	9	10.36	4.63	5.50	21.10		
Crook	10	11.18	3.21	4.70	14.90		
Rat-tail	38	8.41	3.67	2.80	17.30		
S-shape	5	12.00	4.18	6.10	17.70		
Straight-line	6	9.53	4.00	6.50	17.30		
Total	200	10.10	3.52	2.80	21.10		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

➢ *Observations:*

- The greatest inferior velopharyngeal space among soft palate is S-shape 12.00 mm.
- The least inferior velopharyngeal space among soft palate is observed in Rat-tail type of soft palate.
- The P value is 0.026 which is < 0.05 shows significance for soft palate type and inferior velopharyngeal space.

➢ *Inference:*

- The inferior velopharyngeal space is in co-relation with soft palate types with greatest in S-shape and least in Rat-tail type.

The mean comparison between soft palate types and length and width of soft palate evaluated using Tukey Post Hoc test (Table 10)

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Table 10 Mean Comparison Between Soft Palate Types

Soft Plate Comparison between	Length of Soft Palate	Width of Soft Palate	Velopharyngeal Space		
			Superior	Middle	Inferior
	P value	P value	P value	P value	P value
Leaf vs Butt-shape	0.970 NS	0.678 NS	0.035 S	0.996 NS	1.000 NS
Leaf vs Crook	0.734 NS	0.620 NS	0.945 NS	0.929 NS	0.986 NS
Leaf vs Rat-tail	0.905 NS	0.000 S	1.000 NS	0.987 NS	0.020 S
Leaf vs S-shape	1.000 NS	0.288 NS	1.000 NS	0.000 S	0.920 NS
Leaf vs Straight-line	1.000 NS	0.000 S	0.709 NS	1.000 NS	0.989 NS
Butt-shape vs Crook	0.999 NS	1.000 NS	0.047 S	0.892 NS	0.995 NS
Butt-shape vs Rat-tail	1.000 NS	0.001 S	0.086 NS	1.000 NS	0.652 NS
Butt-shape vs S-shape	0.993 NS	0.094 NS	0.414 NS	0.000 S	0.957 NS
Butt-shape vs Straight-line	0.983 NS	0.000 S	0.027 S	0.997 NS	0.998 NS
Crook vs Rat-tail	0.976 NS	0.001 S	0.928 NS	0.825 NS	0.217 NS
Crook vs S-shape	0.941 NS	0.081 NS	0.996 NS	0.000 S	0.998 NS
Crook vs Straight-line	0.896 NS	0.000 S	0.992 NS	0.997 NS	0.940 NS
Rat-tail vs S-shape	0.996 NS	1.000 NS	1.000 NS	0.000 S	0.249 NS
Rat-tail vs Straight-line	0.987 NS	0.001 S	0.687 NS	0.998 NS	0.977 NS
S-shape vs Straight-line	1.000 NS	0.048 S	0.930 NS	0.000 S	0.846 NS

