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Original Article

Morphometric Analysis of the Hard Palate and Its Surgical Significance

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ABSTRACT

Background: The hard palate forms the anterior part of the roof of the mouth and the floor of the nasal cavity, playing an important role in mastication, speech, and facial morphology. Its morphometric variations are crucial for maxillofacial surgery, forensic identification, and prosthodontic applications.
Objective: To analyze the morphometric dimensions of the hard palate in dry human skulls and to classify them based on the palatine index.
Materials and Methods: The study was conducted on 50 dry adult human skulls of unknown sex and age. The palatine length and palatine breadth were measured using a digital vernier caliper. The palatine index was calculated as (palatine breadth × 100) / palatine length and classified into Leptostaphyline (<80%), Mesostaphyline (80–85%), and Brachystaphyline (>85%) types.
Results: The mean palatine length was 46.75 ± 2.65 mm, and the mean palatine breadth was 35.90 ± 2.45 mm. Based on the palatine index, 37 (74%) skulls were Leptostaphyline, 8 (16%) were Mesostaphyline, and 5 (10%) were Brachystaphyline.
Conclusion: The predominance of the Leptostaphyline type suggests that a narrow palate is common in this population. These findings have implications for maxillofacial surgical planning, prosthodontic design, and forensic identification.

Keywords: *Hard palate, Morphometry, Palatine index, Leptostaphyline, Maxillofacial surgery, Skull anatomy.*

INTRODUCTION

The hard palate is situated within the alveolar arch and exhibits a subtle curvature both in the anteroposterior and transverse planes. Structurally, it is constituted by the palatine processes of the maxillae anteriorly and the horizontal plates of the palatine bones posteriorly, demarcated by a cruciform suture. Approximately three-fourths of the osseous palate is derived from the maxillae, while the remaining one-fourth is contributed by the palatine bones. Posteriorly, the hard palate culminates in a crescentic free margin that centrally projects as the posterior nasal spine [1].

A restricted bony pharynx may contribute to sleep apnea syndrome, a condition characterized by difficulty in breathing during sleep. Comprehensive knowledge of the normal anatomy and morphometric dimensions of the palatal region is essential for various clinical procedures involving the upper respiratory tract, such as nasopharyngoscopy and nasogastric intubation. Additionally, it aids in understanding the patterns of spread in cases of nasopharyngeal carcinoma. Understanding its morphometric variations is essential for surgical interventions such as cleft palate repair, palatal flap surgery, dental prosthesis fitting, and reconstructive procedures. Palatal dimensions are known to vary among different populations and ethnic groups, influenced by genetic and environmental factors. Morphometric assessment of the palate also aids in forensic identification, as the palate maintains its shape even after decomposition [2,3].

The present study aims to measure the dimensions of the hard palate and classify it based on the palatine index in dry human skulls, and to compare the findings with those reported in previous studies.

MATERIALS AND METHODS

Sample

The study was conducted on 50 dry human skulls of unknown sex and age from the Department of Anatomy. Skulls with damaged or deformed palates were excluded.

Measurements

- **Palatine Length (mm):** Distance from the posterior nasal spine to the point between the incisal alveolar sockets.
- **Palatine Breadth (mm):** The distance between the inner borders of the sockets of the second molar teeth.
- **Palatine Index:** Calculated using the formula:

$$\text{Palatine Index} = \frac{\text{Palatine Breadth} \times 100}{\text{Palatine Length}}$$

Classification (According to Martin and Saller):

- **Leptostaphyline:** < 80%
- **Mesostaphyline:** 80–85%
- **Brachystaphyline:** > 85%

Statistical Analysis

The mean and standard deviation (SD) were calculated for all parameters.

RESULTS

The mean Palatine length was: 46.75 ± 2.65
The mean Palatine Breadth was: 35.90 ± 2.45

Table 1: Distribution by Palatine Index

Type	Range (%)	Number of Skulls	Percentage
Leptostaphyline	<80	37	74%
Mesostaphyline	80–85	8	16%
Brachystaphyline	>85	5	10%

The Leptostaphyline type was predominant (74%) in the present study.

