Research Article

Supernumerary Bones in the Walls of the Bony Orbit

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Abstract:

Occurrence of supernumerary bones in the walls of the orbit especially in the medial wall and the roof has been described in the literature. Studies of the prevalence of supernumerary bones in the bony wall of the orbit are scarce in the literature. Present study was undertaken to find the prevalence of supernumerary bones in the walls of the orbit in a collection of adult Indian skulls.

In the present study three hundred and twenty six orbital walls from one hundred and sixty three skulls were examined for the presence of the sutural bones. Their location with reference to the sutures in the walls of the orbit and their size was noted. The supernumerary bones were found in 25 skulls (15.34 %) mainly in the lateral wall (11.04 %) and the roof of the orbit (4.29 %). Prevalence of such supernumerary bones in the walls of the bony orbit is of anthropological interest. Many of the bony ossicles were of sufficiently large size, enough to be visualized on lateral skull X-ray and could easily be mistaken for fracture of the bony wall of the orbit.

Key Words: Bony ossicles; Cranium; Orbit; Supernumerary bones; Wormian bones.

Introduction:

Small islands of bones called the sutural bones are known to occur along the cranial sutures or at the junction of cranial sutures on the cranial vault (Inkster, 1951; Black, 2008). The supernumerary bones on the lateral wall of the orbit don't find any mention in the standard text books of anatomy. A number of studies on the prevalence of the sutural bones of the skull among the different races of the world are found in the literature (Carolineberry & Berry, 1967; Pal et al, 1986; Gopinathan et al, 1998).

Specific studies aimed at the prevalence and other morphological features of such sutural bones are scarce in the recent literature. However, Malhotra et al (1980) have reported a prevalence of os orbitale in the roof of the orbit in a collection of Indian skulls.

Hence, an attempt has been made in the present study to ascertain the frequency and morphological features of these sutural bones occurring in the walls of the bony orbit.

Material and Methods:

This study consisted of one hundred and sixty three macerated adult skulls of unknown sex of south Indian origin which were examined from a collection of adult Indian skulls available in the Department of Anatomy, St John's Medical College, Bangalore.

In each skull, the inner surface of the walls of the bony orbit were inspected carefully for the presence of the supernumerary bones. Wherever the supernumerary ossicles were encountered, their exact location with reference to the sutures on the wall of the orbit was noted and their maximum diameters perpendicular to each other were measured to the nearest of mm with a digital caliper. The mean and standard deviations of the above values were calculated.

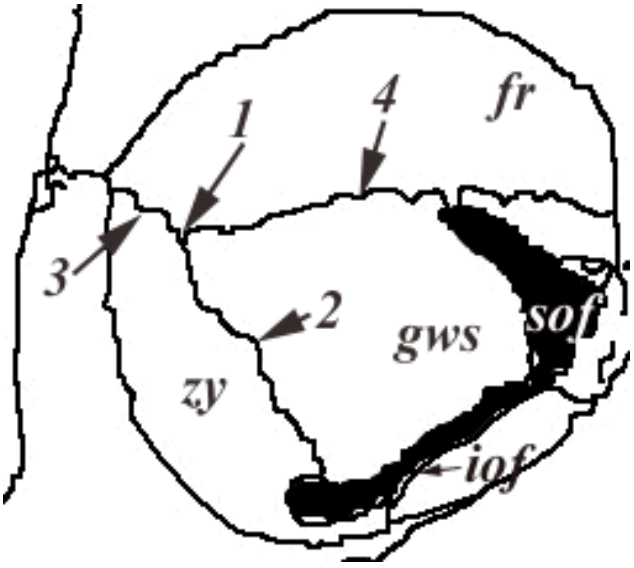

Fig. I: Diagram of the orbit showing locations where supernumerary bones were found on the lateral wall of the skull.1- junction of fronto – spheno – zygomatic sutures; 2- spheno-zygomatic suture; 3- fronto-zygomatic suture; 4- spheno frontal suture.

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Observations:

Supernumerary ossicles were found mainly in the lateral wall and the roof of the orbit. They were of variable size and shape and their occurrence in different locations is shown in the Table-I.