Statistical Analysis: Tukey Post Hoc Test. Statistically Significant If P<0.05

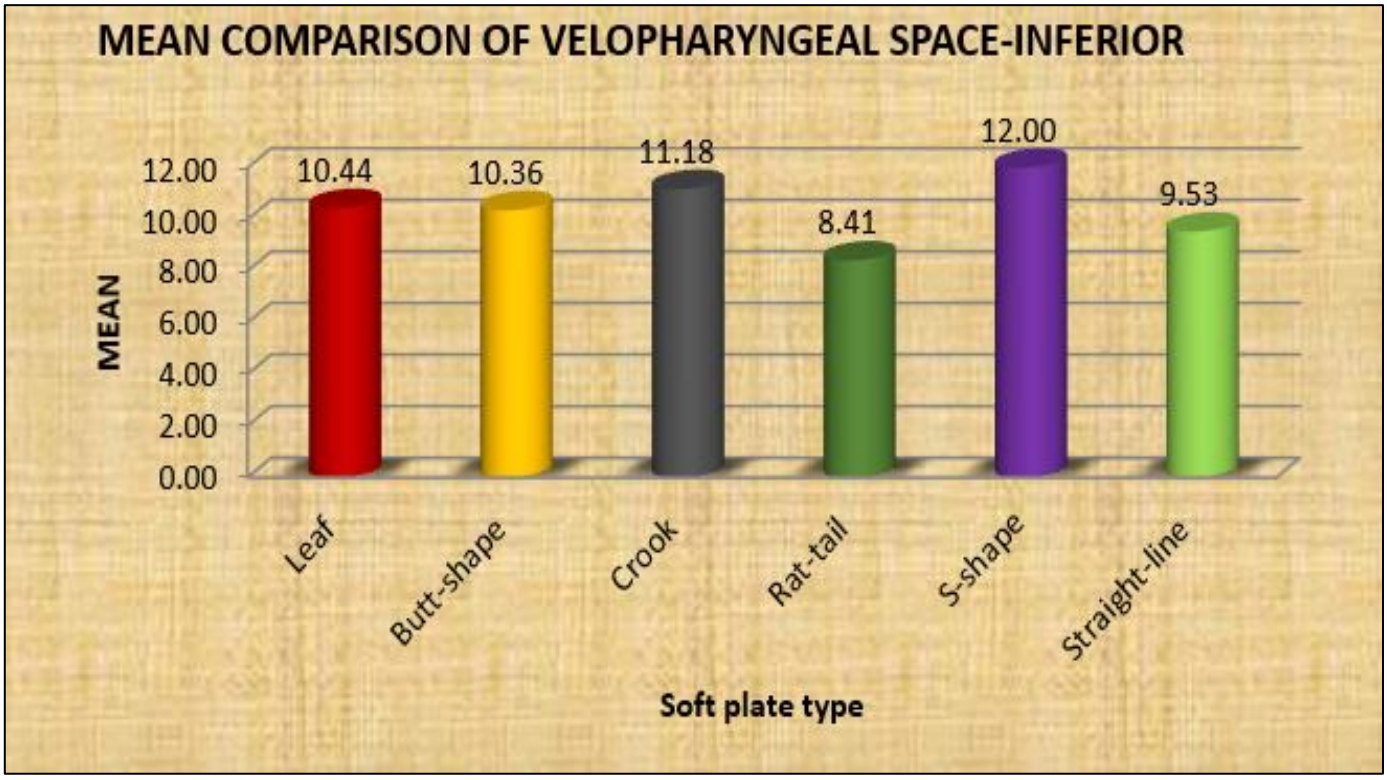

Fig 9 Mean Comparison of Velopharyngeal Space-Inferior

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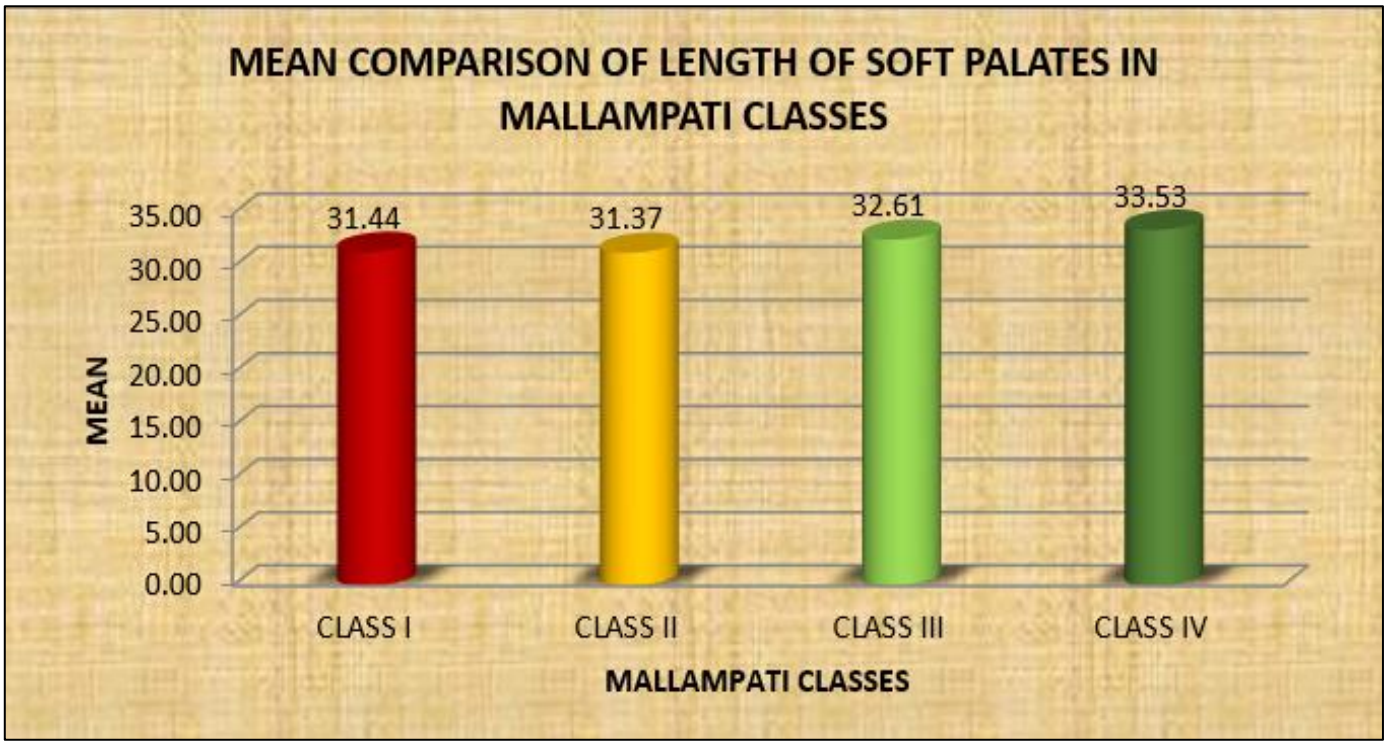

Fig 10 Mean Comparison of Length of Soft Palates in Mallampati Classes

➢ *Observations:*

- Width of soft palate shows significance between leaf vs rat-tail, leaf vs straight line, butt type vs rat-tail, crook vs rat-tail, butt vs straight line, crook vs straight line and rat-tail vs straight line.
- Superior velopharyngeal space shows significance for butt type vs crook and straight line.
- Middle velopharyngeal space shows significance for s shape vs leaf, butt type and rat-tail type.
- Inferior velopharyngeal space shows significance for leaf vs rat-tail type.

➢ *Inference:*

- Length of soft palate does not show any co-relation between soft palate types.
- Width of soft palate shows high significance for soft palate types.
- Superior, middle and inferior velopharyngeal space shows co-relation among types of soft palate.

The mean comparison of length of soft palate types in Mallampati classes was evaluated using One way ANOVA test (Table 11)

Table 11 Mean Comparison of Length of Soft Palate Types in Mallampati Classes

Mallampati test class	Length of Soft Palate					F VALUE	P VLAUE
	N	Mean	SD	MIN	MAX		
CLASS I	79	31.44	3.94	22.40	43.30	2.175	0.092 Not significant
CLASS II	69	31.37	4.10	20.60	40.80		
CLASS III	34	32.61	3.89	20.90	41.20		
CLASS IV	18	33.53	2.67	29.90	39.10		
Total	200	31.80	3.93	20.60	43.30		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

