

Inconstant Skull Foramina in Bovine (*Bos taurus*) and Swine (*Sus scrofa*)

¹Andrés Rinderknecht, ²William Pérez, ³Alejandro Bielli, ²Richard Möller

¹Department of Paleontology, Faculty of Science, University of Uruguay,
Iguá 4225-National Museum of Natural History and Anthropology, C.P. 399, 11.000 Montevideo, Uruguay

²Area of Anatomy, ³Area of Histology and Embryology, Veterinary Faculty,
University of Uruguay, Lasplacas 1550. C.P. 11600 Montevideo, Uruguay

Abstract: To inform about either presence or absence of inconstant foramina in bovine, swine, equine, ovine and canine species and give a description of them in case they were present, 35 bovine skulls, 33 swine skulls, 45 equine skulls, 10 ovine skulls and 20 canine skulls were examined. The inconstant foramina were located on the interparietal bone and on the nugal plane of the parietal bone in *Bos taurus* of Holstein breed and on the dorsal caudal region of the frontal bone in *Sus scrofa*, in the region where the outer bone plaque delimits the frontal sinus. No inconstant foramina were found in *Equus caballus*, *Ovis aries* or *Canis familiaris*. Since we found such perforations in adult livestock, mostly in old lactating cows, we suggest that they correspond to local osteoclastic resorption zones.

Key words: Anatomy, interparietal bone, parietal bones

INTRODUCTION

In most cases, scientific research regarding domestic animals employed in animal production is aimed at improving profit. Thus, many physiological or pathological phenomena, with no evident economic importance, have been neglected by most of the scientific community. One of such phenomena is the presence of inconstant bone foramina located in the caudal region of the skull of the bovine (*Bos taurus*) and swine (*Sus scrofa*). As far as we know, no reference exists regarding such foramina in the veterinary bibliography. Neither anatomy^[1-3] nor pathology^[4] textbooks refer about their existence, nor have we found any scientific publication describing them. Thus, the objective of the present work was to inform about either presence or absence of inconstant foramina in bovine, swine, equine, ovine and canine species and give a description of them in case they were present.

MATERIALS AND METHODS

***Bos taurus*:** Thirty-five bovine skulls were studied. Twenty-eight of them were from adult Holstein bovine (*Bos taurus*) aged more than ten years, and five of them were from animals younger than ten days. Most of the adult skulls (24) belonged to female and only two of them belonged to bulls. Skulls belonged to the collection at the Museum of Anatomy, Veterinary Faculty. Two fresh

bovine heads from adult Holstein cows were collected at a slaughter house, dissected and their crania studied.

***Sus scrofa*:** Thirty-three swine skulls were studied. Thirteen belonged to adult swine and were obtained from the collection at the Museum of Anatomy, Veterinary Faculty, and the Department of Zoology, Science Faculty. Twenty skulls belonged to piglets and were obtained from the Unit of Neonatology at the University Hospital. Neither gender nor age could be established in adult skulls.

***Equus caballus*, *Ovis aries* and *Canis familiaris*:** Forty-five equine skulls, ten ovine skulls and twenty canine skulls were examined. All belonged to adults but neither gender nor age could be established.

Presence or absence of inconstant foramina, number of foramina per skull, maximum diameter of foramina, and shape of every foramen were studied. Percentages of skulls with foramina were calculated for every skull and on a per gender basis.

RESULTS

***Bos taurus*:** Eighteen out of twenty-six adult skulls (69%) presented foramina. Both fresh heads had one foramen that was filled by frontal sinus mucosa and fibrous tissue. No juvenile skull presented foramina. All foramina were found at the nugal region, in the interparietal bone and the nugal planes of the parietal bones (Figure 2, arrows). The

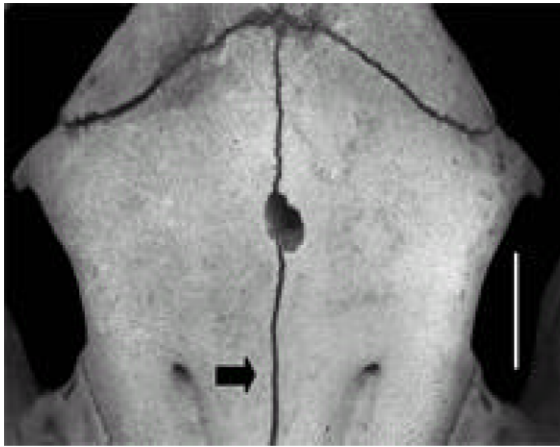


Fig. 1: Dorsal view of swine frontal bone showing an opening in the frontal bone at the interfrontal suture (arrow). Reference bar = 2 cm

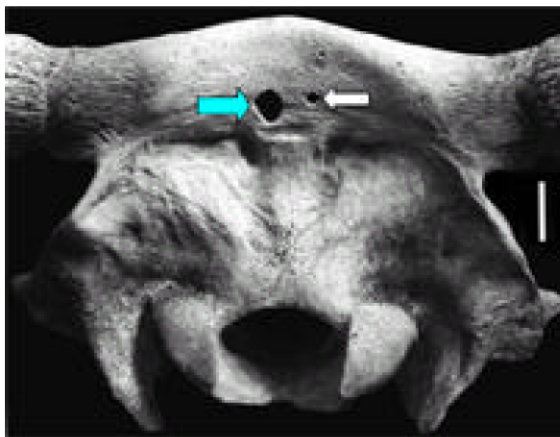


Fig. 2: Nucal view of bovine skull showing two bony foramina in the parietal and interparietal bones (arrows). Reference bar = 2 cm

