

# Frequency and Characterization of the Infratemporal Spine in a Sample of Chilean Human Skulls

Frecuencia y Caracterización de la Espina Infratemporal  
en una Muestra de Cráneos Humanos Chilenos

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**SUMMARY:** The infratemporal spine, or sphenoidal tubercle, is a bony structure described in both classical anatomical literature and contemporary literature. However, the available literature does not mention the specific anatomical characteristics or the distribution of this bony element in the population. The aim of this study was to define this structure, identify its presence, and identify its morphology in a sample of Chilean human skulls. Fifty-seven dry skulls, obtained from the morphology unit at Universidad de los Andes, were used. The great wings of the sphenoid bone on both sides of the skull were evaluated in search of the infratemporal spine. These spines were classified according to their morphological characteristics of either laminar, pyramidal, or truncated pyramidal, as they related to the infratemporal crest and as they related to the pterygoid process. The presence of the infratemporal spine was found in 100 % of the studied skulls, unilaterally or bilaterally. The most common morphology was found to be laminar (40 %), followed by pyramidal (35 %), and, finally, truncated pyramidal (24 %). The majority (73 %) of these infratemporal spines was closely associated with the pterygoid process with a complete or partial relation, with fewer (34 %) being associated with the infratemporal crest.

**KEY WORDS:** Infratemporal spine; Sphenoidal tubercle; Infratemporal crest.

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## INTRODUCTION

Classical anatomical literature (Testut & Latarjet, 1960; Rouvière & Delmas, 1999) describes the presence of an anatomical structure, named the sphenoidal tubercle, relative to the sphenoid bone. This structure is located on the exocranial surface of the greater wing of the bone, specifically in relation to the infratemporal crest, separating the horizontal from the vertical portion of the greater wing. Testut & Latarjet describes it as the most anterior portion of the infratemporal crest, often as an accentuated eminence, where temporal muscle fascicles would be attached. Other authors coined the term 'infratemporal spine' to describe the same structure (Zenker, 1954; Zenker, 1955; Schön Ybarra & Bauer, 2001). This element has become important again because it has been described as the origin of the deep portion of the temporal muscle, known in the literature as the sphenomandibular fascicle (Dunn *et al.*, 1996). Some authors describe it as a separate muscle, however, most others agree that it is a deep medial portion of the temporal muscle as it is not separated by any type of fascia and also presents a common innervation with the rest of the muscle (Dunn *et al.*; Shimokawa *et al.*, 1998; Geers *et al.*, 2005; Palomari *et*

*al.*, 2013). The new interest in this muscle fascicle is due to its possible association in triggering orofacial pain, mainly referred to the second division of the trigeminal nerve (maxillary nerve) by direct compression of the nerve at the round foramen (Schön Ybarra & Bauer; Fuentes *et al.*, 2009). Considering the limited descriptive literature of this bony structure, the objective of this study was to investigate the presence, frequency and characteristics of the infratemporal spine in dry skulls in a sample of the Chilean population. In addition, a classification is proposed, based on different morphologies observed in this bony structure.

## MATERIAL AND METHOD

Fifty-seven skulls, of indeterminate sex and age, were studied. These skulls were obtained from the morphology unit of Universidad de los Andes. Each one was labeled with an Arabic number on the left mastoid process. Then, using the definition by Testut & Latarjet, the researchers proceeded

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to identify the presence or absence of the infratemporal spine and delimit it. This process was repeated by all 4 researchers to reach a consensus. For delimitation, each skull was considered from a lateral view, with a horizontal line being passed through the most concave areas of the vertical portion of the greater wing. The bone found below the line was identified as the infratemporal spine (Fig. 1).

