Original Article

Anthropological Insights into Inca Bones: A Morphological and Morphometrical Study in South Indian Skulls

Balaji M[1], Shradha Iddalgave[2], Meenakshi Parthasarathy[3], Kotakonda Priyanka[4]

[1]Post graduate, Department of Anatomy, SABVMCRI, Bengaluru, Karnataka, India. [2]Assistant professor, Department of Anatomy, SABVMCRI, Bengaluru, Karnataka, India. [3]Professor and Head Department of Anatomy, SABVMCRI, Bengaluru, Karnataka, India. [4]Tutor, Department of Anatomy, Sabvmcri, Bengaluru, Karnataka, India.

Abstract

Background: Inca bones (interparietal bones) are accessory bones of the human skull formed due to the non-fusion of ossification centers in the squamous part of the occipital bone. Though commonly associated with the Inca civilization, these bones have been observed in various global populations, including in India, where their incidence and morphology show regional variation. These bones are of anthropological and clinical importance, particularly in radiology and forensic medicine. **Material and Methods:** This descriptive, cross-sectional study was conducted in the Department of Anatomy at Sri Atal Bihari Vajpayee Medical College and Research Institute, Bengaluru. A total of 100 adult dry human skulls of unknown sex were examined for the presence, number, shape, and size of Inca bones. Morphometric measurements were recorded using a measuring tape, and data were analyzed using Microsoft Excel with descriptive statistics. **Results:** Out of 100 skulls studied, 3 skulls (3%) showed the presence of Inca bones. Among these Inca Bones, 2 (67%) were undivided and 1 (33%) was divided. Morphological types included pentagonal and quadrangular forms. The largest Inca bone observed measured approximately 69.65 cm^2, while the smallest was around 4.93 cm^2. One skull had two separate Inca bones with a combined area of approximately 17.09 cm^2. **Conclusion:** This study reports a 3% incidence of Inca bones in South Indian skulls, with notable morphological variation. These findings contribute to anthropological understanding and serve as a clinical guide for distinguishing normal anatomical variants from fractures or pathological lesions in imaging. Further multicentric studies with larger sample sizes are recommended.

Keywords: Inca bone, interparietal bone, South Indian skulls, accessory bones, cranial morphology, anthropological variation, sutural bones.

Received: 05 July 2025 **Revised: 04 August 2025** **Accepted: 09 September 2025** **Published: 23 September 2025**

Introduction

Accessory bones of the skull, particularly the Inca bone (or interparietal bone), are anatomical variants that arise due to the non-fusion of ossification centers in the occipital region.[1] Though relatively rare, these bones are of anthropological, evolutionary, and clinical significance. They contribute to our understanding of population-specific cranial morphology and can complicate radiological or surgical interpretations if misidentified.[1]

The Inca bone is typically located at or near the lambda and is bordered by the lambdoid sutures. It results from the persistent separation of the interparietal portion of the occipital bone, which develops through membranous ossification.[2] The name "Inca bone" originates from its noted prevalence among ancient Andean populations, particularly the Inca civilization, but similar bones have also been documented globally, albeit with varying frequencies.[3]

In India, regional studies have reported variation in the occurrence of Inca bones. A study in Central India observed an incidence of approximately 1.315% in adult skulls, with a slightly higher occurrence in males.[4] Another study from the Krishna district in South India reported a higher incidence of 2.6%, again more common in male skulls than in females.[5] These findings suggest potential genetic, developmental, and environmental influences on its manifestation.

Given the limited osteological data from South India in global literature, studying the morphology and frequency of Inca bones in this population provides valuable anthropological insights. It also enhances diagnostic accuracy in neuroimaging and cranial surgeries by distinguishing normal variants from pathological conditions.

Aims and Objectives

The primary aim of this study is to investigate the incidence, morphology, and anthropological significance of Inca bones (interparietal bones) in adult South Indian skulls. The objectives include determining the frequency of occurrence, analyzing the shape, size, and location of Inca bones. By doing so, the study seeks to contribute region-specific osteological data that can aid in anthropological research, improve understanding of population variation, and assist clinicians in distinguishing

Address for correspondence: Dr. Kotakonda Priyanka, Tutor, Department of Anatomy, Sabvmcri, Bengaluru, Karnataka, India. E-mail: priyankaroyal225gmail.com

DOI: 10.21276/amit.2025.v12.i3.79

How to cite this article: Dr Balaji M, Iddalgave S, Parthasarathy M, Priyanka K. Anthropological Insights into Inca Bones: A Morphological and Morphometrical Study in South Indian Skulls. Acta Med Int. 2025;12(3):281-284.

anatomical variants from pathological conditions in radiological and surgical settings.

