Study of variations of bony pattern and presence of wormian bone at pterion in dry human skulls

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Abstract
Pterion is an important bony landmark of skull present on normalarteralis. Variations of bony pattern at pterion are common and are of clinical importance. Present study was carried out in Department of Anatomy IIMS & R to find out variations at pterion in dry human skull of north Indian origin. We utilized 60 dry human skulls for the study. The pattern of pterion and presence of sutural was observed. Sphenoparietal was the commonest type of pterion in both left (86.7%) and right (91.7%) side of skull, stellate type was found in (5%) of skulls and frontotemporal was found in 3.3% of left and right each. Sutural bone was present in 5% skulls on the left side. Variation in pattern of pterion and presence of sutural bones are important from surgical and radiological point of view.

Keywords: pterion, sphenoparietal, frontotemporal, sutural bone

1. Introduction
Pterion is defined as an H-shaped sutural junction formed by the meeting of four bones: frontal, parietal, temporal and sphenoid on normalarteralis of the skull\(^1\). Pterion is the weakest part of the skull and the most interesting bone meeting points in craniofacial osteology.

Pterion has a significant importance as it is a craniometric point that is related to various structures in the cranial cavity like, anterior branch of the middle meningeal artery, Broca’s area, the insula, and the stem of the lateral sulcus. Pterional fractures may therefore tear the frontal branch of middle meningeal artery leading to extra dural haematoma\(^2\). It is also a primary site during surgery to gain access to the sphenoid ridge and optic canal\(^3\).

According to the bony pattern of pterion it was classified by different authors e.g. classified into four types (sphenoparietal, frontotemporal, stellate, and epipetric) by Murphy in 1956, six types by Wang et al. 2006 (sphenoparietal, frontotemporal, stellate, epipetric zygomatico-parietal and zygomatico-temporal)\(^4,5\).

In present study we tried to find out incidence of various types of pterion utilizing Murphy’s classification as well as presence of sutural bones at pterion in human dry skulls from Indian population.

2. Materials and Methods
A total of 60 dry human adult aged skull of unknown sex without any gross pathology or abnormality were collected from the Department of Anatomy, Integral Institute of Medical Sciences & Research, Lucknow and King George’s Medical University, Lucknow for the study.

On the either side of each skull, the sutural pattern of the pterion is determined based on Murphy’s classification.

1) Sphenoparietal type: Greater wing of sphenoid articulates with the parietal bone to form the letter ‘H. (figure 1)
2) Frontotemporal type: Squamous part of the temporal bone articulates with the frontal bone. (figure 2)
3) Stellate type: Here all bones articulate at a point in the form of letter ‘K’. (figure 3)
4) Epipetric type: A sutural bone is lodged between the 4 bones forming the pterion. (figure 4)
3. Observation and Results

On observing the sutural pattern and the bones articulating to form the pterion we found that Sphenoparietal type of pattern was most common both the sides. On the left side out of sixty, fifty two (86.7%) skulls were having this pattern and on the right side fifty five(91.7%) out of sixty were having this pattern.

Second commonest was the stellate pattern which was present in three (5.0%) skulls on left side as well as right side. It was followed by Frontotemporal pattern present in two (3.3%) skulls on left side and in two skulls on right side.

Sutural (wormian) bone was found in three (5%) skulls on the left side but none of it was found on the right side. This type of pterion where the sutural bone was present, classified as epipteric type. The findings were tabulated in table 1 and displayed in figure 5.

Table-1: Frequency of different types of pterion on left and right side of skull

| Type of pterion | Left (n=60) | Right (n=60) | Total (n=60) |
|----------------|------------|-------------|-------------|
|                | No.        | %           | No.         | %           | No.         | %           |
| Sphenoparietal | 52         | 86.7        | 55          | 91.7        | 107         | 89.2        |
| Frontotemporal | 2          | 3.3         | 2           | 3.3         | 4           | 3.3         |
| Stellate       | 3          | 5.0         | 3           | 5.0         | 6           | 5.0         |
| Epipteric      | 3          | 5.0         | 0           | 0.0         | 3           | 2.5         |

4. Discussion

It is well known that the morphological configuration of the sutural junctions of the bones associated with the pterion varies significantly in humans. Population-based differences suggest that various genetic variations in humans underlie the different sutural patterns of the pterion.

According to previous studies, the sphenoparietal type of pterion is the dominant form in humans whereas the frontotemporal type is dominant in nonhuman primates. In the present study, sphenoparietal was the commonest type (89.2%) of pterion similar to previous studies. The second commonest type of pattern of pterion mentioned in most of the studies is frontotemporal type. It was different in present study where we found that stellate pattern (5.0%) was more common than frontotemporal (3.3%) type. A comparison of incidences of various studies is displayed in table 2.

Epipteric (wormian) bones are small, irregular ossicles formed due to additional ossification centers in or near the lambdoid suture, pterion and asterion. Studies reveal that the wormian bones are markers for various diseases and are important in the primary diagnosis of brittle bone disease (osteogenesis imperfecta). The presence of sutural bones is usually associated with cranial and central nervous system anomalies.

One or more pterion ossicles or epipteric bones may appear between the sphenoidal angle, parietal and the greater wing of the sphenoid. They can cause weakness of the cranium and help in extension of the fractures according to their location. Hence, presence of these bones provide false impressions of fractures or the fractures may be interpreted for wormian bones, especially in the region of pterion either raiologically or clinically. The presence of epipteric bones may lead to complications in making burr holes at the pterion. It is therefore, relevant to surgeons and radiologists to have this essential information before and during surgical intervention.
An epipetric type pterion was observed in a small number of skulls (5.0%) in the present study, being significantly less than that reported in previous studies but similar to that reported by Zalawadia 2010 as 4.8%. A comparison of incidences of epipetric bones in different studies is displayed in table 3.

