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# Classification and Incidence of Pterion Patterns of Thai Skulls

## Clasificación e Incidencia de los Patrones de Pterion en Cráneos de Tailandia

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**SUMMARY:** The pterion, a landmark for neurosurgery, is the weakest part of the skull owing to relatively thin bone. Variant patterns of pterion can confuse the clinicians during diagnosis of the lateral skull fractures in emergency situations. Thedifferent pterion types of many races have been reported but not of Thais. In this study; therefore, we investigated the incidence of sutural pterion patterns on of Thai skulls. The infratemporal fossa of 110 sides from 55 dried skulls identified as Thais were observed and classified for individual pterion types. The results showed that the pterion patterns can be classified into 4 types; spheno-parietal (87.27 %), fronto-temporal (4.55 %), uni-epipteric (6.36 %), and multi-epipteric (1.82 %) types. It was found that the spheno-parietal type was dominant in males (61.81 %) than in females (25.45 %). The majority of the skulls showed bilateral symmetry (85.45 %) in all types and the unilateral ones were far less (14.55 %). In bilateral pterion incidence, the spheno-parietal type was approximately 93.61 % while the uni-epipteric type was not found. Moreover, the bilateral multi-epipteric type was found only in one female skull (2.13 %). These findings will be useful for the radiologists and the neurosurgeons concerning lateral skull fractures in emergency diagnosis

**KEY WORDS: Pterion; Spheno-parietal type; Fronto-temporal type; Uni-epipteric type; Multi-epipteric type.**

## INTRODUCTION

In general, the pterion in lateral aspect of the human skull is usually an irregular H shaped suture. It is formed by articulation of the frontal, parietal, greater wing of sphenoid and the squamous part of temporal bones. It is the weakest part of the skull owing to the relatively thin bone and is commonly used as a landmark for neurosurgery related to many structures within cranial cavity such as middle meningeal artery and Broca's area (Escosa-Bagé *et al*., 2002; Lindsay *et al*., 1991). Clinically, the variant patterns of pterion can also confuse the clinicians during diagnosis of the lateral skull fractures in emergency condition. Interestingly, the types and positions of the ptrion have been well reported to be varying in different races (Morales *et al*., 2011). Previously, the patterns of pterion have been documented in various populations including Australian Aborigines (Murphy, 1956), Indians (Ahuja *et al*., 1971; Saxena *et al*., 2003; Natekar *et al*., 2010), North Indians (Agarwal *et al*., 1980; Seema & Mahajan, 2014), Japanese (Matsumura *et al*., 1991), Turks (Ersoy *et al*., 2003), Turkish (Oguz *et al*., 2004), Kenyas (Mwachaka *et al*., 2009), Gujurat (Zalawadia *et al*., 2010), Koreans (Lee *et al*., 2001), and Nigerians (Eboh and Obaroefe, 2014; Asala and Mbajiorgu, 1996). Although an incidence about skull morphology like the metopism, a rare variant suture persistence, in Northeastern Thais has been previously documented (Khamanarong *et al*., 2015), there is no later report about classification of pterion formation in our population. Therefore, this study aims to investigate the incidence and to classify the variations of the configuration of sutural pattern of pterion in Thai skulls.

## MATERIAL AND METHOD

A total of 110 sides of infratemporal fossa samples

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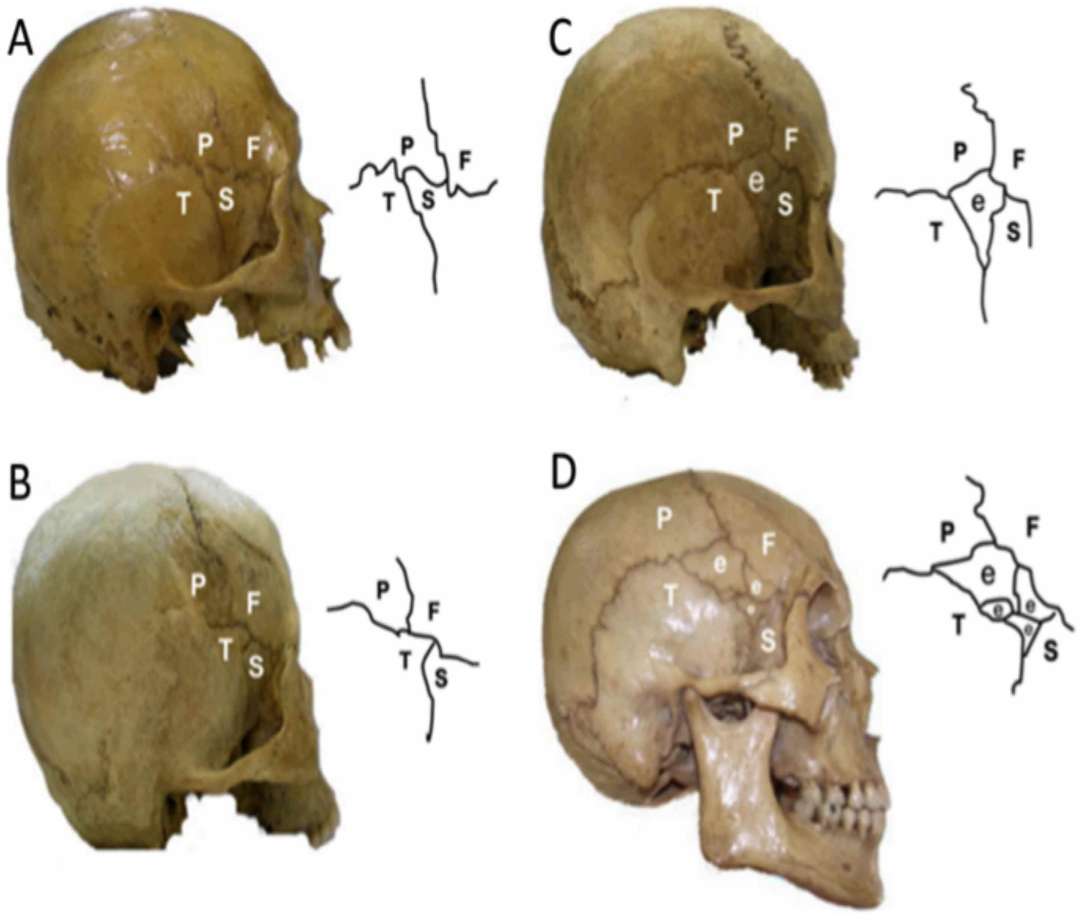