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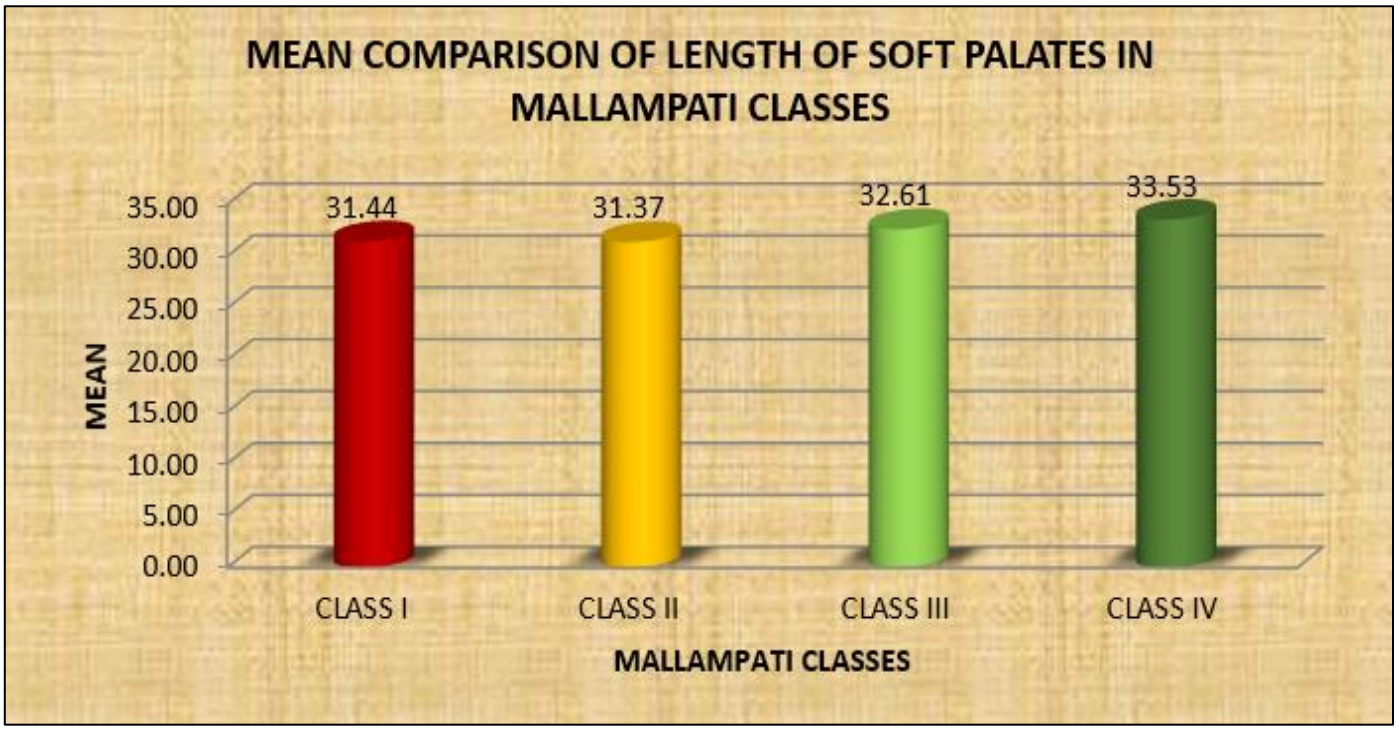

Fig 11 Mean Comparison of Length of Soft Palates in Mallampati Classes

➢ *Observations:*

- The length of soft palate was observed highest in class IV Mallampati class (33.53 mm).
- The P value is 0.092 which is > 0.05 showing no significance for soft palate length.

➢ *Inference:*

- The length of soft palate does not co-relate with the Mallampati classes.

The mean comparison of width of soft palate among Mallampati class is evaluated using One way ANOVA test (Table 12)

Table 12 Mean Comparison of Width of Soft Palate Among Mallampati Classes

Mallampati Test Class	Width of Soft Palate					F VALUE	P VLAUE
	N	Mean	SD	MIN	MAX		
CLASS I	79	7.81	1.73	3.40	13.20	1.321	0.269 Not significant
CLASS II	69	7.98	1.94	3.00	13.70		
CLASS III	34	7.61	2.03	2.30	10.90		
CLASS IV	18	8.65	2.08	5.30	12.50		
Total	200	7.91	1.89	2.30	13.70		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

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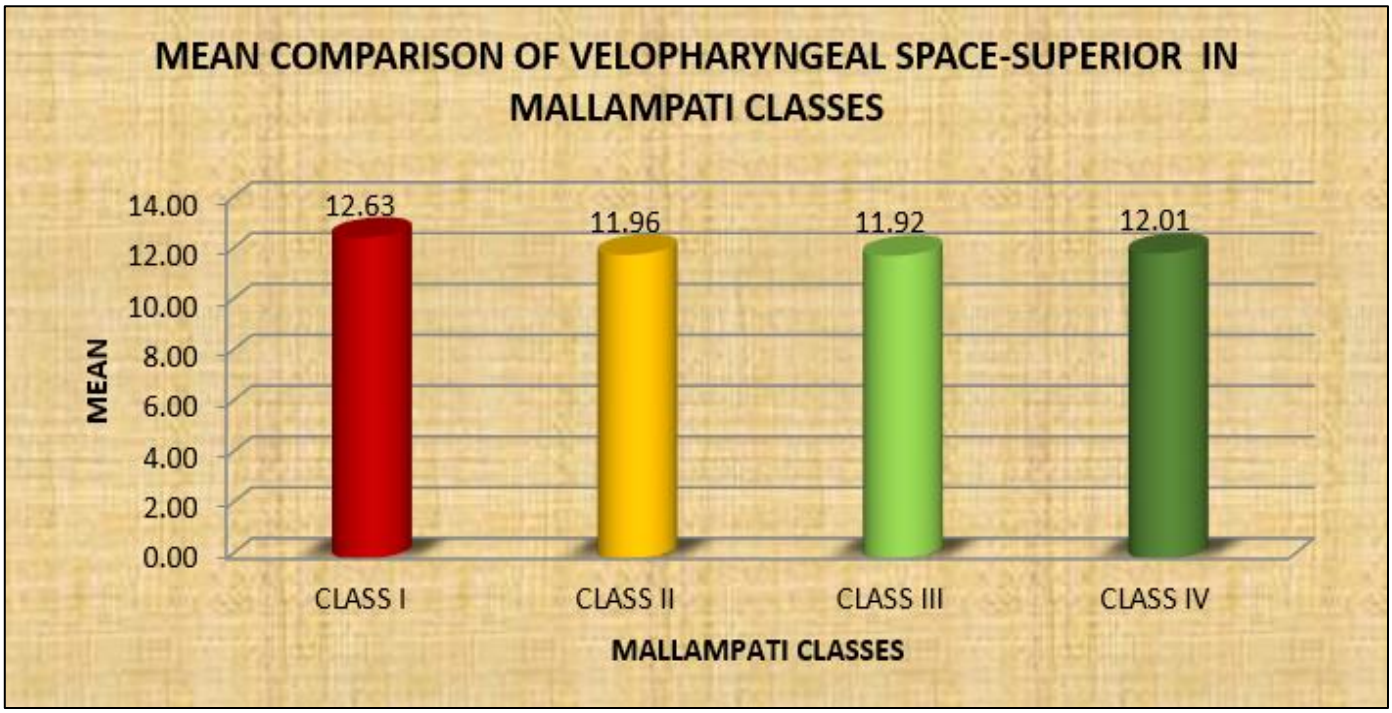

