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Assessment of Morphological Changes in Skeletal Parameters with Reference to Standard Cephalometric Norms in the Telangana Population

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Abstract

Background: Craniofacial morphology varies among different populations and plays a crucial role in determining skeletal relationships and malocclusion patterns. The anterior cranial base and jaw lengths are important parameters influencing maxillomandibular positioning.

Objective: To assess morphological variations in skeletal parameters, including anterior cranial base length, maxillary length, and mandibular length, in individuals from the Telangana population with different types of malocclusion.

Materials and Methods: The study included lateral cephalometric records of 200 individuals aged 10–32 years from the Telangana population. Measurements of Sella–Nasion (S–N), maxillary length, and mandibular length were recorded and analyzed in relation to skeletal malocclusion patterns.

Results: Variations were observed in cranial base and jaw dimensions among different malocclusion groups.

Class II Division 1 malocclusion was the most frequently observed pattern. Mandibular length showed greater variability compared to maxillary length, while S–N length demonstrated population-specific values.

Conclusion: Skeletal parameters exhibit notable variation in the Telangana population, emphasizing the need for population-specific cephalometric norms for accurate orthodontic diagnosis and treatment planning.

Keywords: Cranial base length, Cephalometry, Skeletal malocclusion, Telangana population, S–N length

Introduction

Craniofacial growth and development [1] are complex biological processes influenced by genetic, environmental, and functional factors. A significant portion of facial growth is governed by changes occurring at the cranial base, which serves as a structural foundation for both the maxilla and mandible. Variations in cranial base morphology have been shown to influence jaw position and contribute to the development of different skeletal malocclusion patterns[1].

The anterior cranial base, measured as the distance between sella and nasion (S–N), is frequently used as a stable reference in cephalometric analysis. However, previous studies have indicated that this parameter may vary across populations and continue to change beyond early childhood. Differences in cranial base length and jaw dimensions have also been associated with sagittal discrepancies such as Class I, Class II, and Class III malocclusions.

Since most cephalometric norms are derived from Caucasian populations, their universal application may lead to diagnostic inaccuracies. Therefore, evaluating skeletal parameters in specific regional populations, such as the Telangana population, is essential for developing reliable orthodontic standards.

Materials and Methods

This cross-sectional study was conducted using 200 lateral cephalometric records obtained from individuals belonging to the Telangana population. The sample consisted of subjects aged between 10 and 32 years, including both males and females, with no history of orthodontic treatment, craniofacial anomalies, trauma, or systemic conditions affecting growth.

Cephalograms were taken in natural head position with teeth in maximum intercuspation and lips at rest. Standardized tracing procedures were followed to minimize measurement error. The following skeletal parameters were evaluated:

- **Anterior cranial base length (S–N)**
- **Maxillary length**
- **Mandibular length**

Subjects were classified into skeletal Class I, Class II Division 1, Class II Division 2, and Class III malocclusion groups based on cephalometric assessment. The collected data were tabulated and analyzed descriptively to evaluate morphological variations among different malocclusion patterns.

Results

Analysis of the cephalometric data revealed measurable variations in cranial base and jaw dimensions across different skeletal malocclusion groups. Class II Division 1 malocclusion constituted the largest proportion of the sample. The anterior cranial base length showed inter individual variability, suggesting that it may not be a fixed parameter within this population.

Mandibular length demonstrated greater variation than maxillary length, particularly in Class II and Class III malocclusions. Subjects with Class III malocclusion generally exhibited increased mandibular length relative to the maxilla, whereas Class II Division 1 individuals showed comparatively shorter mandibular dimensions.

Overall, the findings indicate that skeletal measurements in the Telangana population differ from traditionally accepted cephalometric norms, highlighting the importance of population-specific evaluation.

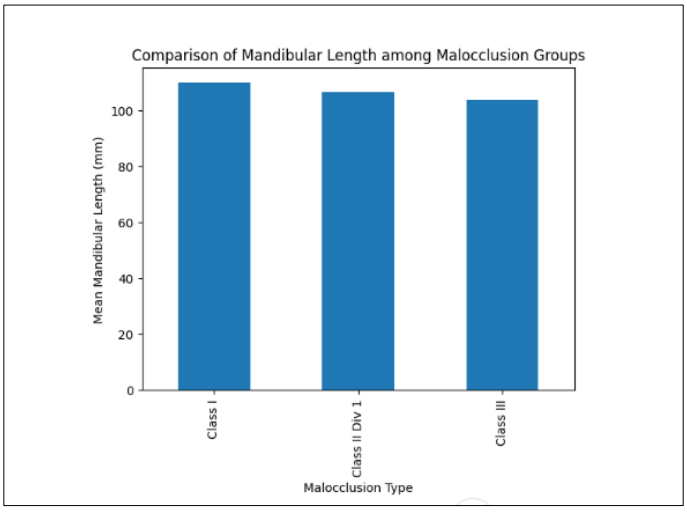
Table 1: Descriptive Statistics of Skeletal Parameters According to Malocclusion Pattern.

