

Os Inca Totum-Anthropological and Embryological Basis

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Abstract:

Complete division of membranous and cartilaginous part of occipital bone by a transverse suture extending between the two lambdoid sutures at the level of highest nuchal line above the external occipital protuberance, results in a rare cranial variation presenting as Os Inca totum.

During osteological study of human skull in the central India region, one male skull showing complete undivided Inca bone was found. The interparital bone is formed by the part of the squamous occipital bone that is bounded by two lambdoid sutures on two sides and inferiorly by transverse suture. Such finding is rare in occurrence and have a significant anthropological and embryological basis.

Key Words: Inca bone, highest nuchal line, lambdoid suture, transverse suture.

Introduction:

The interparital part of occipital bone may be divided by a transverse suture at the level of highest nuchal line. Squamous part of occipital bone above this suture is the Inca bone described by various authors. It was first described by Rivero & Tschudy (1851) in cranium of Peruvian origin¹. The same variation was also described as Os interparitale.²

Transverse suture extends between the two lambdoid sutures at the highest nuchal line above the external occipital protuberance dividing the membranous and cartilaginous part of occipital bone. The Inca bone may be subdivided by the presence of additional longitudinal and transverse suture leading to bipartite, tripartite and multipartite Inca bones.³

The frequency distribution of the Inca bone in modern populations has been reported by various observers in different populations. The incidence of the complete Inca bone is very low in the western hemisphere of the old world i.e. Europe and Asia except for sub-Saharan Africa. Among the modern population originally derived from eastern Asian population, the frequencies are highest in some of the marginal isolated groups. In Indian sub-continental population, relatively low incidence of complete Inca bone has been reported.⁴⁻¹⁰

Observation:

Occipital bone forming the back and base of

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the cranium, is trapezoid in shape and internally concave. It encloses the foramen magnum, expanded plate posterosuperior to this is squama, and the massive quadrilateral part anterior to foramen magnum is basilar part. On each side of the foramen is lateral part. Squama is convex externally with external occipital protuberance along with two curved lines extending laterally called as superior nuchal lines and above it to faintly perceptible highest nuchal line. The superior angle at the squama summit meets the occipital angle of parital bones. The lateral angles of the squama project between the parital and temporal bones. The lambdoid borders extend from superior to lateral angles. Variety of ossicles may occur at or near the lambda known as inter-parital ossicles.¹¹

During the osteological study of 270 human skulls in central India region, we found one case of Os Inca Totum. One male skull showed presence of transverse suture measuring 115mm between two lambdoid sutures that subdivided the occipital bone into two parts resulting in formation of os Inca totum. Measurements of Inca bone was 85mm X 115mm X 80mm. It belonged to type III classification of Hanihara & Ishida (Fig. I).¹² The presence of os Inca totum is associated with the two sutural bones in the region of squamous interparital bone at the lambdoid suture.

Discussion:

Anthropologically, the occurrence of Os Inca totum in fossils of hominids such as Australopithecus, Homo erectus and early homosapiens was described by various authors.^{9,13} Presence of Inca bone was important primitive feature found in Chinese Homo

erectus and early Homo sapiens also.¹⁴ Thus the Inca bone is regarded as one of the character that forms the morphological basis of multiregional model of origin of modern human population in east Asian region.¹⁵ Pedigree studies showed that the Inca bone is inherited as dominant trait with 50% penetrance and suggested a genetic background for occurrence of Inca bone.¹⁶

Cranial deformation in order to achieve distinctive characteristics for special group affiliation in closed marginal groups was practiced. Cranial deformation is the dynamic distortion of the normal vectors of the infantile neurocranial growth through the agency of the externally applied forces. It was practiced in every continent in the past. Such cranial deformation could have been intentional or unintentional. Intentional cranial deformation is especially linked to group affiliation and social supremacy in closed marginal tribal societies.^{17,18} Such cranial elongations to have longer conical skulls provide a special supremacy to rule over others in terms of then prevalent cultural rituals and beliefs. Thus such prolonged efforts to alter the cranial structure may lead to the presence of transverse suture and formation of Inca bone in the progeny of Inca tribes.

The formation of Os Inca totum has embryological and osteological viewpoints. The portion of the occipital bone inferior to superior nuchal line ossifies in cartilage whereas superior portion ossifies in membrane. A common but oversimplified account of occipital ossification states that above the highest nuchal line, the squama develops in a fibrous membrane and ossifies from two centers, one on each side from the second fetal month; this part may remain separate as interparital bone. The rest is preformed in cartilage below the highest nuchal lines, the squama ossifies from two centers appearing in the seventh week and then soon unites; these two regions of squama unite in the third post natal month but the line of union is recognizable at birth. In the cartilaginous supra occipital part, five endochondral centres, a pair each for right and left lateral segments and one for the central segment (Kerckring's Centre) appears. The formation of Inca bone is caused because of failure of fusion of interparital bones formed by primary ossification centers.^{4,7,8,11}

Some researchers proposed that the membranous or dermal part above the nuchal lines as compounded of interparital and pre-interparital parts; the interparital consisting of two lateral plates and a central piece. The intra membranous centres proposed

for these are a pair for each lateral plate and two for the central piece, additionally a pair of centres for pre interparital bone,^{6,7} while other researchers have stated that the pre interparital elements are sutural. But much uncertainty still persists regarding the status of these accessory ossicles. Fusion may fail, partly or completely, between any of these elements.⁴

The earlier studies based on secondary data, in Central and South Asian Region showed the frequency distribution of os Inca totum to be 0.0325, 0.0317, 0.0081, 0.000, 0.0228, 0.0 in Tibetan and Nepalese, Assamese and Sikkimese, East Indian, South Indian, Northwest Indian and Kazakhs population respectively.¹² In one of the study conducted in the central India region in 92-94, gross incidence of Inca bone was found to be 1.315 %. Incidence rate was higher in male skulls than female skulls (male: 1.428%; female: 1.176%). The Inca bones frequently occurred singly. Out of the five observed Inca ossicles, two were fragmented.^{12, 19}

Some researchers have established the co-occurrence of wormian bones with Inca bones in same skull than those without it. This resembles with findings of the present case which is also associated with wormian bones. Among modern population, the frequency of Inca bone is highest in marginal isolates, those who have retained traits of early ancestral population.¹ Inca bone is considered to be regional character of East-Asians providing evidence of regional continuity. Such occurrence of Inca bone has paleoanthropological, morphological, medicolegal and evolutionary importance.



Fig. I: Showing Os Inca Totum

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