Fig 12 Mean Comparison of Velopharyngeal Space-Superior in Mallampati Classes

➢ *Observations:*

- The mean width of soft palate in Mallampati Class III is least 7.61 mm.
- The mean width of soft palate in Mallampati class IV is greatest 8.65 mm.
- The P value is 0.269 > 0.05 showing non significance for soft palate width among Mallampati classes.

➢ *Inference:*

- There is no co-relation between soft palate width and Mallampati classes.

The mean comparison of superior velopharyngeal space among Mallampati classes was evaluated using One way ANOVA test (Table 13)

Table 13 Mean Comparison of Velopharyngeal Space – Superior Among Mallampati Classes

Mallampati Test Class	Velopharyngeal Space-SUPERIOR					F VALUE	P VLAUE
	N	Mean	SD	MIN	MAX		
CLASS I	79	12.63	2.63	6.10	18.60	0.975	0.405 Not significant
CLASS II	69	11.96	2.63	5.00	18.40		
CLASS III	34	11.92	2.97	6.80	19.00		
CLASS IV	18	12.01	2.86	2.80	15.80		
Total	200	12.22	2.71	2.80	19.00		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

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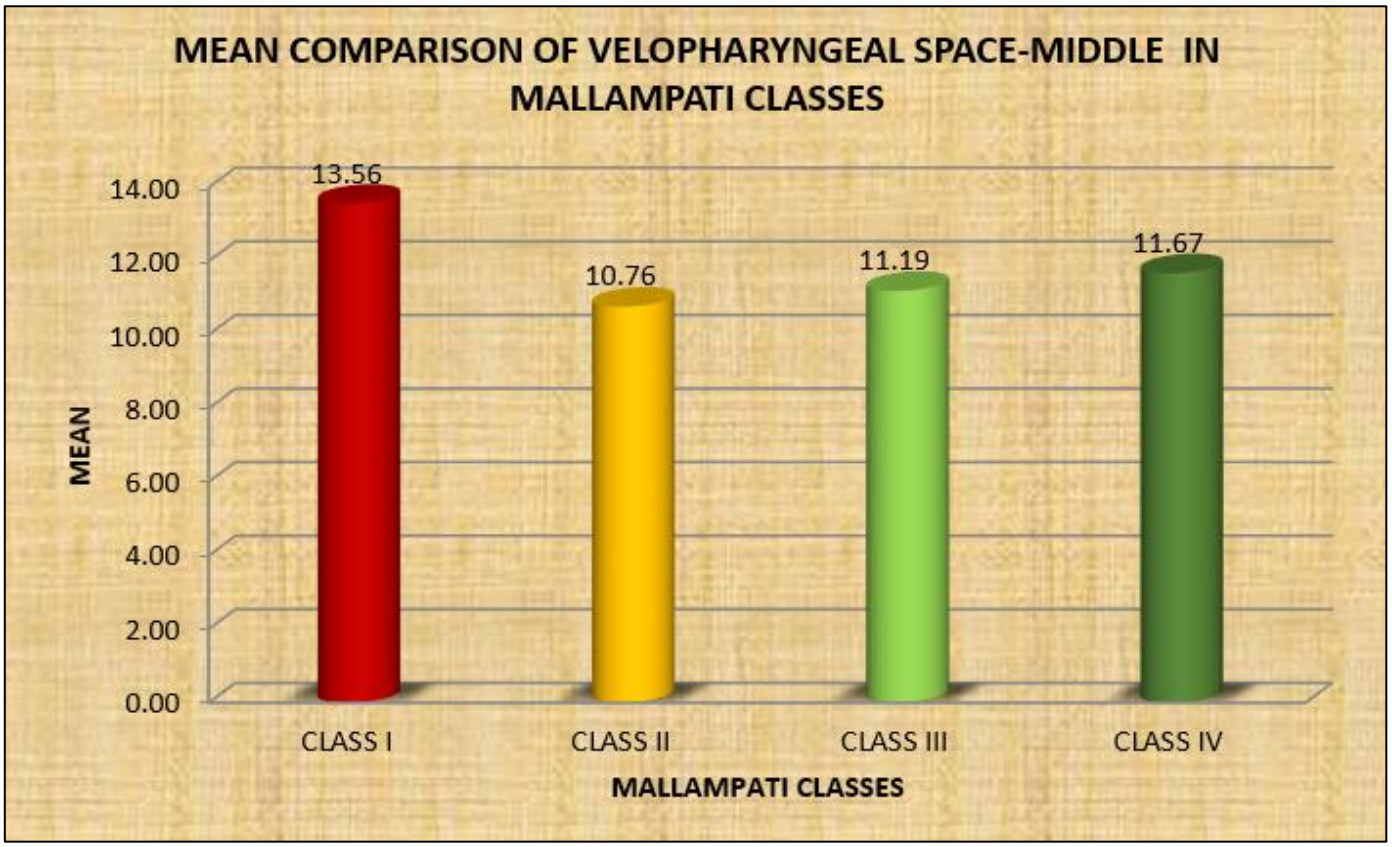

Fig 13 Mean Comparison of Velopharyngeal Space-Middle in Mallampati Classes

➢ *Observations:*

- The mean superior velopharyngeal space is greatest in Class I is 12.63 mm and least in Class III 11.92 mm.
- The P value is 0.405 > 0.05 showing non-significance for superior velopharyngeal space among Mallampati classes.