Ossicles in the lateral wall of the orbit:

Supernumerary ossicles were found in 18 skulls (11.04%). Only in two cases it was observed bilaterally and in all other cases the ossicles were observed unilaterally of which thirteen were of right side and three were of left side.

The ossicles were found on the lateral wall in four sites (Fig. I) viz: (1) junction of the suture between frontal, sphenoid and zygomatic bones; (2) along the spheno-zygomatic suture; (3) along the fronto-zygomatic suture and (4) along the spheno-frontal suture.

Site 1: In seven skulls a supernumerary bone was found wedged at the junction of the frontal sphenoid and zygomatic bones (Fig. II-A, C, D, E). Of these in one skull it was bilateral and in other six skull it was unilateral (5 right side and 1 left side). In one skull on the right side the ossicle occupied the full thickness of lateral wall and was visible on the floor of the temporal fossa (Fig. II-B). In another skull it was associated with a supernumerary ossicle along with the spheno-zygomatic suture.

Site-2: In seven skulls, the supernumerary ossicles were found unilaterally along the spheno-zygomatic suture (5 on right side and two on left side; Fig. II-F,G). In one skull on the right side, two ossicles were found one below the other (Fig. II-I,H) and in another skull four ossicles were found successively along the spheno-zygomatic suture extending upto the upper border of the inferior orbital fissure (Fig. III-J). In another skull a number of ossicles were found clustered within an area along the spheno-zygomatic suture (Fig. III-I).

Site-3: In only two skulls a supernumerary ossicle was found on right side only in fronto-zygomatic suture (Fig.II-F; Fig. III-M). In one of these skulls an ossicle was observed in the sites 2 and 3).

Site-4: In only one skull an ossicle was found along the spheno-frontal suture bilaterally (Fig. III-K, L).

In only one of the skulls supernumerary ossicles were found on the external surface of the lateral wall of the right orbit (temporal fossa) along the fronto-zygomatic suture (Fig. III-N).

Ossicles in the roof of the orbit:

Ossicles of varying shape and size were found in the roof of the orbit of seven skulls (4.29%). In one skull tiny ossicles of roughly quadrilateral shape were visible through the orbital cavity in the roof anterior to

