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Interparietal or Incaic Bone: Terminology, Classification, and Clinical Relevance. Literature Review and Case Report in Uruguayan Specimens

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ABSTRACT: The human cranium is a complex osseous structure whose development is subject to multiple variations, many of which have clinical, radiological, and surgical relevance. One such variation is the presence of the interparietal bone, a structure whose nomenclature and classification have long been the subject of controversy. The present study aims to review the relevant literature and to present the first reported cases of interparietal bones in a Uruguayan population. A literature search on the interparietal bone was conducted using Google Scholar, PubMed, and Scopus. Subsequently, two human crania presenting interparietal bones were analyzed and designated as cranium A and cranium B. Anthropometric measurements were obtained, and both specimens were classified according to the classifications proposed by Kandánov and by Hanihara and Ishida. Cranium A presented two interparietal bones, measuring 91 mm and 50 mm in maximum length, respectively, corresponding to type 3C according to the Kandánov and Hanihara and Ishida classification. In contrast, cranium B exhibited a single interparietal bone with a maximum length of 45 mm, corresponding to type 1B. The literature reveals significant discrepancies and inconsistencies regarding the terminology and classification of the interparietal bone. Based on the present analysis, the term “interparietal bone” is considered the most appropriate designation for this structure, and the use of the term “Incaic bone” should be avoided. Considering its developmental origin, the interparietal bone should be regarded as an intercalary bone rather than a Wormian bone. Finally, relevant clinical and demographic aspects of this anatomical variation are discussed.

KEY WORDS: interparietal bone, Incaic bone, cranial variation, skull development, intercalary bones, anatomical classification.

INTRODUCTION

The human skeleton is divided into two major components: the appendicular skeleton of the limbs and the axial skeleton, the latter formed by the vertebral column and the skull. The skull is the most complex bony structure in the entire organization of the human body. In this sense, its study throughout history has made it possible to characterize even the smallest and most complex parts; however, variations still persist that have not been sufficiently characterized or whose function or origin remains under discussion.

One of these is the interparietal bone, which has been described by some anatomists throughout history. The first anatomical description of the interparietal bones was made by Bartolomé Eustaquio in 1744 in the publication called “Explicatio tabularum anatomicarum”. Later, Geoffroy Saint-Hilaire named it the interparietal bone in 1823, while it was named the Inca bone by Rivero & Von Tschudi in 1851 (García-Hernández & Murphy-Echeverría, 2008). The term Inca bone was coined because it was believed to be exclusive to populations of ancient Peru (Wu *et al*., 2011;

Mamani-Rodriguez *et al*., 2022); Gordan in 1963 compared the bone to a triangular structure whose shape was typical of Inca architecture (Marathe *et al*., 2010).

In this work, current views on the etymology of the interparietal bone will be presented, as well as some of the hypotheses regarding its origin, its prevalence, and its little-known clinical and surgical relevance, making the interparietal bone an essential structure for neurosurgeons, as well as for imaging specialists.

MATERIAL AND METHOD

A literature review on the interparietal bone was conducted. For this purpose, the search engines Google Scholar, PubMed, and Scopus were used. The bibliographic search was carried out in July 2025. Articles in both Spanish and English were searched. To perform the search, the MeSH terms “Skull”; “Anatomy”; “Parietal bone”; “Occipital bone” were used, as well as the non-MeSH terms “Interparietal bone”; “Inca bone”; “Wormian bones”; “intercalary bones”, along with their equivalent terms in English.

After the bibliographic search, two bony skulls of Uruguayan origin were analyzed, belonging to the Anatomy Museum of the Faculty of Medicine of the University of the Republic of Uruguay. All cadaveric material used in this work comes from voluntary donation for research and teaching purposes.

A digital caliper, thickness caliper, and measuring tape were used as measurement instruments, and a Nikon D500 camera was used for photographic recording. Microsoft Excel was used to design the tables and analyze the measurements.