DISCUSSION

The present study demonstrates that the mean palatine length and breadth were 46.75 mm and 35.90 mm, respectively. The predominance of the Leptostaphyline type suggests a narrower and longer palate shape in the studied population.

Table 2: Palatal Dimensions and index in different studies

Authors	Palatine Length (mm)	Palatine Breadth (mm)	Palatine Index / Distribution
Hassnali & Mwaniki[4]	49.2 ± 3.6	40.2 ± 3.0	L–43.2%, M–23.7%, B–33.1%
Manmohan Patel[2]	49.56 ± 3.95	36.65 ± 3.03	74.2 ± 6.64
Antony Sylvian Dsouza[5]	49.13	40.04	L–37.5%, M–22.5%, B–40%
Badal Jotania[6]	49.74	37.75	L–70%, M–15%, B–15%
Mitesh Dave[7]	43.54 ± 0.28	33.83 ± 0.20	L–63%, M–24%, B–13%
Erli Sarilita[8]	52.2 ± 3.2	37.97 ± 3.2	L–84.1%, M–7.9%, B–7.9%
Varalakshmi KL[9]	48.47 ± 4.66	36.00 ± 4.41	L–66%, M–18.5%, B–15.5%
Saadia A. Shalaby[10]	51.65 ± 4.7	38.68 ± 2.9	L–64%, M–24%, B–12%
Vinodini Lakmala[11]	M–54.18, F–48	M–34, F–32.54	M–62.75, F–67.79
Anil Kumar[12]	M–52.5 ± 0.37, F–48.1 ± 0.36	M–36.51 ± 0.27, F–32.33 ± 0.20	L–58%, M–27%, B–15%
Vasudha Kulkarni[13]	40.42	44.15	L–86.9%, M–4%, B–11.6%
Subhash Gujar[14]	47.10 ± 3.34	36.26 ± 2.55	L–68%, M–20%, B–12%
Present Study	46.75 ± 2.65	35.90 ± 2.45	L–74%, M–16%, B–10%

The present study demonstrates a predominance of the Leptostaphyline (narrow) palate, a finding consistent with several previous reports among Indian populations, where the average recorded length and breadth fall within the normal anatomical range yet are marginally smaller compared to most Indian studies. For instance, while Hassnali & Mwaniki reported higher values in an African sample, indicating broader facial skeletons, the measurements from Manmohan Patel and Subhash Gujar closely resemble the current study's dimensions and palatine index, suggesting similar palatal proportions. This trend of leptostaphyline predominance is further corroborated by the works of Antony Sylvian Dsouza

and Badal Jotania, whereas Mitesh Dave's report of smaller dimensions and Varalakshmi KL and Saadia A. Shalaby's observations highlight geographic variations across Indian subpopulations. Although Anil Kumar and Vinodini Lakmala highlighted significant sexual dimorphism, a direct comparison remains inconclusive as the present sample was unsexed, while Vasudha Kulkarni's report of an unusually broad palate may reflect ethnic craniofacial specializations, collectively affirming the representativeness of the current data within Indian cohorts. These comparative observations reinforce the role of genetic and ethnic variations in determining palatal configuration. The consistent predominance of narrow palate types seen in Indian populations may reflect evolutionary adaptation to dietary and functional demands.

A comprehensive understanding of palatal morphometry is critically important across multiple clinical and scientific disciplines. In maxillofacial surgery, it provides essential guidance for the precise design of mucoperiosteal or osteocutaneous flaps during complex procedures such as cleft palate repair, palatal reconstruction, and graft harvesting. For prosthodontists and orthodontists, this knowledge directly assists in the fabrication of accurately fitting dentures, the application of expansion appliances, and the planning of alignment corrections. Furthermore, in the fields of ENT and neurosurgery, detailed morphometric data facilitates safe and effective surgical access to the nasal cavity and skull base via transpalatal and transnasal approaches. Beyond its immediate clinical applications, palatine dimensions also serve as reliable indicators in forensic anthropology for determining sex and racial identification, proving particularly valuable when other skeletal elements are unavailable.