inconstant foramina were located ventral to the intercornual eminence and dorsal to the insertion crest of the nuchal ligament. Both size and shape of the foramina were very variable (maximum diameter ranged 27.0 mm-1.8 mm). The inconstant foramina had either subcircular, filiform, clover shapes, or sometimes irregular. Regarding number of foramina per skull, 10 skulls had no foramen, 7 skulls had one foramen, 8 skulls had two foramina, 5 skulls had 3 foramina. No calf skull had foramina. On dissection of the two fresh heads, no inconstant foramen showed signs of mechanical or inflammatory lesions in adjacent tissues. The borders of the foramina were smooth. Foramina were found in regions limiting cranial sinuses. The lumina of the foramina were filled by the paranasal mucosa

lining the sinus and fibrous connective tissue. No vascular nor neural structure was seen traversing the foramina.

***Sus scrofa*:** Out of thirteen adult swine skulls, four had foramina. Unlike *Bos taurus*, most *Sus scrofa* skulls with inconstant foramina had only one of them, and they were always found on the interfrontal suture (Figure 1, arrow). The abnormal foramina were mostly on the caudal skull region but never beyond supraorbital foramina. All foramina found on the interfrontal suture had their major axis oriented rostrocaudally (range: 7.8-11.4 mm) with transversal axis ranging 3.4-6.8 mm).

Only one swine skull had an extra inconstant foramen, located on the caudal left frontal region, not reaching the interfrontal suture. Such foramen was subcircular, and its diameter was 5.6 mm. No juvenile skull had inconstant foramina.

***Equus caballus*, *Ovis aries* and *Canis familiaris*:** No abnormal foramina were found in *Equus caballus*, *Canis familiaris* and *Ovis aries* skulls studied.

DISCUSSION

Inconstant foramina were only found in adult *Bos taurus* and *Sus scrofa* skulls. The absence of such foramina in *Equus caballus*, *Ovis aries* and *Canis familiaris* suggests specificity of this phenomenon, perhaps limited to big sized Artiodactyla. Moreover, it is noticeable that inconstant foramina were found only in older animals indicating an age related process. It is not possible to determine the life period when the above-mentioned foramina first appear, neither whether they appear at the same age in all individuals, since we only studied new-born and old animals.

No signs of trauma, neither recent nor ancient, were found in dissected fresh bovine skulls near the foramina. This indicates inconstant foramina are neither traumatic nor inflammatory. The absence of bone tissue in the foramina could be explained either by absence of ossification or by bone tissue resorption. We rule out the first possibility because young skulls did not present inconstant foramina.

A supratrochlear foramen in the humerus of cattle was described in 3 adult local cattle from the Turkey^[5] such type of foramen, although located in a long bone, might have the same physiologic or pathological origin.

Localized osteoclastic bone resorption is related to nutritional deficits and allows calcemia haemostasis. Although studies regarding this matter are not frequent in

domestic animals, osteoporosis in adult animals is a well known pathology that could explain the presence of bone perforations^[6].

In this respect, Santos *et al.*^[7] have studied the histology of frontal bone samples from 2000 bovines from slaughter houses in Rio Grande do Sul (Brazil). They found microscopic bone tissue alterations in 93.9% of samples studied. It is also worth considering the limited localization of the foramina here reported: they only appear in the region where frontal sinuses are most developed (dorsal region of the occipital plane in *Bos taurus*, and medial dorsal zone of the cranium in *Sus scrofa*). Since frontal sinuses develop by progressive osteoclastic resorption of cancellous bone tissue and of the planes of compact bone tissue that surround it^[8], the inconstant foramina described in the present work could be originated the progressive growth of the frontal sinus cavity, in points where bone resorption has been particularly active.

ACKNOWLEDGEMENTS

To Prof. Dr. Pedro Primo Bombonato, Faculty of Veterinary Medicine and Zootechnics of University of Sao Paulo, Brazil and Dr. Daniel Scavone, Department of Morphology and Development, Veterinary Faculty, Uruguay for their bibliographic contribution.

REFERENCES

1. Barone, R., 1999. Anatomie Comparée des Mammifères Domestiques. 4th Edn., Osteologie. Vigot Frères, Paris.
2. Nickel, R.A., E. Schummer, J.F. Seiferle and K.H. Wille, 1977. Lehrbuch der Anatomie der Haustiere. Bewegungsapparat, I. Paul Parey, Berlin.
3. Sisson, S., 1975. Ruminant Osteology. In: Sisson and Grossman's the Anatomy of the Domestic Animals. (Getty, R., Ed.) 5th Edn., W.B. Saunders, Philadelphia, USA., pp: 741-786.
4. Jubb, K.V.F., P.C. Kennedy and N. Palmer, 1993. Pathology of Domestic Animals. 4th Edn., Academic Press, USA.
5. Hazirolu, R.M. and M. Ozer, 1990. A supratrochlear foramen in the humerus of cattle. Anatomia, Histol. Embryol., 19: 106-108.
6. Radostits, O.M., C.C. Gay, D.C. Blood and K.W. Hinchcliff, 1999. Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. Harcourt Publishers Ltd., Orlando.
7. Santos Dos, B.M., V.A. Nunes, I.J. Nunes, J.A.C. Viana, J.C. de Souza, C.P. Costa and B.M. dos Santos, 1991. Osteodistrofias do frontal de bovinos dos Estados de Goias, Mato Grosso, Mato Grosso do Sul e Minas Gerais. Arquivo Brasileiro de Medicina Veterinaria e Zootecnia. 43: 61-70.