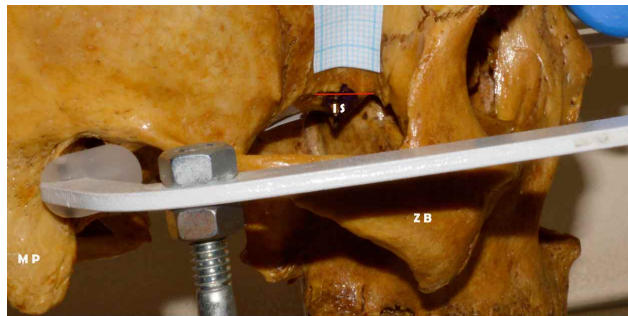


Fig. 1. Image of infratemporal spine identified with blue marker pen. A line has been drawn, indicating the limits proposed in this article. MP: mastoid process; ZB: zygomatic bone; IS: Infratemporal spine

Using an ink skin marker, the entire infratemporal spine was painted, if it was present in the sample. A classification system was developed, based on the observation of multiple morphologies of this spine. Three main criteria were taken into account to determine a classification. The first criterion was based on the macroscopic morphology of the spine. The second criterion corresponded to the relationship with the infratemporal crest, that is, if the infratemporal spine was continuous or not with the infratemporal crest. Finally, the third criterion was based on proximity to the lateral plate of the pterygoid process. Data was tabulated in an Excel table (Microsoft Corporation, Redmond, WA, USA), considering assessments for both the right and left sides. Stata 11® (StataCorp LP®, College Station, Texas, USA) was used for descriptive statistics, and the differences in the presence and morphology between the left and right sides were compared.

## RESULTS

Of the fifty-seven skulls observed, the presence of at least one infratemporal spine was found in all cases. In fifty-five skulls, the infratemporal spines were found bilaterally, while there was a unilateral presence in 2. For classification, the following three criteria were utilized: morphology, relationship with the infratemporal crest, and relationship with the pterygoid process.

With respect to the morphology of the infratemporal spine, the following sub-classifications were determined (Fig. 2).

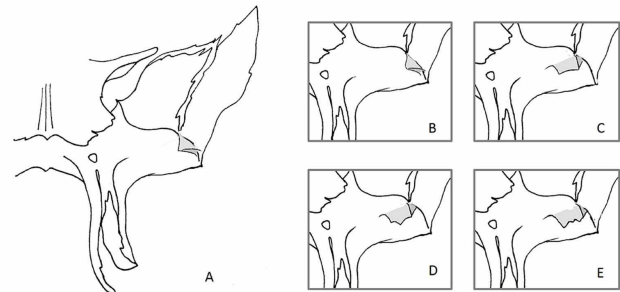


Fig. 2. Classification of the infratemporal spine morphology. A: Pyramidal. B: Truncated pyramidal. C: Smooth laminar D: Spiniform laminar. E: Irregular laminar.

**a) Pyramidal.** A spine in which there is a base and 3 to 4 sides with a sharp corner.

**b) Truncated pyramidal.** With similar characteristics to pyramidal, except the apex is not acute but blunt.

**c) Laminar.** Corresponds to a thin structure that has a linear base and two thin papyrus like faces. It can be found in 3 varieties.

- i. Smooth: where the lower edge is straight.
- ii. Spiniform: in which the lower edge has a sharp corner.
- iii. Irregular: in which multiple vertices of different heights are presented.

Regarding the relationship with the infratemporal crest, it was found that the infratemporal spine might appear as a continuation of the crest or as an isolated eminence (Fig. 3).

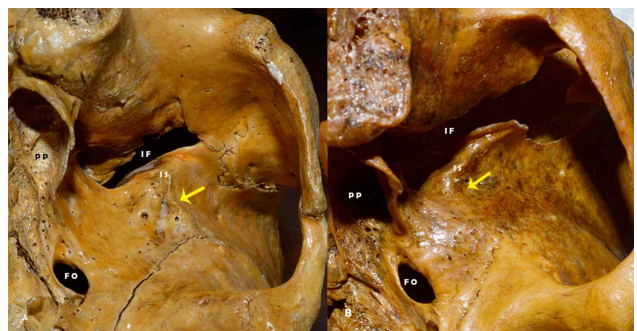


Fig. 3. Relationship with infratemporal crest. A: A complete relation between the spine and the infratemporal crest is observed. B: Lack of a complete relation between spine and infratemporal crest is observed. PP: Pterygoid process; IF: Inferior orbital fissure; IS: Infratemporal spine; FO: Foramen ovale.