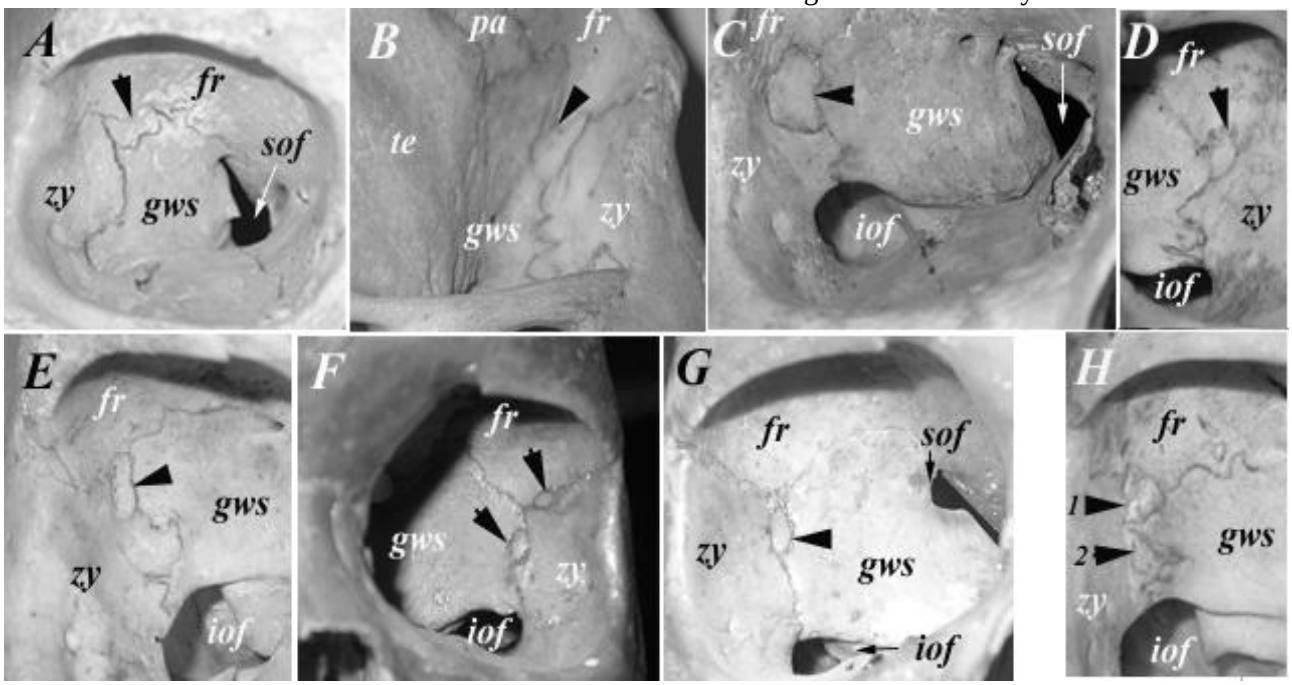

Fig. II: A-H show supernumerary bones on the lateral wall of the orbit (arrow heads) ; A- shows a large ossicle in site-1; B- same ossicle seen on the lateral aspect in the floor of the temporal fossa; C, D & E-shows the ossicles of different size and shape (site 1); F & G-shows small island of bones along spheno-zygomatic suture (Site-2); F-shows a tiny ossicle along the fronto-zygomatic suture close to the orbital opening; H-shows two ossicles one below the other with a gap in between along the spheno-zygomatic suture.