Fig. 1. Photographs (left panel) with schematic suture patterns (right panel) showing lateral view of dried skulls observed in Thais. They were classified into 4 different pterion patterns: A) Spheno-parietal type, B) Fronto-temporal type, C) Uni- type, and D) Multi-epipteric type. P; parietal bone, F; frontal bone, T; temporal bone, S; sphenoid bone, e; epipteric bone (as known as pterion ossicle, sutural or Wormian bone).

Table I. Incidence of pterion types observed on left and right sides of Thai skulls.

| Types of pterion | Males (*individual side of both sexes, n = 55*) | | | | Females (*individual side of both sexes, n = 55*) | | | | Total (N = 110) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Left side | % | Right side | % | Left side | % | Right side | % | | |
| Spheno-parietal type | 34 | 61.81 | 34 | 61.81 | 14 | 25.45 | 14 | 25.45 | 96 | 87.27 |
| Fronto-temporal type | 0 | 0 | 1 | 1.81 | 2 | 3.63 | 2 | 3.63 | 5 | 4.55 |
| Uni-epipteric type | 3 | 5.45 | 2 | 3.63 | 1 | 1.81 | 1 | 1.81 | 7 | 6.36 |
| Multi-epipteric type | 0 | 0 | 0 | 0 | 1 | 1.81 | 1 | 1.81 | 2 | 1.82 |

Table II. Incidence of bilateral symmetry in individual type of pterion patterns on Thai skulls.

| Types of pterion with bilateral symmetry | Males | | Females | | Total | % |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Spheno-parietal type | 31 | 65.96 | 13 | 27.65 | 44 | 93.61 |
| Fronto-temporal type | 0 | 0 | 2 | 4.26 | 2 | 4.26 |
| Uni-epipteric type | 0 | 0 | 0 | 0 | 0 | 0 |
| Multi-epipteric type | 0 | 0 | 1 | 2.13 | 1 | 2.13 |
| Total | 31 | 65.96 | 16 | 43.04 | 47 | 100 |

from 55 dried skulls identified as Northeastern Thais were used. Fifty four samples were adult dried skulls (37 males and 17 females, ranging from 27 to 89 years of age at decease). One female teen-ager's skull, (13 years of age at death) was also used. All skulls were identified and recorded systematically form bone Collection Unit, Department of Anatomy, Faculty of Medicine, Khon Kaen University, Thailand. Both sides of the infratemporal fossa were systemically investigated to classify the pattern of articulation of the pteria and recorded. The data were then analyzed using descriptive statistics.

## RESULTS

We found that the pterion patterns of Thai skulls could be classified into 4 different types as shown in Figures 1. The incidence of each pterion pattern was shown in Table I. Type 1 is the spheno-parietal type, irregular H like-shaped suture, formed by articulation of the frontal, parietal, greater wing of the sphenoid and the squamous part of temporal bones. Apparently, the sphenoid bone of this type directly contacted to the parietal bone (Fig. 1A). It was the most frequent type, found in 96 (left 48, right 48; 87.27 %) out of 110 sides of the skulls. Type 2 is the fronto-temporal type with irregular K like-shaped suture, in which the frontal bone directly contacts to the temporal bone (Fig. 1B). This type was rare and found as in 4.55 % of total skull sides. Type 3 is the uni-epipteric type, in which a small irregular-shaped epipteric (also called pterion ossicle, sutural or Wormian) bone was found interposing within this type of pterion (Fig. 1C). It was found in only 7 sides (6.36 %) of specimens (5 males and 2 females). Type 4, the specimen with multiple small irregular-shaped epipteric bones interposed within a pterion, was classified as multi-epipteric type (Fig. 1D) which as observed only in 2 sides (1.82 %) of the female's skull.