This study is descriptive, observational, and cross-sectional, and was organized into three parts: the first consisted of identifying the sex of the two skulls; the second consisted of classifying the interparietal bone; finally, the third part consisted of obtaining measurements of these bones and analyzing their clinical implications, etymology, incidence, and origin.

For the estimation of the sex of the skulls, a morphognostic analysis was performed that included the morphology of the mastoid process, the supraorbital prominence, the shape of the base of the orbital cavity, the morphology of the occiput, the overall size and architecture, the roughness of the zygomatic arch, as well as the size and shape of the nasal aperture (Williams & Rogers, 2006) Table 1. Likewise, the distance between the most prominent point of the mastoid process and the porion (on the right) was measured, as well as the distance between both mastoid processes (Jain *et al*., 2013). It should be noted that due to the absence of the mandible in both skulls, the mandibular parameters used in the classification of William and Rogers 2006 could not be recorded.

For the classification of both bones, the classification of Kandanoff and Hanihara and Ishida (Hanihara & Ishida, 2001; García-Hernández & Murphy-Echeverría, 2008) was used.

Each of the sides of the interparietal bone was measured in millimeters with a digital caliper, named in a counterclockwise direction (A, B, C, D, E). The distance in centimeters fromthe external occipital protuberance to the glabella was also measured, and finally the cranial perimeter was measured; using a thickness caliper and a non-extensible tape, respectively.

Table 1. Morphological parameters of cranial sexual dimorphism according to the Williams & Rogers (2006) classification, as well as morphometric parameters of cranial sexual dimorphism.

PARAMETERS	SKULL A	SKULL B
Base of the orbit	Circular	Circular
Supraorbital ridges	Small and sharp	Small and sharp
Occiput	Not prominent	Not prominent
Nasal aperture	Low and rounded margins	Low and rounded margins
Zygomatic arch	Narrow and smooth	Narrow and smooth
Mastoid	Small and sharp	Small and sharp
Mastoid–Porion distance (right)	2.4 cm	2.6 cm
Bimastoid distance	10.1 cm	10.4 cm

RESULTS

Both skulls were classified as female skulls following the morphognostic guidelines of the Williams & Rogers (2006) classification (Table 1), as well as other complementary morphometric parameters as proposed by Jain *et al*. (2013).

Following the modified classification of Kadanoff and Hanihara and Ishida (Hanihara & Ishida, 2001; García-Hernández & Murphy-Echeverría, 2008) (Fig. 1), our observations conclude that skull A (Fig. 2) corresponds to type 3C, given that it is divided into a more central and larger portion, and a more lateralized portion to the right of smaller size. Skull B (Fig. 3) is type 1B, as there is one large interparietal bone located over the right lambdoid suture.

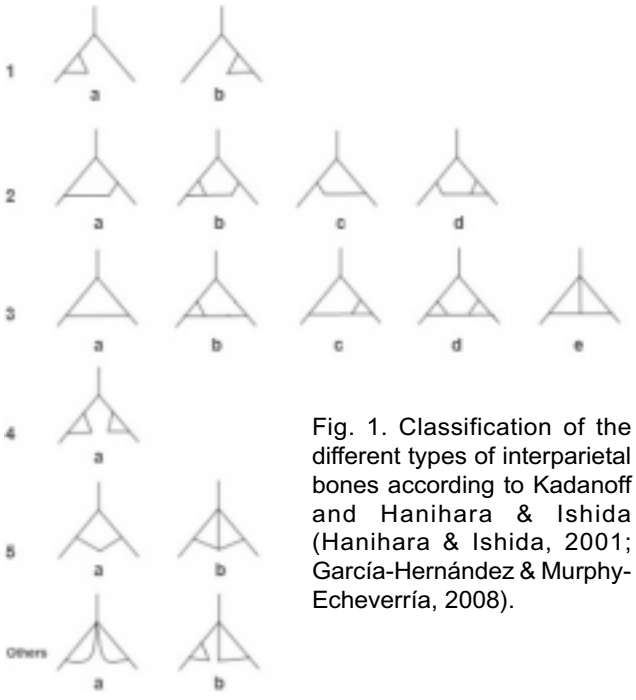

Fig. 1. Classification of the different types of interparietal bones according to Kadanoff and Hanihara & Ishida (Hanihara & Ishida, 2001; García-Hernández & Murphy-Echeverría, 2008).