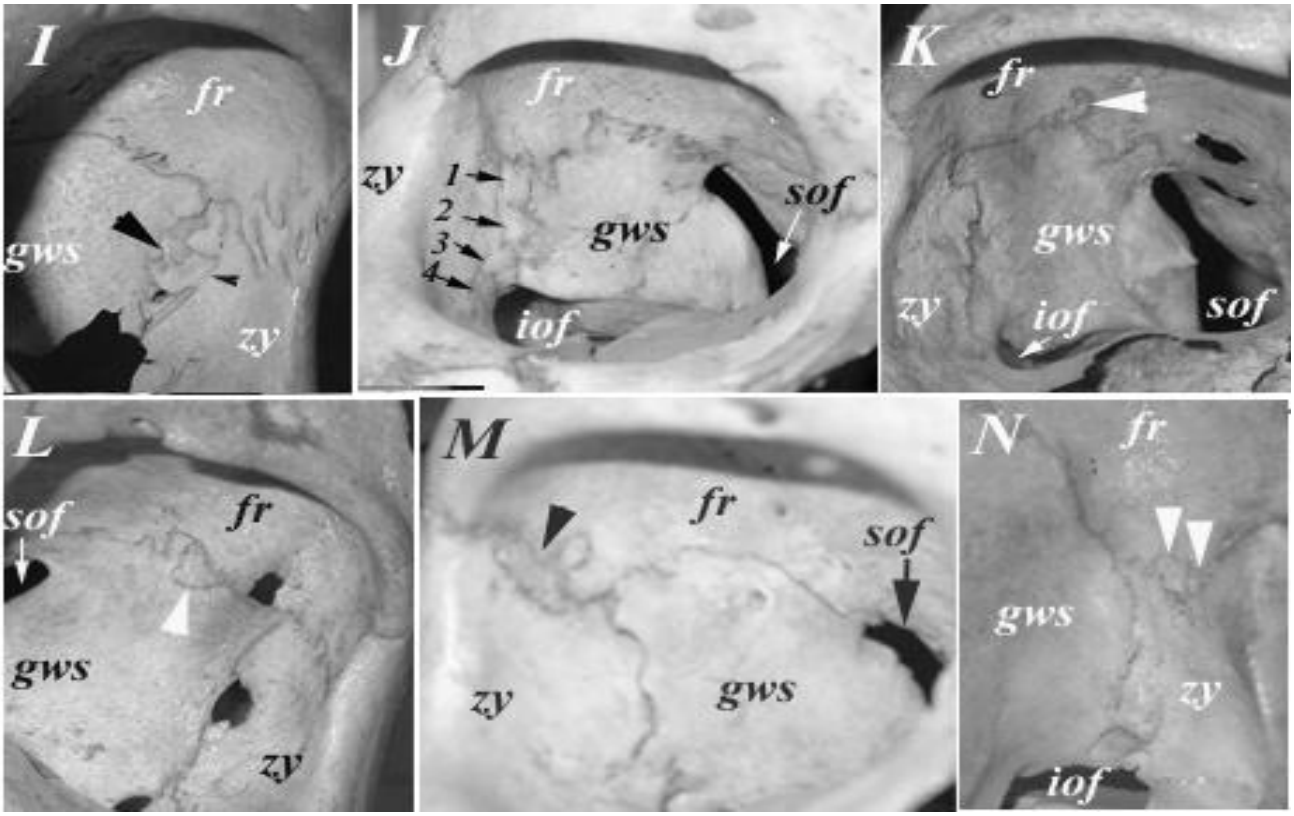

Fig. III: I-shows a cluster of ossicles grouped in the middle of the spheno-zygomatic suture (site-2); J-shows four ossicles arranged one below the other along the spheno-zygomatic suture; K & L-shows tiny ossicles along the spheno-frontal suture in the right and left orbits of the same skull; M-shows an ossicle along the fronto- zygomatic suture close to orbital aperture; N-shows two tiny ossicles along the fronto-zygomatic suture on the external surface of the lateral wall of the orbit (floor of the temporal fossa).

the superior orbital fissure. These ossicles were not visible on the floor of the anterior cranial fossa (Fig. IV-O, P).

In six skulls the supernumerary ossicles were visible from the floor of the anterior cranial fosse but since they did not extend into the full thickness of the roof they were not visible from the orbital cavity (Fig. IV-Q,W). Of these, in two skulls it was bilateral and in five skulls it was unilateral (three on right side and two on left side). These ossicles were usually of irregular shape but in one case on the right side, two ossicles were found adjacent to each other; the medial one being triangular and the lateral one quadrilateral in shape (Fig. IV-T). Usually the ossicles were located anterior to the lesser wing of the sphenoid and possessed indistinct margins. In one skull on left side the ossicle had distinct margin and was of triangular shape (Fig. IV-V). No ossicles were observed on the medial wall or the floor of the orbit in the present study.

Discussion:

A number of sutural bones have been described in relation to the bony walls of the orbit in the literature (Duke-Elder, 1964):

On the medial wall: *Ossiculum maxilla-frontale* in the lateral aspect of the frontal process of the maxilla,*os maxilla-naso lacrimale* in the medial wall of the angular process of the frontal bone, small *ethmo-lacrimal ossicles* in the ethmo-lacrimal sutures. Small wormian bones may be found behind the ethmoid and between the palatine and sphenoid bones. The hamular process of the lacrimal bone may form a separate ossicle – *the os hamulus* of Macalister, or may be separated from the orbital floor by an accessory Ossicle, the *ossiculum canalis naso-lacrimalis* of Gruber (Macalister, 1884; Le double, 1906; Gruber, 1887).

Lateral wall: Infrequently accessory ossicles are known to occur in the spheno-zygomatic suture on the lateral wall (Last, 1968; Bron et al, 1997; Black, 2008). The lateral wall is the thickest of the orbital walls. Triangular in outline, it is formed by the orbital surface of the greater wing posteriorly and orbital surface of the frontal process of the zygomatic bone anteriorly.It is traversed horizontally near the roof by the suture between the frontal bone and the upper borders of the greater wing of the sphenoid and the zygomatic bones, and vertically by the suture between the zygomatic and greater wing of the sphenoid bone. Developmentally