Malocclusion Type	Mean S–N (mm)	Mean Maxillary Length (mm)	Mean Mandibular Length (mm)
Class I	64.5	86.0	110.0
Class II Div 1	67.6	88.8	106.8
Class III	65.0	82.0	104.0

Interpretation

- The anterior cranial base length (S–N) showed slightly higher mean values in Class II Division 1 malocclusion compared to Class I and Class III groups.
- Maxillary length was greater in Class II Division 1 individuals, suggesting a tendency toward maxillary prognathism.
- Mandibular length was highest in Class I individuals and relatively reduced in Class II Division 1 malocclusion, supporting the skeletal basis of sagittal discrepancy.

Graph 1: Comparison of Mean Mandibular Length among Malocclusion Groups



Graph Interpretation

The bar graph demonstrates a clear variation in mandibular length among different malocclusion groups. Class I subjects exhibited the greatest mandibular length, while Class III and Class II Division 1 groups showed comparatively reduced values. This indicates that mandibular morphology plays a significant role in determining sagittal skeletal relationships.

Clinical Implications:

- Cephalometric norms derived from other populations may not be directly applicable to the Telangana population.
- Mandibular length should be carefully evaluated during orthodontic diagnosis, especially in Class II malocclusion cases.
- Population-specific databases improve treatment planning accuracy and stability of orthodontic outcomes.

Discussion

The cranial base plays a pivotal role[2] in determining the spatial relationship of the maxilla and mandible. Variations in anterior cranial base length[2] can influence sagittal jaw positioning and contribute to the development of skeletal discrepancies. The present study observed that S–N length varied across age groups and malocclusion types, supporting previous findings that cranial base growth may continue beyond early adolescence.

Similar findings were reported by Sushma Kumari et al., who observed regional differences in cranial base and jaw relationships in the Indian population[2]. These variations may be attributed to differences in cranial base

length and growth direction, as also highlighted in studies by T. M. Graber[1].

The predominance of Class II Division 1 malocclusion in the sample aligns with patterns reported in other Indian populations. Differences in mandibular length were more pronounced than maxillary length, suggesting that mandibular growth plays a critical role in sagittal disharmony[4].

A systematic review published in 2024 analyzing craniofacial characteristics across Indian populations highlighted significant heterogeneity among different geographic groups, emphasizing that a single normative standard cannot be universally applied[5]. Similarly, another systematic review in 2022 reported that North Indian populations tend to exhibit features such as reduced cranial base length, shorter facial height, and increased mandibular incisor inclination when compared to Caucasian norms[6].

A recent study conducted in the Northeastern Andhra Pradesh population (2025) demonstrated that most cephalometric parameters were lower than Caucasian standards, further validating the concept of population-specific skeletal morphology[7]. These findings are particularly relevant to the Telangana population, as both regions share genetic, ethnic, and environmental similarities. The study also emphasized the importance of developing individualized cephalometric norms for accurate orthodontic diagnosis and orthognathic surgical planning[7].

In addition, recent observational research (2025) evaluating cephalometric values in Indian children showed that skeletal parameters vary not only with ethnicity but also with age and developmental stage, indicating the dynamic nature of craniofacial growth[8]. This suggests that regional standards must also consider age-specific variations for precise clinical application.

These findings reinforce the concept that cephalometric norms should not be universally applied and must be tailored to specific populations for accurate orthodontic diagnosis and treatment planning.

Conclusion

The present study demonstrates significant morphological variation in cranial base and jaw dimensions among individuals from the Telangana population. The anterior cranial base length cannot be considered a stable parameter and appears to be population-specific. Mandibular length showed greater variability and contributed substantially to skeletal malocclusion patterns. Establishing regional cephalometric norms is essential for improving diagnostic accuracy and achieving optimal orthodontic outcomes.

Limitations and Future Scope

The study relied on two-dimensional cephalometric analysis, which may not fully capture complex craniofacial relationships. Future studies using three-dimensional imaging techniques and larger sample sizes are recommended to establish comprehensive population-specific norms.

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