➢ *Inference:*

- Mean superior velopharyngeal space does not co-relate with Mallampati classes.

The mean comparison of middle velopharyngeal space among Mallampati classes using One way ANOVA test (Table 14)

Table 14 Mean Comparison of Velopharyngeal Space – Middle Among Mallampati Classes

Mallampati Test Class	Velopharyngeal Space-MIDDLE					F VALUE	P VLAUE
	N	Mean	SD	MIN	MAX		
CLASS I	79	13.56	11.60	5.00	111.10	1.845	0.140 Not significant
CLASS II	69	10.76	2.68	5.80	18.90		
CLASS III	34	11.19	2.72	5.00	16.10		
CLASS IV	18	11.67	3.28	6.90	17.50		
Total	200	12.02	7.68	5.00	111.10		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

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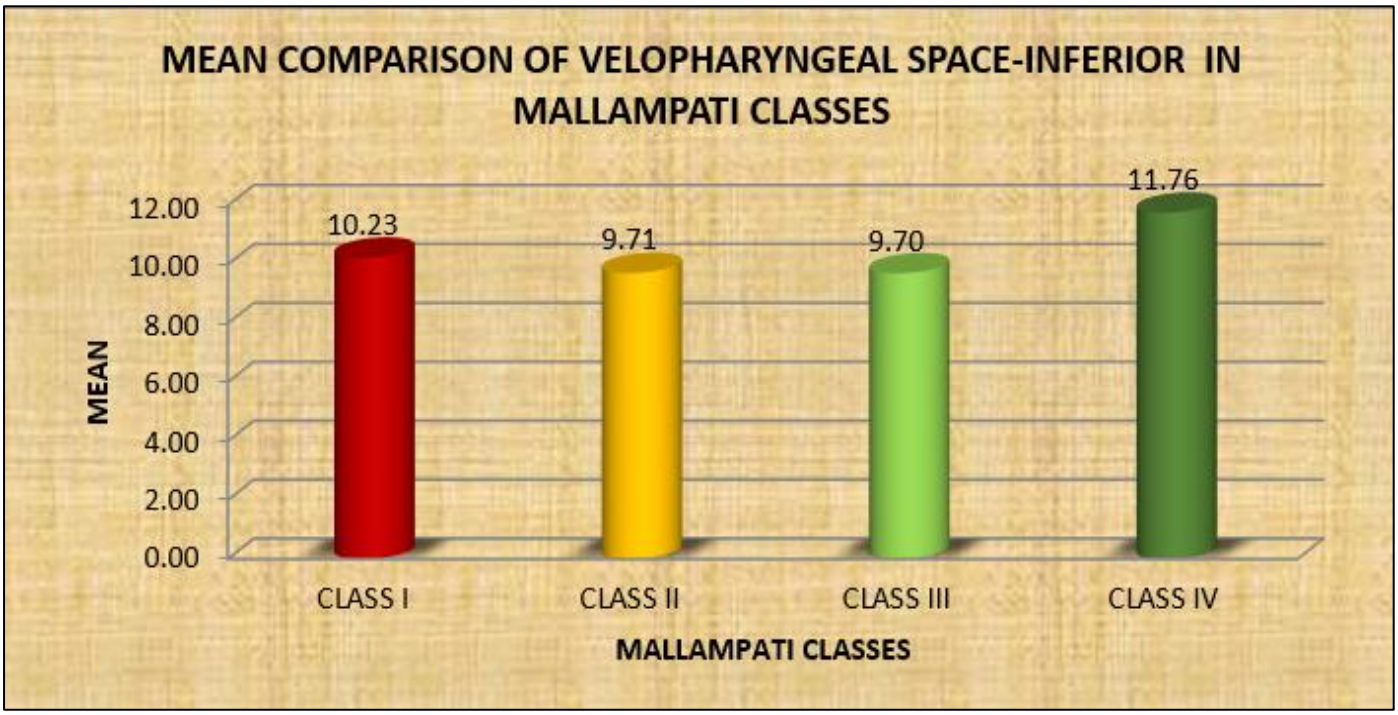

Fig 14 Mean Comparison of Velopharyngeal Space-Inferior in Mallampati Classes

➢ *Observations:*

- The mean middle velopharyngeal space is least 10.76 mm in Mallampati Class II.
- The greatest middle velopharyngeal space is 13.56 mm in Mallampati Class I.
- The P value is 0.140 > 0.05 which shows non significance for middle velopharyngeal space among Mallampati classes.

➢ *Inference:*

- The mean middle velopharyngeal space does not co-relate with Mallampati classes.

The mean comparison of inferior velopharyngeal space among Mallampati classes using One way ANOVA test (Table 15)

Table 15 Mean Comparison of Velopharyngeal Space – Inferior Among Mallampati Classes

Mallampati Test Class	Velopharyngeal Space-INFERIOR					F VALUE	P VALUE
	N	Mean	SD	MIN	MAX		
CLASS I	79	10.23	3.63	3.30	21.10	1.826	0.144 Not significant
CLASS II	69	9.71	3.25	4.00	18.70		
CLASS III	34	9.70	3.51	2.80	17.30		
CLASS IV	18	11.76	3.81	6.40	19.60		
Total	200	10.10	3.52	2.80	21.10		

Statistical Analysis: ANOVA One Way Test. Statistically Significant If P<0.05

➢ *Observations:*

- The mean inferior velopharyngeal space is greatest in Mallampati Class IV 11.76 mm and least 9.70 mm in Mallampati Class III.
- The P value is 0.144 > 0.05 which shows non-significance for Mallampati class and inferior velopharyngeal space.

