



GENDER DIMORPHISM IN THE VELAR MORPHOLOGY IN POPULATION OF NAGPUR DISTRICT : A RETROSPECTIVE CEPHALOMETRIC STUDY

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ABSTRACT

Objective: To evaluate pharyngeal airway dimensions by focusing on velum length (LV), velum width (WV), pharyngeal depth and Need's ratio (NR) across different soft palate morphologies and vertical growth patterns in patients with skeletal Class I malocclusion in the male and female population of Nagpur district. **Materials and Methods:** This retrospective study analyzed 100 pre-treatment digital lateral cephalograms of subjects aged 18–30 years presenting with skeletal Class I malocclusion and average growth pattern, with equal number of male and female. The morphological shape of the soft palate was categorized into six types (leaf-shaped, rat-tail, butt-like, straight-line, S-shaped, and crook-shaped) based on You et al. classification. Cephalometric measurements were recorded for LV(velum length) , WV(width of velum), and pharyngeal depth (PD) to calculate the Need's ratio ($NR = PD/LV$). Data was analyzed using the t test (two tail), ($p < 0.05$). **Results:** The leaf-shaped soft palate (Type I) was observed most frequently, constituting nearly 62% of the sample, whereas there were only two S shaped and no Crook shaped palatal shapes . Significant variations in LV and WV were identified across the morphological variants. Need's ratio was highest in subjects exhibiting the S-shaped (Type V) palate. The LV,WV and PD were greater in men however, the highest NR (0.86) was found in females

KEYWORDS : soft palate, velar morphology, Needs ratio, airway

INTRODUCTION

Velopharyngeal mechanism along with the dimensions and shape of soft palate proves to be an important factor in functions like nasal breathing, deglutition and speech. The structural integrity and dynamics of the soft palate serve as important determinants of retropalatal airway patency. Deformities or morphological deviations in this region often result in functional impairments, ranging from hypermasality in cleft palate patients to obstructive sleep apnea (OSA) in the general population.

The mathematical ratio of pharyngeal depth(PD) and length of velum (LV), known as Need's ratio ($NR = PD/LV$), offers a reliable cephalometric indicator of airway adequacy¹. Subtelny et al. previously established that a normative Need's ratio ranges from 0.6 to 0.7 in healthy subjects, while ratios exceeding this threshold suggest anatomical velopharyngeal incompetence or airway constriction¹.

Research suggests that a variety of orthodontic interventions like myofunctional therapy, orthognathic surgery and orthopaedic appliances.^{2,5} Much of this research has focused on Class I populations or generalized samples without differentiating the soft palate morphology and its influence on airway constriction. Similarly very few studies have been done taking into consideration gender dimorphism and none have been reported in Nagpur district. The primary aim of this investigation was to quantitatively evaluate the radiographic length of the velum (LV), width of the velum (WV), and Need's ratio (NR) across six distinct morphological types of the soft palate in male and female population of Nagpur district.

MATERIALS AND METHODS

Following ethical approval, this retrospective cephalometric study reviewed the archival records of 100 subjects aged 18 to 30 years out of which, 50 were males and 50 females. Sample selection was strictly limited to patients native to Nagpur district only and presenting with a fully erupted permanent dentition and skeletal Class I pattern with ANB angle = 2-3 °). Exclusion criteria eliminated subjects with illegible or worn out lateral cephalograms, a history of tonsillectomy or

adenoidectomy, previous orthodontic or dentofacial orthopaedic treatment, dental extractions, and major craniofacial anomalies such as cleft lip and palate.

Digital lateral cephalograms were manually traced by a single calibrated investigator on 0.003-inch acetate sheets using a 0.35-mm HB pencil in a darkened room.

The anatomical outline of the soft palate was traced, and all 80 cephalograms were morphologically classified into six variants as proposed by You et al⁶: Type I (leaf-shaped), Type II (rat-tail), Type III (butt-like), Type IV (straight-line), Type V (S-shaped), and Type VI (crook-shaped).