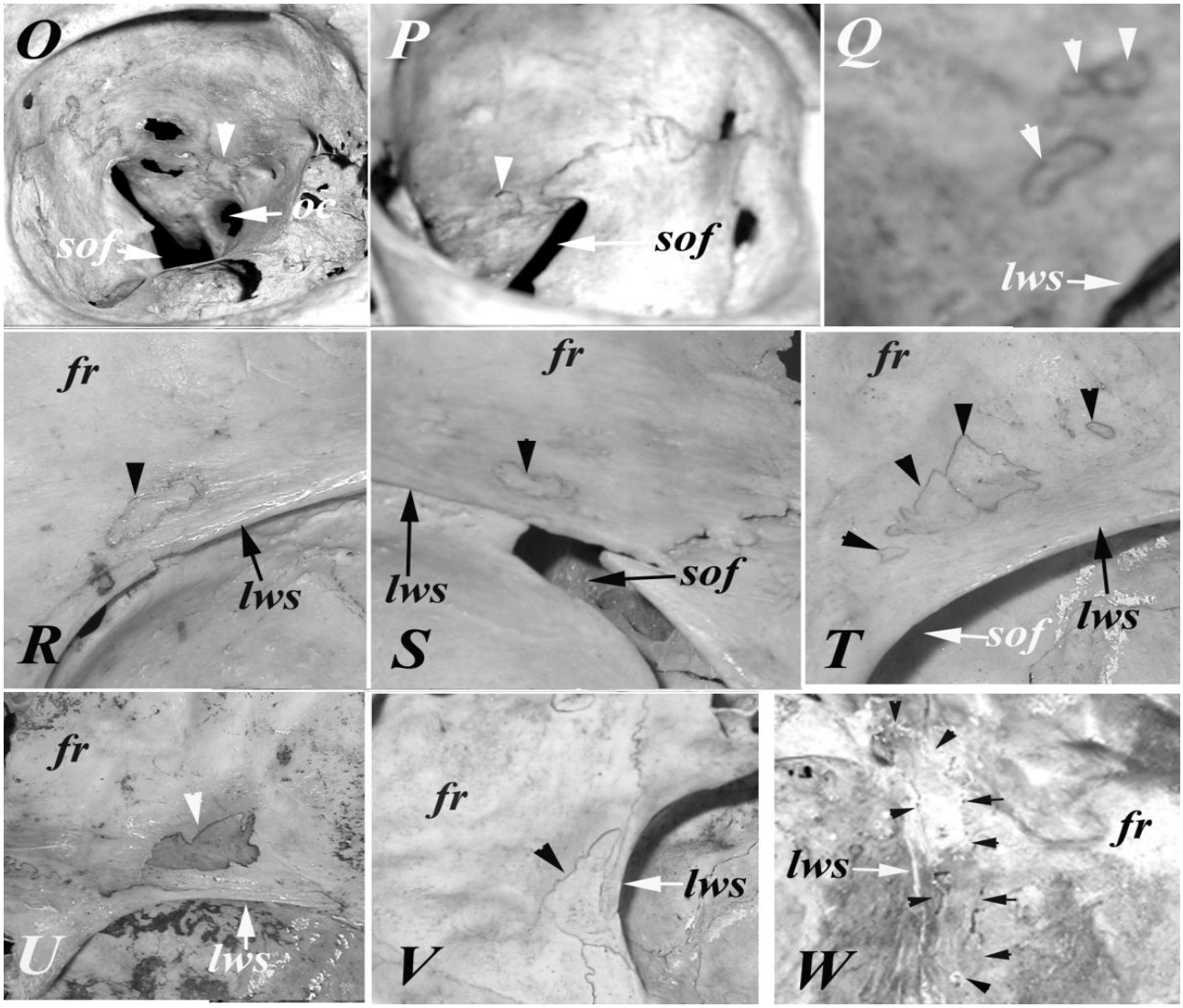

Fig. IV: Shows ossicles in the roof of the orbit. O & P-shows small ossicles in the roof of the orbit located anterior to the superior orbital fissure as seen through the right and left orbits of the same skull ; Q & W-shows ossicles in the roof of the orbit as seen on the floor of the anterior cranial fossa; Q-shows a tiny ossicle in the orbital plate of the frontal bone anterior to the lesser wing of the sphenoid; R and S-shows ossicles in the orbital plate of the frontal on the left and right side of the same skull; T-shows a pair of ossicles located adjacent to each other in the orbital plate of frontal on the right side of a skull; U, V & W-shows large irregular shaped ossicles in the anterior cranial fossa.The ossicles in U and V had well defined margins but the ossicle in the W has indistinct margins due to fusion of the sutures.