➢ *Inference:*

- The mean inferior velopharyngeal space does not co-relate with Mallampati classes.

The mean comparison between Mallampati classes and length, width and velopharyngeal space using Tukey Post Hoc test (Table 16)

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Table 16 Mean Comparison Between Mallampati Classes

Mallampati Classes Comparison Between	Length Of Soft Palate	Width of Soft Palate	Velopharyngeal space		
			SUPERIOR	MIDDLE	INFERIOR
	P value	P value	P value	P value	P value
Class I vs Class II	0.999 NS	0.948 NS	0.449 NS	0.120 NS	0.800 NS
Class I vs Class III	0.460 NS	0.954 NS	0.581 NS	0.430 NS	0.883 NS
Class I vs Class IV	0.174 NS	0.322 NS	0.818 NS	0.779 NS	0.340 NS
Class II vs Class III	0.425 NS	0.785 NS	1.000 NS	0.993 NS	1.000 NS
Class II vs Class IV	0.160 NS	0.534 NS	1.000 NS	0.970 NS	0.122 NS
Class III vs Class IV	0.853 NS	0.233 NS	1.000 NS	0.996 NS	0.185 NS

Statistical Analysis: Tukey Post Hoc Test. Statistically Significant If P<0.05

➢ *Observations:*

- The length and width of soft palate were non-significant for Mallampati classes.
- The velopharyngeal space was non significant for Mallampati classes.

➢ *Inference:*

- The length, width and velopharyngeal space do not co-relate with Mallampati classes.

V. DISCUSSION

The study of soft palate morphology is important for clinical dental practice as well as general well being of an individual. The soft palate is a dynamic separator of the oral cavity and nasal cavity. The soft palate is the soft tissue constituting the back of the roof of the mouth that does not contain bone.

The soft palate is formed by an interweaving of muscles from the skull base (tensor veli palatine, levator veli palatine), tongue (palatoglossus) and pharynx (palatopharyngeus). The soft palate is suspended from the skull base by the tensor veli palatine and the levator veli palatine, which course down the nasopharyngeal wall, enter the soft palate laterally, decussate and fuse in the midline with their partner from the contralateral side.

The soft palate participates in most oral functions, especially velopharyngeal closure which is related to the normal functions of sucking, swallowing and respiration.

The soft palate elevates in the middle third to separate the oropharynx and nasopharynx during speech, respiration and swallowing. The soft palate elevates, the pharyngeal wall moves anteriorly and medially at the level of soft palate elevation. The sphincter formed by the soft palate and pharyngeal wall tightly closes and prevents any passage of liquid or food into the nasopharynx during deglutition.

During respiration, an individual either inspires or expires through the nose or mouth but never both simultaneously. During expiration, air passes through the lungs, through the pharynx, and then through the oropharynx. During inspiration, the air passes in the opposite direction, through either the nasal cavity or the oral cavity.

Velopharyngeal closure refers to the normal apposition of the soft palate, or velum, with the posterior and lateral pharyngeal walls. The upward and backward movement of the velum, coupled with the mesial movement of the posterior pharyngeal walls, separates the oral cavity during deglutition and speech.

Clinical visualization of the soft palate becomes inadequate due to limited accessibility of the velopharyngeal region and it thus becomes obligatory to rely on other diagnostic methods for complete evaluation. Mallampati test has been introduced early for airway assessment. Clinically, velopharyngeal closure can be evaluated using a nasopharyngeal fiberscope and Magnetic Resonance Imaging methods.

On the other hand, Cephalometry provides an excellent practical tool for immediate, easy to use, economical, non-destructive and non-invasive imaging technique specific for mid-sagittal structures such as soft palate and pharynx. The Lateral view is by far the most valuable view for evaluation of soft palate as there is extensive bone and soft tissue overlap on other views. Radiologic studies of soft palate morphology may greatly facilitate to diagnose a variety of neurologic, inflammatory and neoplastic disorders of the adult soft palate.

Early researches were concerned in speech function and upper airway structures contributing objective measurements of the soft palate. 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. Even after closure of the soft tissue defect in cleft patients, normal function of the soft palate is frequently not achieved, and velopharyngeal insufficiency (VPI) with hypernasal speech ensues in 30% or more of patients. Cohen et al 6 suggested that one of the several explanations for this surgically successful yet functionally compromised repair may be difference in morphology of soft palate and other associated structures in these patients than normal. Hence, presurgical evaluation of soft palate morphology will aid in the success of surgery. The soft palate morphology initially was thought to be only one type (Pepin et al)[13] and was difficult to understand. Therefore, the morphology was evaluated and visualized.

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Mallampati test is specific test for assessment anatomically relative to tongue/pharyngeal size. The classification correlates tongue size to pharyngeal size. Since it is not possible to measure the size of the posterior part of the tongue relative to the capacity of the oropharynx, this method of assessment gives an indirect means of evaluating their relative proportionality.

In our study, clinical assessment by Mallampati test showed distribution of Class I 79/200 (35%), Class II 69/200 (34.5&), Class III 34/200 (17%) and Class IV 18/200 (9%). This is higher in co-relation with Californian population (Nuckton et al).[32] This is also higher in correlation with Brazilian population (Wanderley et al).[33]

It has been accepted that the soft palate morphology is of six types. Additional types have also been described but the classification still maintains the former six types. These additional types have been considered as variations of the existing types seen in various populations.