After measuring the length, width, as well as the sides of each bone in a counterclockwise direction, the following results expressed in millimeters were obtained. Interparietal 1 of skull A had the greatest length and width, with 91 mm and 60.6 mm, respectively. On the other hand, the longest side was side A of interparietal 1 of skull A, measuring 79.5 mm. The shortest side was side C of interparietal 2 of skull A, measuring 10.6 mm. Table 2.

The maximum cranial length (distance from the external occipital protuberance to the glabella) and the cranial perimeter were recorded. In our study, the following results were obtained: the cranial length was greater in skull A at 18 cm, while in skull B it was 18.1 cm. Skull B also had the greatest cranial perimeter, measuring 53 cm, whereas that of skull A was 51.5 cm.

Fig. 2. Skull A, posterior view. 1: Occipital bone. 2: Interparietal bone. 2´: Interparietal bone. 3: Left parietal bone. 4: Right parietal bone.

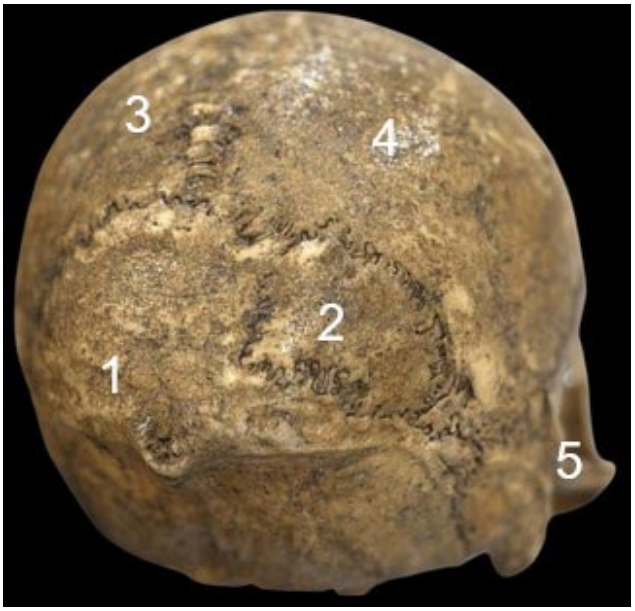

Fig. 3. Skull B, posterolateral view. 1: Occipital bone. 2: Interparietal bone. 3: Left parietal bone. 4: Right parietal bone. 5: Right mastoid process.

Table 2. Measurements of the sides of the interparietal bones, as well as their length and width.

Measurements	Skull A – Interparietal 1	Skull A – Interparietal 2	Skull B – Single Interparietal
Length	91 mm	50 mm	45 mm
Width	60.6 mm	40.4 mm	33.5 mm
Side A	79.5 mm	36.4 mm	34.5 mm
Side B	14.8 mm	37.2 mm	42 mm
Side C	62.1 mm	10.6 mm	44.5 mm
Side D	38.5 mm	49.6 mm	
Side E	39.3 mm		

DISCUSSION

From the analysis of the literature on the subject, it is important to highlight that there are marked differences between the terminology used by different researchers. This limits the usefulness of some information sources. Therefore, emphasis is placed on the immediate need for an anatomical consensus regarding these structures.

The authors of this work consider that the term “Inca bone” should not be used, given that the international anatomical nomenclature committee recommends not using eponyms, with the aim of employing more descriptive, precise, and simple names. In accordance with the above, it is necessary to mention that authors such as Jorge Eduardo Duque Parra state that the use of eponyms can hinder the learning of anatomy, as they often create difficulties in morphofunctional reasoning or fail to provide clues about the location of structures in the human body (Duque Parra *et al*., 2002). At the same time, the name “Inca” does not imply that it is a bone found only in populations descended from the Inca population.