Materials and Methods

Study Design: This descriptive, cross-sectional study was conducted in the Department of Anatomy at Sri Atal Bihari Vajpayee Medical College and Research Institute (SABVMCRI), Bengaluru. A total of 100 dry adult human skulls, available in the department's osteology collection, were examined as the primary data source. Each skull was systematically analyzed to identify the presence of Inca bones, and detailed observations were made. The study focused on documenting morphological variations and presence of Inca bones within the South Indian population.

Inclusion and Exclusion Criteria

The study included dry human skulls of both sexes and from all age groups available in the Department of Anatomy SABVMCRI Bengaluru. Skulls selected for analysis were intact and free from any visible damage. Skulls showing pathological deformities or evidence of antemortem or postmortem injuries were excluded to ensure accurate observation of Inca bone prevalence morphology and morphometry.

Data collection procedure: The data for this study were collected through direct visual and manual examination of 100 adult dry human skulls available in the Department of Anatomy at SABVMCRI, Bengaluru. Each skull was carefully inspected under adequate lighting to identify the presence of Inca bones. When present, the bones were further assessed for their number, shape (triangular, quadrilateral, irregular), size with the help of measuring tape. Observations were recorded systematically, and tabulated for analysis.

Statistical Analysis: The collected data were compiled and analyzed using Microsoft Excel. Morphological variations such as shape and number were calculated for percentages. Descriptive statistics were used to summarize the findings, and the results were presented in the form of tables and charts.

Results

The [Table 1] presents the frequency of Inca bones observed in a sample of 100 South Indian skulls, showing a 3% incidence rate. Among this skulls, 67% had undivided Inca bones, while 33% had a divided variant.

Table 1: Frequency and Distribution of Inca Bones in South Indian Skulls

S.No	Total Number of Skulls	Normal Skulls	Skulls with Inca	Undivided	Divided
1	100	97	3	2	1
2	100%	97%	3%	67%	33%

Table 2: Morphometric Measurements of Inca Bones

S.No	Inca Bone	Superior Border	Left Border	Right Border	Inferior Border	Approx. Area
1	I1	4.6 cm (L), 5 cm (R)	6.4 cm	6 cm	11.4 cm	≈ 69.65 cm²
2	I2	2.1 cm	2.2 cm	2.2 cm	2.4 cm	≈ 4.93 cm²
3	I3	3.5 cm / 3 cm	3 cm / 2.5 cm	2.5 cm / 3 cm	3 cm / 3 cm	≈ 8.87 + 8.22 = 17.09 cm²

The [Table 2] shows the morphometric dimensions of individual Inca bones observed in the skulls, including measurements of each border and the approximate area. One case (I3) showed two separate divisions, each measured independently.

Table 3: Classification of Inca Bones Based on Division and Shape

S. No	Inca Bone	Division	Shape/Type	Approx. Area
1	I1	Undivided	Pentagonal	≈ 69.65 cm²
2	I2	Undivided	Quadrangular	≈ 4.93 cm²
3	I3	Divided	Each division quadrangular	≈ 17.09 cm²

The [Table 3] categorizes Inca bones based on their morphological division and shape. Two were undivided (pentagonal and quadrangular), while one (I3) was divided into two quadrangular parts, with a combined area of approximately 17.09 cm².

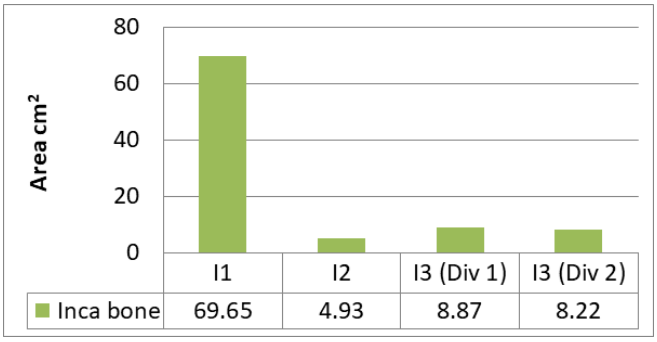

Figure 1: Showing single undivided inca bone (Pentagonal shape)