In the present study, the most common soft palate type is Leaf type 132/200 (66%), rat-tail type 38/200 (19%), the Crook type is significantly higher in our study 10/200 (5%) which is higher than the study in Chinese population (M You et al)[1] , in Indian population (Guttal et al)[20] , (Kalyan KD et al)[18], (Praveen et al)[19] , (Deepa V et al)[21] , (Verma et al)[22], (Jagdhari et al)[23] , (Khaitan et al)[24] , (Santosh K et al)[25] , (Samdani et al)[26] , (Kaur S et al)[27] , (Kecik D et al).[29] This may be due to same age group subjects selected for the study.

In our study, the soft palate morphology type distribution in males and females of Leaf type is 80/100 (80%) and 52/100 (52%) respectively which is higher than in Chinese population (M You et al)[1], and higher than in Indian population (Praveen et al)[19], (Deepa V et al)[21], (Samdani et al)[26]. The Rat-tail type distribution in Males and females in our study is 4/100 (4%) and 34/100 (34%) respectively which is lower in relation to both abroad and Indian population studies.

In our study, when correlating Mallampati Class with Soft palate morphology, all Classes had proportionate distribution of soft palate morphology types with p value of 0.474 which is > 0.05 showing non- significance of correlation to each other.

In our study, the mean soft palate length of soft palate morphology types were comparable to each other showing values of 32.07 mm, 31.32 mm, 30.27 mm, 32.26 mm, 32.43 mm and 31.00 mm for Leaf type, Rat-tail type, Crook type, S-shape, Straight line and Butt type respectively. These values are lower than in Chinese population (M You et al)[1]. These values are similar to those studies in Indian population (Praveen et al, Deepa V et al[21], Santosh et al[25], Samdani et al[26], Khaitan T et al[24]). There is no co-relation between soft palate type and mean length in our study. This is in negative to the earlier studies in Indian population thus do not correlating soft palate type with length of soft palate.

In the present study, the mean width of soft palate was greatest in Butt-type and Crook type 9.12 and 9.13 mm respectively. The Straight line type showed least mean width of soft palate 3.90 mm. the Leaf type showed 8.30 mm mean width and Rat-tail and S-shape showed mean width of 6.73 and 6.74 mm respectively. These values are higher than in other studies in Indian population (Guttal S et al[20]). The p value is 0.000 which is < 0.05 showing high significance for soft palate width among different soft palate morphological types.

In our study, velopharyngeal space was divided into three – superior, middle and inferior. The velopharyngeal space was measured accordingly showing the variations according to soft palate morphology.

The superior velopharyngeal space was greatest in Straight line type of soft palate 13.87 mm which is in accordance to the study (Kaur S et al[27]). The smallest superior velopharyngeal space was measured in Butt-type which is similar to that of in Chinese population (M You et al[1]). The other types of soft palate showed comparable measurements to each other. The p value is 0.03 which is < 0.05 showing significance for superior velopharyngeal space among soft palate types as described in Turkey population (Defne Cecik et al[29]).

In our study, the mean middle velopharyngeal space was observed greatest in Crook type 13.79 mm and least in Butt type 10.34 mm which is similar to that in Chinese population (M You et al[1]) and in Indian population (Samdani et al[26]). The p value is 0.00 which is < 0.05 showing high significance for correlation of soft palate types and middle velopharyngeal space.

In the present study, the inferior velopharyngeal space was greatest in S-shape 12.00 mm and least in Rat-tail type 8.41 mm. These findings are similar to that in Indian population (Samdani et al[26]). The p value is 0.026 which is < 0.05 showing significance for soft palate types and inferior velopharyngeal space.

In our study, comparison of mean length of soft palate in Mallampati classes was done. The mean length of soft palate in all Mallampati classes was comparable to each other ranging from 31.37 mm to 33.53 mm. The p value is 0.092 which is > 0.05 showing non- significance for soft palate length.

In our study, comparison of mean width of soft palate in Mallampati classes was done. The mean width of soft palate in class I is 7.81mm, in class II is 7.98mm, in class III is 7.61mm and in class IV is 8.65mm. the p value is 0.269 which is > 0.05 showing non-significance for soft palate width among Mallampati classes.

In our study, comparison of mean superior velopharyngeal space among Mallampati classes is least in class III is 11.92 mm and greatest in class I 12.63 mm. The p

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value is 0.405 which is > 0.05 showing non-significance for superior velopharyngeal space among Mallampati classes.

In our study, comparison of mean middle velopharyngeal space among Mallampati classes is least in class II 10.76 mm and greatest in class I 13.56mm. The p value is 0.140 which is > 0.05 which shows non-significance for middle velopharyngeal space among Mallampati classes.

In our study, the comparison of mean inferior velopharyngeal space among Mallampati classes is least in class III 9.70mm and greatest in class IV 11.76 mm. The p value is 0.144 which is > 0.05 which shows non-significance for Mallampati class and inferior

REFRENCES

[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, William and Wilkins,2002.

[3]. Rhonda F Jacob, Ting-Ling Chang.Maxillofacial prosthodontics for edentulous patients.prosthodontic treatment for edentulous patients,13th edition.Elsevier;2013.p.351-352

[4]. Clinical application of palatal lift appliance in velopharyngeal incompetence. Journal of Indian Society of Pedodontics and Preventive Dentistry 2009;29(supplement-2):70-73

[5]. Johns DF, Rohrich RJ, Awada M. velopharyngeal incompetence: a guide for clinical evaluation.*Plas Reconstr Surg* 2003:112;1890-1898.

[6]. B.J. Moxham.The development of the palate- a brief review.*Eur J Ana (2003),*7 Suppl.1:53-74.

[7]. *Gupta, Sharma, Jain*: AIRWAY ASSESSMENT PREDICTORS OF DIFFICULT AIRWAY. *Indian J. Anaesth. 2005;49(4):257-262*

[8]. M. Okan Ackam, T. Ufuk Toygar, Takeshi Wada. Longitudinal Investigations of Soft Palate and Nasopharyngeal Airway Relations in Different Rotation types. *Angle Orthod* 2002;72:521–526.