Nomenclature: Inca/epactal vs interparietal

Ricardo Palma understands the Inca bone as a triangular bone located in the reentrant angle between the two parietal bones (Palma, 1943), or rather, in the interparietal region, located between the two parietal bones and the occipital bone (Testut & Latarjet, 1982; Khan *et al*., 2013); it is usually single but may be double or triple, or divided forming a conglomerate of Wormian bones (Palma, 1943; Hanihara & Ishida, 2001). On the other hand, Palma (1943) describes the interparietal bone as a giant Inca bone, shaped like an isosceles triangle, whose base extends from one asterion to the other, while its other two sides join the parietals forming the lambdoid suture. However, other authors describe the same concept using the designation Inca bone or interparietal bone; as a result of this conflict and the variability in its presentation and description, the classification proposed by Kandanoff and Hanihara & Ishida for Inca/interparietal bones arises (Hanihara & Ishida, 2001; da Mata *et al*., 2010). Like the Inca bone, it may be double or triple (Palma, 1943); however, for other authors, the existence of a single interparietal bone is rare, with an incidence of 0.4% to 2.6% (Wu *et al*., 2011); in any case, several authors agree that its existence is rare (Khan *et al*., 2013; Paiyee Villegas *et al*., 2025).

However, Testut and Latarjet differentiate Inca or epactal bones from interparietal bones, stating that the former are Wormian bones, whereas interparietal bones are bones formed by their own ossification centers, where the persistence of the sutures that separate them from the different ossification centers of the occipital gives rise to the formation of this bone (Testut & Latarjet, 1982).

In accordance with the above, we agree that the designation of interparietal bone is currently the most accepted, and that it refers to the same entity as the Inca bone, this being the result of the non-fusion of the different parts of the occipital bone.

Wormian bone or intercalary bone?

Many authors treat the interparietal bone as a Wormian bone. According to Testut & Latarjet (1982), a Wormian bone is understood as any supernumerary bone found among the various bones of the skull, either between the sutures that articulate them or within them. They were described by Olaus Wormius in the 17th century (Mamani-

Rodriguez *et al*., 2022), although their first description is attributed to Gonthier d'Andernach (Testut & Latarjet, 1982); records of Wormian bones are even found in the pharmacopeia of ancient Greek physicians (Testut & Latarjet, 1982; da Mata *et al*., 2010). In line with this, many authors classify interparietal bones as Wormian bones, as they consider them additional bones originating from anomalous ossification centers during the membranous ossification process of the skull (Mamani-Rodriguez *et al*., 2022).

There is another view on the subject in which, as previously mentioned, certain authors establish that interparietal bones should not be considered Wormian bones, but rather intercalary bones. In agreement with this, García Hernández & Murphy Echeverría (2025) state that interparietal bones are not Wormian bones, as they understand that Wormian bones are formed by ossification centers located within the sutures and surrounded by connective tissue. On the other hand, they state that the interparietal is an intercalary bone, defining intercalary bones as isolated bones surrounded by their own sutures from adjacent bones; and which, in turn, are formed by their own ossification centers (García Hernández & Murphy Echeverría, 2025).

Regarding one of the hypotheses supporting that the interparietal bone is not a Wormian bone, it is explained as follows: during a stage of embryonic development, the occipital bone is composed of a cartilaginous portion and a membranous portion. The latter ossifies through three pairs of ossification centers. The first pair (primary centers) forms between the highest and supreme nuchal lines, forming the intermediate segment of the squamous portion. The other two pairs (secondary centers) are located on each side of the midline, superior to the supreme nuchal line, forming the secondary centers. Defects in the fusion of these centers are what give rise to interparietal bones. With some exceptions described, all variants of this type of bone can be explained based on the ossification centers that should have fused in the membranous portion of the occipital bone (Hanihara & Ishida, 2001; Khan *et al*., 2013). In accordance with this, a certain genetic incidence in the appearance of this bone has been studied. This trait appears to be inherited as a dominant trait, with a penetrance of 50% (Tørgersen, 1951).