### Table 2: Comparison of types of the pterion in different studies to present study

| Study/Population          | Sphenoparietal | Frontotemporal | Stellate | Epipetric |
|---------------------------|----------------|----------------|----------|-----------|
| Saxena et al., 1988, Nigerian 1 | 84.79%         | 10.11%         | 5.06%    | -         |
| Saxena et al., 1988, Indian 1 | 95.3%          | 3.46%          | 1.38%    | -         |
| Manjunath et al., 1993, South Indian 2 | 93.55%         | 3.52%          | 2.93%    | 17.3%     |
| Zalawadia et al 2010, Western Indian 2 | 91.7%          | 2.4%           | 1.2%     | 4.8%      |
| Apinhasmit et al., 2011 Thai 3 | 81.2%          | -              | -        | 17.4%     |
| Suchit 2011 North Indian 4 | 86.25%         | 11.25%         | 2.5%     | -         |
| Nair 2014 Indian 5 | 89.9%          | 2.3%           | 1.9%     | 5.9%      |
| Present study             | 89.2%          | 3.3%           | 5.0%     | 2.5%      |

### Table 3: Comparison of incidences of wormian bones at pterion reported in different studies.

| Type of studies     | Incidence of sutural bone at pterion |
|---------------------|--------------------------------------|
| Majunath KY et al 1993 7 | 17.30%                                |
| Gopinath et al 1998 7 | 6.74%                                |
| Ersoy et al 2003 7  | 9.0%                                 |
| Zalawadia et al 2010 12 | 4.8%                                |
| Khatri et al 2012 22 | 11.73%                               |
| Present study 2014   | 5.0%                                 |

### Acknowledgement

We sincerely acknowledge Mr. Asif computer operator in the Department of Anatomy, IMS & R for his help and support during the study and preparation of manuscript.

### References
1. Standing R, Collins P Gray’s anatomy, 40th edn. Elsevier Churchill Livingstone, London, 2008; 412.
2. Lama M, Motolese C. Middle meningeal artery aneurysm associated with meningoima. J. Neurosurg. Sci., 2000; 44:39-41.
3. Saxena RC, Bilodi AKS, Mane SS, Kumar A. Study of pterion in skulls of awadh area-in and around Lucknow. Kathmandu Univ Med J 2003; 1:32–33.
4. Murphy T. The pterion in the Australian aborigine. Am J Phys Anthropol 1956; 14:225-4.
5. Wang Q, Opperman LA, HaviL LM, Carlson DS, Dechow PC. Inheritance of sutural pattern at the pterion in Rhesus Monkey skulls. Anat. Rec. Discov. Mol. Cell. Evol. Biol 2006; 288:1042-9.
6. Ashley-Montagu, FM. The tarsian hypothesis and the descent of man. J. R. Anthropol. Inst. Great Britain Ireland 1930; 60:335-62.
7. Saxena SK, Jain SP, Chowdhary DS, A comparative study of pterion formation and its variations in the skull of Nigerian and Indians. Anthropol Anz 1988; 46: 75-82.
8. Pryles CV, Khan AJ. Wormian bones. A marker of CNS abnormality? Am. J. Dis. Child. 1979; 133: 380–382.
9. Das S, Suri R, Kapur V. Anatomical observations on os inca and associated cranial deformities. Folia Morphol. (Warsz). 2005; 64: 118–121.
10. Nayak S, Soumya KV. Unusual sutural bones at pterion. JAV 2008;1:19-20
11. Ersoy M, Evliyaoglu C, Bozkurt MC, Konukstan B, Tekdemir I, Keskili IS. Epipetric bones in the pterion may be surgical pitfall. Minim Invasive Neurosurg 2003; 46:364–365.
12. Zalawadia DA, Vadgama DJ, Ruparelia DS, Patel DS, Patel DSV. Morphometric Study of Pterion In Dry Skull Of Gujarat Region. NJIRM. 2010; 1(4): 25-29.
13. Manjunath KY, Thomas IM. Pterion variants and epipetric ossicles in South Indian skulls. J Anat Soc India 1993; 42:85-94.
14. Apinhasmit W, Chompoopong S, Chaisuksunt V, Thiraphathanavong P, Phasukdee N. Anatomical consideration of pterion and its related references in Thai dry skulls for pterional surgical approach. Journal of The Medical Association Of Thailand Chotmaihet Thangphaet 2011; 94(2): 205-214.
15. Suchit K, Anurag, Munjal S, Chauhan P, Chaudhari A, Jain SK. Pterion its location and clinical implications- A Study Compared. Journal of Evolution of Medical and Dental Sciences 2013; 12 (25): 4599-4608.
16. Nair SK, Singh S, Bankwar V. Sutural morphology of the pterion in dry adult skulls of Uttar Pradesh and Bihar region of Indian subcontinent. Indian Journal of Forensic Medicine & Toxicology 2014; 8 (1):181.
17. Gopinath K, Dhall U, Chhabra S, Sutural bones in the North Indian Population, J. Anat. Soc. India 1998; 47(2):91-96.
18. Khatri DCR, Gupta DS, Soni DJS, Study of pterion and incidence of epipetric bones in dry human skulls of Gujrat. NJIRM 2012; 3 (2):57-60.