[9]. Rubesin S., Jones B, Donner W. M. Radiology of the adult soft palate. Dysphagia 1987(2);8:17

[10]. Subtelny J D. a Cephalometric study of the growth of the soft palate. Plast Reconstr Surg 1957;7:443-454

[11]. Cohen SR, Chen L, Trotman CA, Burdi AR. Soft-palate myogenesis: a developmental field paradigm. Cleft palate- Craniofac J 1993; 30: 441–446.

[12]. taylor M, Hans MG, Strohl KP, Nelson S, Broadbent BH. Soft tissue growth of oropharynx. Angle Orthodontist 1996;66:393-400

[13]. pepin JL, Veale D, Ferrati GR, Mayer P, Levy PA. Obstructive sleep apnea syndrome: hooked appearance of the soft palate in awake patients-cephalometric and CT findings. Radiology 1999;210:163-170

[14]. Kollias I, Krogstad O. Adult craniocervical and pharyngeal changes – a longitudinal cephalometric study between 22 and 42 years of age. Part II: morphology of uvulo-glossopharyngeal changes. Eur J Orthod 1999; 21: 345–355.

[15]. Johnston CD, Richardson A. Cephalometric changes in adult pharyngeal morphology. Eur J Orthod 1999; 21: 357–362

[16]. Battagel JM, Johal A, Kotecha B. A cephalometric comparison of subjects with snoring and obstructive sleep apnoea. Eur J Orthod 2000; 22(4): 353-65.

[17]. Niu YM,Wang H, Zheng Q, He X, Zhang J, Li Xm,et al. Morphology of the soft palate in Normal humans with digital cephalometry. Hua Xi Kou Qiang Yi Xue Za Zhi 2006;24:321-27.

[18]. D. Kalyan , Gopla Saraswati K. Morphological Variants Of Soft Palate In Normal Individuals: A Digital Cephalometric Study Journal of Clinical and Diagnostic Research. 2011 November (Suppl-1), Vol-5(6): 1310-1313

[19]. *Praveen BN, Amrutesh S, Pal S, Shubhasini AR, Vaseemuddin S.* Various Shapes of Soft Palate: A Lateral Cephalometric Study*World Journal of Dentistry, July-September 2011;2(3):207-210*

[20]. Guttal KS, Breh R, Bhat R, Burde KN, Naikamasur VG. Diverse Morphologies of soft palate in Normal Individuals: A Cephalometric Perspective. J Indian Aca Oral Med Radiol 2012;24(1):15-19.

[21]. Deepa V, David CM, Ramnarayan BK. Morphological Varieties of Soft Palate in Normal Individuals Cleft Palate Patients and Obstructive Sleep Apnea Patients with Reference to Indian Population: A Preliminary Digital Cephalometric Study. World J Dent 2013;4(4):241-249.

[22]. Pradhuman Verma1, Kanika Gupta Verma2,*, Kikkeri Lakshminarayana Kumaraswam3,Suman Basavaraju4, Suresh K. Sachdeva1, Suruchi Juneja2Correlation of morphological variants of the soft palate and Need's ratio in normal individuals: A digital cephalometric study. Imaging Science in Dentistry 2014; 44: 193-8

[23]. Dr. Jagdhari. Smriti. B1 , Dr. Patni V.M.2 , Dr. Motwani Mukta3. Correlation of Types of Soft Palate, Body Mass Index and Apnoea Hypoapnoea Index in Patients with Sleep Apnoea: A Pilot Study. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 13, Issue 7 Ver. II (July. 2014), PP 74-77*

[24]. Khaitan T, Pachigolla R, Uday G, Balmuri PK, Chennoju SK, Pattipati S. Digital cephalometric analysis illustrating morphological variation of the soft palate. J Indian Acad Oral Med Radiol 2015;27:532-8.

[25]. Santosh VK, Singh P, Pagare SS. Normative Soft Palate Dimensions and Morphology in a Subset of Indian Population: A Digital Cephalometric Study. Indian J Oral Health Res 2015;1:48-51.

[26]. Samdani D, Saigal A, Garg E. correlation of morphological variants of soft palate and types of malocclusion: A digital lateral cephalometric study. J Indian Acad Oral Med Radiol 2015;27: 366-71.

[27]. Kaur S, Rai S, Sinha A, Ranjan V, Mishra D, Panjwani S. A lateral cephalogram study for evaluation of pharyngeal airway space and its relation to neck circumference and body mass index to determine

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jun105

predictors of obstructive sleep apnea. J Indian Acad Oral Med Radiol 2015;27:2-8.

[28]. Smriti K, Pai KM, Vineetha R, Pentapati KC. Radiographic Evaluation of Soft Palate Morphology and Correlation with Gender on Lateral Cephalograms. World J Dent 2015;6(3):147-149.
[29]. Defne Kecik (2016) Three-dimensional analyses of palatal morphology and its relation to upper airway area in obstructive sleep apnea. The Angle Orthodontist In-Press.
[30]. Rubsin SE, Rabischong P, Bilaniuk LT, Laufer I, Levine MS. Contrast examination of the soft palate with cross sectional examination. Radiographics 1988; 8(4): 641-65.
[31]. Gupta S, Sharma KR, Jain D. Airway assessment: predictors of Difficult Airway. Indian J Anaesth 2005;49(4):257-262
[32]. Nuckton T, Glidden D, Browner W, Claman D. Physical examination: Mallampati Score as an Independent Predictor of Obstructive Sleep Apnea. SLEEP 2006;29(7):903-908
[33]. Wanderley S, Lima C L, Couceiro T, Silva W, Coelho R, Lucena A, Soares A. Clinical Criteria for airway assessment: Correlations with Laryngoscopy and Endotracheal Intubation Conditions. O J Anaesthesiology 2013;3:320-325