Figure 2: Showing undivided inca bone (Quadrangular shape)

Figure 3: Showing divided inca bone (Quadrangular shape)

Discussion

The present study observed a 3% incidence of Inca bones in South Indian skulls, which aligns with findings from Central India, where Nayak et al. reported a 1.3% occurrence in adult skulls.[6] In contrast, a study from Gujarat found a higher incidence of 9.6%.[7] This variability underscores the influence of regional genetic and environmental factors on cranial morphology.[7]

Regarding the morphology of Inca bones, the present study identified both undivided and divided forms, with undivided bones being more prevalent. This finding is consistent with the study by Sarvaiya et al., which also reported a higher frequency of undivided Inca bones.[7] The variations in shape and size observed in this study, with areas ranging from approximately 4.9 cm² to 69.6 cm², are comparable to those reported by Singh et al., who noted similar morphological diversity in Inca bones.[8-10]

The clinical significance of these findings is notable. Inca bones can be mistaken for fractures in radiological imaging, leading to potential misdiagnoses. Therefore, awareness of their existence and variability is crucial for clinicians, radiologists, and forensic experts to avoid diagnostic errors.[8]

The study contributes valuable data on the incidence and morphology of Inca bones in South Indian skulls, highlighting regional variations and emphasizing the importance of recognizing these anatomical variants in clinical and forensic settings.[11]

Limitations: The present study was limited by its relatively small sample size of 100 dry adult skulls, which may not fully represent the broader South Indian population. Additionally, the sex and age of the skulls were not known, limiting the ability to analyze potential sex-based or age-related differences in the occurrence of Inca bones. The study was also restricted to a single institution's collection, which may introduce sampling bias. Advanced imaging techniques such as CT or 3D scanning were not used, which could have provided more precise morphometric data.

Conclusion

This study highlights a 3% incidence of Inca bones in South Indian skulls, with a predominance of undivided forms and notable morphological variations. The findings support the presence of regional diversity in cranial anatomy and reinforce the anthropological and clinical relevance of identifying Inca bones. Understanding these anatomical variants is important in differentiating normal sutural bones from pathological findings in radiology and neurosurgery. Further large-scale, multi-centric studies incorporating age, sex, and radiological correlation are recommended to enhance the clinical and anthropological understanding of these structures.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Standring, S. (Ed.). (2020). Gray's Anatomy: The Anatomical Basis of Clinical Practice (42nd ed.). Elsevier.
2. Williams, P. L., Warwick, R., Dyson, M., & Bannister, L. H. (1995). Gray's Anatomy (38th ed.). Churchill Livingstone.
3. Sinnatamby, C. S. (2011). Last's Anatomy: Regional and Applied (12th ed.). Churchill Livingstone.
4. Berry, A. C., & Berry, R. J. (1967). Epigenetic variation in the human cranium. Journal of Anatomy, 101(1), 361–379
5. Hauser, G., & De Stefano, G. F. (1989). Epigenetic Variants of the Human Skull. Stuttgart: Schweizerbart Science Publishers.
6. Marathe R, Yogesh A, Pandit S, Joshi M, Trivedi G. Inca - interparietal bones in neurocranium of human skulls in central India. J Neurosci Rural Pract. 2010 Jan;1(1):14-6. doi: 10.4103/0976-3147.63094. PMID: 21799611; PMCID: PMC3137824.
7. Sarvaiya B, Singal G, Chaudhari J, Patel SM, Patel SV. A study of incidence of interparietal bones in adult human dry skulls. Southeast Asian J Case Rep Rev. 2014;3(5):1586-9.
8. Badkur DS, Sharma V, Badkur P. Medicolegal importance of inca bone in forensic. J Indian Acad Forensic Med. 2011;33(4):358-60.
9. Murlimanju BV, Prabhu LV, Paul MT, Pai MM, Krishnamurthy A,

Rai A. Variant morphogenesis of squamous part of occipital bone in human skulls. Journal of Morphological Sciences. 2017 Jan 16;27(3-4):0

10. B. Ashwinidevi, A. Saranya,R.Yasoda. Anatomical variation in South Indian population in the parietal bones: Wormian bone/Inca bone. Int J Med Sci Clin Res Stud. 2021;1(4):21-5. Pg.82-84
11. Akbar Basha MP, Sugavasi R. Study of metopic suture in south Indian skulls. Int J Res Med Sci. 2015;3(6):1450-2