In addition, symmetry in the types of pterion was detected in 47 (31 males and 16 females) specimens (Table II). The bilateral spheno-parietal and fronto-temporal types occurred in 44 (93.61 %) and 2 (4.26 %) skulls, respectively. No symmetry was observed in uni-epipteric type of pteroin. The bilateral multi-epipteric type was rare, observed only in a female specimen (2.13 %).

## DISCUSSION

The pterion is used as an important anatomical landmark for many regions of the brain with respect to neurosurgery. The morphological variability of pterion has been documented in various populations (Murphy; Ahuja *et al*.; Agarwal *et al*.; Matsumura *et al*.; Lee *et al*. 2001; Saxena *et al*.; Ersoy *et al*.; Oguz *et al*.; Mwachaka *et al*.; Zalawadia *et al*.; Natekar *et al*.; Seema & Mahajan; Eboh & Obaroefe). Basically, the patterns of pterion have been classified into 4 types: spheno-parietal, fronto-temporal, stellate, and epipteric types (Seema & Mahajan). In the present study, spheno-parietal, fronto-temporal, uni-epipteric and multi-epipteric types were detected. The stellate type, in which the frontal, parietal, sphenoid and the temporal bones interconnected to each other (Murphy and Saxena *et al*.) was not observed. The spheno-parietal type was the most common type observed in Thais (87.27%). When the present data were compared with other races, the frequency of the spheno-parietal type in Thais was similar to the most common finding in the following races: Turks, 87.35 % to 88 % (Oguz *et al*.; Ersoy *et al*.); Indians, 84.72 to 85.33 % (Saxena *et al*.; Natekar *et al*.), and in North Indians 89 %, (Seema & Mahajan). The low frequency of the incidence of the fronto-temporal type (4.55 %) in Thais was similar to that reported in North Indians (4.35%) by Agarwal *et al*. While the incidence of 8.18% for both epipterics (uni-epipteric 6.36% and multi-epipteric 1.82%) in Thais is very close to that of Turks (8.98 %) reported by Ersoy *et al*.

In the case report by Satheesha & Soumya (2008), they found only three epipteric bones on the right pterion region in Indian adult skulls. In the preset study, we detected a unique type, in which 4 unusual small irregular-shaped of epipteric bones inserted within the pteria of both sides (Type 4, muti-epipteric). This was rare in incidence, occurring only 1.82 % of a total of 110 specimens. The variation of pterion which contained unusual epipteric bones may lead to surgical pitfall in cranial surgery. The bilateral symmetrical type of pterions was found in 47 of 55 skulls. The most frequent type was the bilateral spheno-parietal type (93.61 %).

In conclusion, the knowledge of the pterion types in relation to many brain landmarks may be important for neurosurgical interventions and for clinicians during diagnosis of the lateral skull fractures in emergency situations. The detailed anatomical information of variation pterion in Northeastern Thais will help the surgeons for operation planning.

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**RESUMEN**: El pterion es un punto de referencia para la neurocirugía, y es la parte más débil del cráneo debido a estar conformado por hueso relativamente delgado. Los diversos patrones de pterion pueden confundir a los clínicos durante el diagnóstico de fracturas laterales de cráneo en situaciones de emergencia. Con excepción de los tailandeses, diferentes tipos de pterion se han reportado en muchas razas. hemos investigado la incidencia de diversos patrones de pterion en cráneos de Tailandia. Analizamos 110 fosas infratemporales, correspondientes a 55 cráneos secos del Noreste de Tailandia y se clasificaron de acuerdo al tipo de pterion. Los resultados mostraron que el pterion puede clasificarse en 4 tipos: esfeno-parietal (87,27 %), fronto-temporal (4,55 %), epiptérico (3,63 %) y multi-epiptérico (1,81 %). Se encontró que el tipo esfeno-parietal tuvo mayor incidencia en hombres (61,81 %) que en mujeres (25,45 %). Además, la incidencia de simetría bilateral (85,45 %) fue mayor que la unilateral (14,55 %). A nivel bilateral, el tipo esfeno-parietal fue de 93,61 %, mientras que el tipo epiptérico no se observó. Por otra parte, el tipo multiepiptérico fue encontrado bilateralmente en un solo cráneo femenino (2,13 %). Esta incidencia puede ser utilizada como un conocimiento básico para los radiólogos tailandeses sobre las fracturas laterales del cráneo en un diagnóstico de emergencia.

**PALABRAS CLAVE: Pterion; Tipo esfeno-parietal; Tipo fronto-temporal; epíptericos.**

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