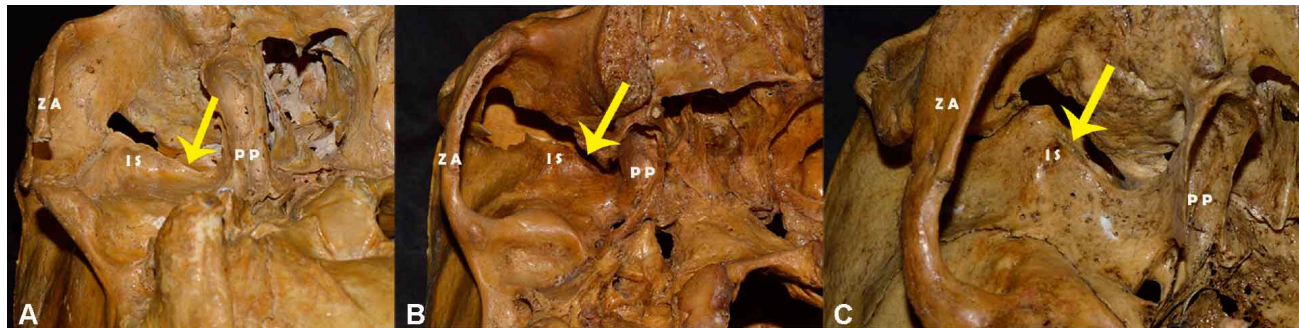


Fig. 4. Relationship with the lateral plate of pterygoid process. A: Complete relation between the spine and the lateral plate. B: A partial relationship is observed with the lateral plate. C: No relation between the spine and the lateral plate. ZA: Zygomatic arch; IS: Infratemporal spine; PP: Pterygoid process.

Finally, regarding the relationship with the pterygoid process, it was found that the infratemporal spine appeared from the most lateral portion of the greater wing of the sphenoid bone with a bone extension that continued as far as the lateral plate of the pterygoid process. With this in mind, the spines were divided into 3 types of relationships (Fig. 4):

- a) Complete relation with pterygoid process. Infratemporal spine extends to the lateral plate of the pterygoid process.
- b) Partial relation with pterygoid process. Infratemporal spine extends beyond 50 % of the distance between the side edge of the greater wing of the sphenoid and pterygoid process, but without contact with the lateral plate.
- c) Unrelated: Infratemporal spine extends to less than 50 % of the distance between the side edge of the greater wing of the sphenoid and pterygoid process.

With this classification defined in its three components of morphology, the relation with the infratemporal crest, and the relation with the pterygoid process, the distribution of the results are presented in Tables I, II and III.

With regard to the relationship between the right and left sides, it was found that 100 % of the sample had infratemporal spines on the right side, while 96 % of the sample had it on the left. Within the research sample, 40.35 % presented a relationship with the infratemporal crest on the right side, while 26.32 % of the sample presented this relationship on the left side. In addition, 33.33 % of the sample had a pyramidal shape on the right side, and 36.84 % had it on the left. Furthermore, 29.82 % had a truncated pyramidal shape on the right side, while 17.54 % had it on the left. Finally, 36.84 % of the sample was laminar on the right side, while 43.86 % was on the left.

Table I. Results of the sample spines studied by their morphologies.

	Pyramidal	Truncated Pyramidal	Laminar	Smooth L.	Spiniform L.	Irregular L.
N° of Spines	40	27	46	16	14	16
Percentage	35.09 %	23.68 %	40.35 %	14.04 %	12.28 %	14.04 %

The percentage exposed is in regard to the total sample of the analyzed skulls.

Table II. Results of the sample spines studied by their relation with the infratemporal crest.

	With Relation	Without Relation
N° of Spines	38	73
Percentage	33.33%	64.04%

The percentage exposed is in regard to the total sample of the analyzed skulls.

Table III. Results of the sample spines studied by their relation to the lateral plate of the pterygoid process.

	Complete Relation	Partial Relation	Unrelated
N° of Spines	39	44	28
Percentage	34.21%	38.6%	24.56%

\* The percentage exposed is in regard to the total sample of the analyzed skulls.

Complete relation with the pterygoid process was observed in 28.07 % and 40.35 % of the sample, on the right and left sides respectively. Partial relation was observed in 38.6 % of the sample on both sides; no relation was observed in 31.58 % on the right side, and 17.54 % on the left side.