From what has been described regarding the embryonic development of the interparietal bone and Wormian bones, it follows that their presence has a different genesis. Therefore, it is proposed that the most appropriate approach is to consider the interparietal bone as an intercalary bone, even taking into account that both Wormian and intercalary bones represent supernumerary bony structures.

However, there are other explanations for the existence of interparietal bones, such as reduced ossification occurring in certain metabolic diseases, increased space between sutures, as well as the application of forces on the skull and the stretching of the meninges (Mamani-Rodriguez *et al*., 2022). However, others state that it may be due to skull fractures in childhood (Marathe *et al*., 2010).

Clinical relevance

It should be noted that there is more information on the implications of Wormian bones, but not interparietal bones, as a manifestation or cause of a pathology; for example, an increased number of Wormian bones in the lambdoid suture, and not of interparietal bones, has been associated with sagittal craniosynostosis (Wu *et al*., 2011). The hypothesis proposed for this is that the occurrence of interparietal bones is less common in individuals with sagittal craniosynostosis (Wu *et al*., 2011). On the other hand, the presence of interparietal bones has been reported in patients with certain pathologies such as early fusion of sutures, such as the metopic, coronal, lambdoid, among others; as well as in patients with Muenke and Apert síndromes (Wu *et al*., 2011).

It is important to highlight that the presence of Inca bones is associated with the incorrect diagnosis of skull fractures in radiographic studies, as well as with complications in neurosurgeries aimed at decreasing intracranial pressure, such as trepanation surgeries, by allowing the continuation of fracture lines (Marathe *et al*., 2010).

Demographic aspects

Regarding their distribution by sex, some authors have not established significant differences between samples (Hanihara & Ishida, 2001), while others have (Marathe *et al*., 2010). Likewise, there is no clear pattern of distribution worldwide regarding the presence of the Inca bone.

However, there are some trends in particular geographic areas. While in western Eurasia and northeast Asia this bone is not frequent, in populations of the New World and sub-Saharan Africa it is. Within the populations of the New World, the samples with the highest prevalence of the Inca bone were those from Peru and from the northwest coast of America. Then, in sub-Saharan Africa, populations from West Africa showed the highest frequency of occurrence (Hanihara & Ishida, 2001).

In Uruguay, there are no records of the frequency of the Inca bone. There is also no estimate in the Río de la Plata region. However, considering the ethnic-racial ancestry of the region, which is predominantly European, it would be between 1.5% and 2% (Hanihara & Ishida, 2001).

It is essential to mention that the length, width, and the measurements of each side of the interparietal bones were measured with the aim of characterizing them in greater detail. On the other hand, none of the consulted articles described the length of these bones, therefore we encourage that in future studies the corresponding measurements be carried out in order to characterize them more precisely.

On the other hand, the maximum cranial length and the cranial perimeter remained within the normal range of adult skulls for the female sex that do not present interparietal bones (Poca *et al*., 2013; Sathiya *et al*., 2022; Sahoo *et al*., 2025).

CONCLUSION

We highlight that there is still a conflict regarding the origin of the bone and its correct nomenclature; however, we chose the approach that names this bone as interparietal in order to avoid eponyms and, in turn, we adopted the position that it is an intercalary bone rather than a Wormian bone due to the different morphogenesis of each.

It is necessary to mention that anatomical knowledge of the interparietal bone is fundamental for any professional dedicated to the imaging study of the skull, as well as for the neurosurgeon; and on the other hand, not to miss the opportunity to emphasize that it is a poorly studied structure and that few anatomical books describe it; therefore, the reporting of these structures is essential to continue deepening knowledge about them.

Finally, it should be mentioned that this is possibly the first report of the interparietal bone in Uruguay, since we have not found online articles or textbook bibliography that demonstrate otherwise.

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Joaquin Silva: conceptualization, data curation, investigation, methodology, visualization, writing-original draft
Patricio Fornos: conceptualization, data curation, investigation, methodology, visualization, writing-original draft
Augusto Garrido: conceptualization, data curation, investigation, methodology, writing – review & editing, supervisión

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