Abbreviations Used: ***fr***- orbital plate of the frontal bone; ***gws***-greater wing of the sphenoid; ***iof*** –inferior orbital fissure; ***lac***-lacrimal bone ***lws***-lesser wing of the sphenoid; ***max***- maxilla; ***oc***-optic canal; ***pa***- parietal bone, ***sof***- superior orbital fissure; ***te***- temporal bone, ***zy***- frontal process of the zygomatic bone.

both the bones forming the lateral wall are formed by membranous ossification (Inkster, 1951; Last, 1967; Black, 2008).

In the present study the sutural bones were found along the spheno-zygomatic, fronto-zygomatic sutures and at the junction where the sutures between the frontal, zygomatic and greater wing of the sphenoid meet.

The mechanism for the formation of the sutural bones is not precisely known. They have been variously linked with rapid cranial expansion , metabolic disorders of the mesoderm , head stress including pathology and hydrocephaly as the basis (Dorsey,1897; Hess, 1946; Inkster,1951; Bennett,1965; Finkel,1971). Skulls showing sutural bones in the lateral wall of the orbit in the present study did not show any evidence of cranial pathology or deformities. It is opinion of many workers that sutural bones derive from normal developmental process and are genetically determined (Finkel, 1971).

As such only few studies dealing with anomalies and pathology of the bony orbit are available which have made a brief mention of the occurrence of

Table-I: Prevalence of the sutural bones on the lateral wall and roof of the Orbit in the present study

Location	Bilateral (no. of cases)	Unilateral (R/L-no. of cases)	Total (%)	Mean dimensions of the ossicles in mm SD			
				Right		Left	
				vertical	transverse	vertical	transverse
Lateral Wall:							
1.Junction of the frontal, greater wing of the sphenoid and the zygomatic bones.	1	5 R;1L	7 (4.29)	6.96 2.49	8.54 3.47	3.0 1.41	2.5 0.71
2. Spheno – zygomatic suture.	0	5R; 2L	7(4.29)	5.25 2.05	4.37 2.2	4.0 0	3.0 0
3. Fronto -zygomatic suture.	0	3 R;0L	3 (1.84)	5.85 1.63	3.92 0.11	nil	nil
4. Spheno-frontal suture.	1	0	1(0.61)	4.68 0.078	3.38 1.31	3.85 0.95	4.53 1.9
Ossicles in the roof of the orbit.	2	3R;2L	7(4.29)	12.1 9.37	5.33 2.09	12.4 6.88	6.36 3.56

supernumerary ossicles in the bony walls of the orbit. No details regarding their frequency or ethnic variations in occurrence could be found in these studies (Duke-Elder, 1964; Last, 1968; Bergman et al, 1988; Bron et al, 1997; Black, 2008).

Only one report of occurrence of a supernumerary ossicle in the orbital wall could be found in the recent literature. These authors found the ossicle in the roof of the bony orbit in only one skull bilaterally among 1,276 skulls (0.8%) examined by them. The ossicle was an irregular bone found bilaterally between the orbital plate of the frontal and the lesser wing of the sphenoid bone measuring 12x10 mm. According to them this type of ossicle has not been described in the literature previously which they have named as 'os orbitale' (Malhotra et al, 1980).

According to Mafee et al (2005), anomalies in ossification may result in accessory sutures and supernumerary ossicles in the orbital walls.

In the present study, seven instances of ossicles resembling the 'os orbitale'were found in the roof of the orbits. Except in one skull where the ossicle was visible from the orbital cavity, in all the other instances the ossicles were found in the floor of the anterior cranial fossa only and these were not visible from the orbital cavity. The roof of the orbit is formed by the orbital plate of the frontal bone and the lesser wing of the sphenoid. The frontal bone develops from a pair of centers for ossification one each for right and left halves of the bone whereas the presphenoidal part of the sphenoid develops from six centers of ossification (Inkster, 1951). The supernumerary ossicles seen in the roof may result from the failure of fusion of one of these bones. Most of the supernumerary ossicles observed in the present study were found in the lateral wall of the orbit, and no ossicles were observed on the medial wall or the floor of the orbit.

Quite a few ossicles observed in the present study were sufficiently large; in one instance an ossicle measured 8x12 mms. An ossicle of such size is most likely to be visualized in a lateral skull X-ray. In cases with head injury it may be mistaken for a fractured fragment of the bony wall of the orbit or it may get dislodged due to impact of the injury and damage the intraocular soft tissue structures.

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