## DISCUSSION

This study found that this bony structure is constant, being found in 100 % of the skulls studied in the sample, either unilaterally or bilaterally. It presents a wide variation in terms of the morphology and the relationship with neighboring bony structures. The most prevalent morphology found was laminar, corresponding to 40 % of the spines, followed by pyramidal with 35 %, and, finally, truncated pyramidal morphology which corresponded to 24 % of the skulls analyzed.

Most of the spines found were related to the pterygoid process, either totally reaching the base, or following the lower edge of the orbital surface of the greater wing of the sphenoid bone (73 %), and they were less related to the infratemporal crest (34 %). It is possible that this close relationship between the infratemporal spine and the pterygoid process may be caused by medial fibers of the superior fascicle from lateral pterygoid muscle.

Also, the description of the current temporary muscle dissections have demonstrated the presence of a deep temporal fascicle, inserted in the infratemporal spine (Geers *et al.*; Palomari *et al.*; Schön Ybarra & Bauer; Sedlmayr *et al.*, 2009). Several authors have linked this with the possible pathogenesis of the trigeminal neuralgia, originating in the maxillary division, by compression in the vicinity of the round foramen (Fuentes *et al.*; Schön Ybarra & Bauer). The high percentage of spines that were related with the pterygoid process show the feasibility of this possible pathogenesis.

The relationship between the right and left sides was asymmetric for all variables studied. Besides the varied morphologies, relationship with the infratemporal crest, and relationship with the pterygoid process, there was also a high presence of the spine, either on the right side at 100 % or the left side at 96 %.

There is debate about which term is more appropriate for this bony structure. In the classical literature, the term 'sphenoidal tubercle' can be found repeatedly in reference to the bony structure described in this article (Rouvière & Delmas; Testut & Latarjet). Other

clinical studies refer to the same bony structure as the infratemporal spine (Schön Ybarra & Bauer; Zenker, 1954; Zenker, 1955).

The authors of this article believe that it is more appropriate to use the name 'infratemporal spine' because of its position (located on the edge of the infratemporal region) and also its shape, which, in this sample, shows structures similar to bony spines with sharp edges (pyramidal and spiniform laminar). The term 'sphenoidal tubercle' seems ambiguous because of the variety of possible shapes that relate to a tuber. In addition, the term 'sphenoidal' expresses a very large area within the skull base by exo- and endocranium. Another interesting finding is that the spine is often isolated from the infratemporal crest, thus differing from Testut's sphenoidal tubercle definition. This study found the definition does not necessarily depend on the infratemporal crest.

## CONCLUSION

The researchers in this study conclude that the infratemporal spine has been defined, its presence noted as fairly constant, and it can present a variety of morphologies, with these being classified as pyramidal, truncated pyramidal and laminar. This spine's relations with neighboring structures can vary, with the most constant relationship with the lateral plate of pterygoid process near the round foramen. We further propose the name 'infratemporal spine' to replace 'sphenoidal tubercle' in the International Anatomical Terminology, for the bone structure described in this paper.

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**RESUMEN:** La espina infratemporal o tubérculo esfenoidal es un reparo óseo mencionado tanto en la literatura anatómica clásica como en los artículos más actuales. Las publicaciones disponibles no mencionan las características anatómicas ni la distribución en la población de este elemento óseo. El objetivo de este trabajo fue definir, iden-

tificar la presencia y describir la morfología de la espina infratemporal en una muestra de población chilena. Se utilizaron 57 cráneos secos de la unidad de anatomía de la Universidad de los Andes. Se evaluaron las alas mayores del hueso esfenoideas tanto derechas como izquierdas en búsqueda de la espina infratemporal. Se clasificaron según sus características morfológicas, siendo piramidal, piramidal truncada o laminar, según su relación con la cresta infratemporal y según su relación con el proceso pterigoideo. Se encontró la presencia de la espina infratemporal en un 100 % de los cráneos estudiados, ya sea de manera uni o bilateral. La morfología más común correspondió a laminar con un 40 %, seguido de piramidal con un 35 % y finalmente un 24 % de morfología piramidal truncada. Se relacionaron más bien con el proceso pterigoideo ya sea de manera completa o media (73 %) y en menor medida con la cresta infratemporal (34 %).

**PALABRAS CLAVE: Espina infratemporal; Tubérculo esfenoidal; Cresta infratemporal.**

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