CONCLUSION

The present morphometric analysis of 50 adult skulls revealed that the mean palatine length was 46.75 mm and mean breadth was 35.90 mm. The leptostaphyline type predominated (74%), followed by mesostaphyline (16%) and brachystaphyline (10%). These findings are consistent with most Indian studies and confirm that narrow palates are more prevalent in this population. The findings highlight the importance of regional anatomical variations in surgical and dental practice. Knowledge of palatal dimensions can assist surgeons in cleft repair, maxillary reconstruction, and anesthetic block administration.

REFERENCES

1. Datta A K. Head and Neck. Essential of Human Anatomy. 5th ed. Kolkata: Current Book International ,2009, pp-54.
2. Patel M. A study of the hard palate in the skulls of the central Indian population. Int J Pharm Bio Sci. 2012;3(2):527-33.
3. Rani S et. al. A Morphometric Study of The Hard Palate in Dry Adult Skulls and Its Clinical Significance. Azerbaijan Pharmaceutical and Pharmacotherapy Journal. 2025;(24): 13-17
4. Hassanali J, Mwaniki D. Palatal analysis and osteology of the Kenyan African skulls. Ant Rec. 1984; 209:273-280.
5. Sylvian, A.D., Mamtha, H., Nayak, J. Morphometric analysis of hard palate in South Indian skulls. Biomed Res, 2012; 23: 173 - 175.
6. Jotania B, Patel S, Patel S, Patel P, Patel S, Patel K. Morphometric analysis of hard palate. Int J Res Med 2013; 2: 72-75.
7. Dave MR, Gupta S, Vyas KK, Joshi HG. A study of palatal indices and bony prominences and grooves in the hard palate of adult human skulls. NJIRM 2013; 4: 7-11.
8. Sarilita E, Soames R. Morphology of the hard palate: a study of dry skulls and review of the literature. Rev Arg Anat Clin. 2015;7(1):34–43.
9. Varalakshmi KL, Sangeeta M, Naik SN, Acharya A. An osteological study of morphometry of hard palate and its importance. Int J Res Med Sci. 2015;3(9):2210–3.
10. Shalaby S, Eid E, Sarg N, Sewilam A. Morphometric analysis of hard palate in Egyptian skulls. Benha Med J. 2015;32(1):59.
11. Lakmala, V. & Gangam, R.R. & Nagaraju, P. A study of normal anatomy of hard palate in south Indian population.2016;7(1):339-342.
12. Anil Kumar et al. Morphological and morphometric study of hard palate in Indian population International Journal of Biomedical Research 2016; 7(11): 778-784.
13. Vasudha Kulkarni, Ramesh BR. Palatometry in South Indian Skulls and Its Clinical Implications. Int J Anat Res 2017;5(1):3362-3366. DOI: 10.16965/ijar.2016.477.
14. Subhash M Gujar, Sunil G Oza. Morphometric analysis of hard palate and its clinical importance. National journal of clinical anatomy.2018;7(1):36-40.
15. Abhilasha M. Wahane, Rajeshree A. Nandanwar. A Study of Palatal Indices and Foramina in The Hard Palate of Adult Human Skulls in Central India Region. Int J Anat Res 2019;7(2.1):6397-6403. DOI: 10.16965/ijar.2019.125.
16. Chandimak K M et al. Palatine morphometry, morphology, and position of the greater palatine foramen with reference to various anatomical landmarks of Sri Lankans with reference to sex. Int. J. Morphol. 2025;43(3):800-808.
17. Pallavi et al. Morphometric Analysis of Hard Palate & It's Clinical Significance. Int J Med Res Prof. 2020 May; 6(3): 5-8. DOI:10.21276/ijmrp.2020.6.3.002.