The cephalometric analysis exclusively targeted the following parameters: velum length (LV), measured as the linear distance from the posterior nasal spine to the tip of the uvula; velum width (WV), capturing the thickest cross-sectional dimension of the soft palate; and pharyngeal depth (PD), the horizontal linear distance from the posterior nasal spine to the posterior pharyngeal wall. Need's ratio (NR) was subsequently calculated as the ratio of PD to LV¹. (fig 1.)



Fig 1 (1) PNS- S –velum length; (2) velum width(WV); (3) Pharyngeal depth(PD)

Statistical Analysis

Statistical analysis was executed on SPSS software. The t test(two tail) was applied to compare the mean values of LV, WV, and NR across the soft palate shapes and between males and females, with statistical significance defined at $p < 0.05$

RESULTS

The evaluated sample presented a mean age of 22.5 years. Distribution analysis of the soft palate morphotypes revealed that the leaf-shaped soft palate (Type I) was overwhelmingly the most frequent, representing approximately 62% of the entire sample. Conversely, the S shaped (Type IV) was identified in two subjects while and crook shape (Type V) palates were not identified in any of the lateral cephalograms. (Table 1)

Table 1. Prevalence of Soft Palate Morphotypes in Percentage.

Type	Percentage of occurrence
Type I	62
Type II	18.5
Type III	11
Type IV	6
Type V	2
Type VI	-

Table 2. Correlation of Mean Lv, Vw, Pd,nr in Male and Female Population of Nagpur District

parameters	male	female
Velar length (LV)	31.2	28.9
Velar width (VW)	7.01	6.74
Pharyngeal depth (PD)	23.4	25.8
Need's Ratio (NR)	0.75	0.82

Significant dimensional discrepancies in LV and WV were recorded across the different soft palate types in male and female population. Type I or leaf shaped was the most commonly found soft palate shape across both the genders followed by Type II or rat tail shaped palate. When evaluating the critical metric of Need's ratio (NR), substantial variations emerged based on both the shape of palatal and gender of the subject. The average velar length (LV) was seen to be more in males (31.2) than females (28.9) while Needs ratio in females was found to be 0.82

DISCUSSION

Identifying anatomical predispositions to airway constriction is an essential facet of modern orthodontic diagnosis and local gender dimorphism is an important factor in the same.

In this study conducted in Nagpur district, The leaf-shaped (Type I) palate proved to be the most prevalent. Males showed overall increase in velum length and width but in females the Need's ratio was found to be higher. This is in contradiction to the study by Kollias and Krogstad⁷ where they found no significant difference in velum length (LV). However the study by Verma et al⁸ supports the findings of this study. Verma et al⁸ also observed a rise in need's ratio in females as compared to males which is in agreement with this present study.

Need's ratio serves as a highly sensitive metric for assessing this velopharyngeal relationship. An elevated ratio signals that the anatomical depth of the pharynx is disproportionately small relative to the length of the soft palate¹. The findings clearly demonstrated that S-shaped (Type V) palates yielded the highest Need's ratios. This morphologic predisposition structurally correlates with velopharyngeal narrowing and places the patient at a substantially elevated risk for sleep-disordered breathing and obstructive sleep apnea.⁹ since the Need's ratio in females was found to be higher in females, they can be carefully screened for impending Obstructive sleep diseases. Lateral cephalogram can be a cost effective and easily available screening tool in tier II places like Nagpur district, but better idea of volumetric capacity of the airway can be obtained if a 3D evaluation by scans can be done.

CONCLUSION

1. The leaf-shaped soft palate (Type I) remains the most frequently encountered morphotype in adults while crook shaped (type VI) is the rarest.
2. Males show increased values of velum length (LV) and velum width (VW) than women.
3. Females show greater Need's ratio thereby warranting early screen for velopharyngeal insufficiency disorders.

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