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Original Research Article

Study on Morphometric Features of Coronal Suture Along with it Absence and Craniosynostosis

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ABSTRACT

Background: Cranial sutures are syndesmosis between the cranial bones. The coronal suture is oblique in direction and extends between the frontal and the parietal bones. Craniosynostosis is a rare birth defect that occurs when the coronal suture in the skull fuses prematurely, but the brain continues to grow and develop. This leads to a misshapen head. There are a number of forms of this defect, such as coronal, sagittal, lambdoid, and metopic.
Materials and Methods: Total 500 skulls were used for study, coronal suture length measured by thread method, distance between Nasion to bregma and midsupraorbital rim to coronal suture were measured. For finding skull with absence of coronal, sagittal, lambdoid, and metopic suture, we examined many skulls during routine osteology classes of Medical, Dental and other medical sciences students. Around 500 skull observed and we find only one skull with absence of left coronal suture completely.
Results: The length of coronal suture was 24.8±1.4cm length, the distance between nasion to bregma was 126.7 ±10.25 mm and Midsupraorbital rim to cranial suture was 102.76±8.64mm We have found only one skull with absence of coronal suture. Some of the skulls shows partly fusion of sagittal, coronal sutures. The skull with complete absence of coronal suture showing the features of other sutures clearly and right side of coronal suture is showing the complete suture. The skull was not damaged and it is in perfect condition which was using by students for their osteology study.
Conclusion: We found the skull with absence of left coronal suture, which may resulted due to craniosynostosis. It may be due to hot climate in India also might be resulted for absence of suture.
KEY WORDS: Birth defect, Skull, Coronal suture, Craniosynostosis.

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INTRODUCTION

Cranial sutures are syndesmosis between the cranial bones. A syndesmosis is a fibrous joint between two bones. The coronal suture is oblique in direction and extends between the frontal and the parietal bones. It is one of the four major sutures of the skull alongside the metopic, sagittal, and lambdoid sutures. The coronal suture extends cephalad and meets the sagittal suture. This point is called the "bregma" and indicates the position of the anterior fontanel. The coronal suture extends caudal (toward the base of the skull) to the pterion. The pterion is the area where four bones, the parietal, frontal bones, the greater wing of the sphenoid bone, and the squamous

part of the temporal approach each other. Several minor sutures such as the sphenoparietal suture, sphenosquamous suture, sphenofrontal suture are at the pterion. The pterion is deemed the skull's weakest part[1,2].

Craniosynostosis is a congenital deformity of the infant skull that occurs when the fibrous joints between the bones of the skull close prematurely. Due to this closure, the baby develops an abnormally shaped skull because the bones do not expand normally with the growth of the brain. The condition is usually apparent in infancy as an abnormal but characteristic head shape and, in some patients, abnormal facial features. In some cases, the growth of the skull is restricted enough to cause increased pressure in the head and can lead to headaches, visual problems or developmental delays. The severity and type of deformity depends on which sutures close, the point in the development process that the closure occurred and the success or failure of the other sutures to allow for brain expansion. Synostosis of a particular suture alters the skull shape in a recognizable manner. An abnormal skull shape at birth is not always craniosynostosis and may be related to fetal head position or birth trauma. The difference is that those abnormalities usually self correct, while craniosynostosis worsens if it is left untreated. Coronal synostosis begins at the ear and goes back to the sagittal suture. Premature closure leads to a condition called anterior plagiocephaly. This may cause the baby's forehead to flatten on the affected side. Elevation of the eye socket, on the involved side, a deviated nose and a slanted skull may also occur. If untreated, this may lead to amblyopia - loss of vision on the affected side[3].

The coronal suture is located at the top of the head, and it is responsible for separating the two parietal bones within the frontal bone of the skull. It is also impacted by numerous birth defects, one of which is craniosynostosis. This rare defect requires babies to undergo invasive procedures. Due to the potentia l danger – among other factors – medical professionals want a better understanding of craniosynostosis to be able to better treat it. Craniosynostosis represents premature closure of cranial sutures. Prevalence is approximately 3.1-6.4 in 10.000 live births, which is reportedly rising. Craniosynostosis results in symptoms like a misshapen skull, slowed or no growth of the head, raised edges along the affected sutures, and an abnormal feeling on the skull. Medical professionals are unsure as to what exactly causes this birth defect, but they believe that genetics plays a role. In terms of treatment, doctors aim to relieve pressure on the brain and correct head shape. This can be accomplished through surgery, and some babies are given a molded helmet to reshape their heads[4].

The bones of the cranium are divided into the skull base and the calvarial vault. The growth of skull bones is driven primarily by the expanding growth of the brain. The brain grows rapidly in utero and during the first three years of life. An infant born at term has nearly 40 percent of his or her adult brain volume, and this increases to 80 percent by three years of age. Correspondingly, the size of the cranium of an infant born at term is 40 percent of adult size; by seven years, this increases to 90 percent. Term infants have well-formed skull bones separated by strips of connective tissue, sutures, and fontanelles[5]. **Craniosynostosis** is the premature closure of one or more of the joints that connect the bones of a baby's skull. Normally, the bones remain separate until about age 2, while the brain is growing. They then fuse together and stay connected throughout life. The closure is premature when it occurs before brain growth is complete[6,7,8].

Symptoms and severity vary depending on how many sutures close prematurely. For example, if only one closes prematurely, brain growth may continue in other parts of the skull, leading only to an abnormally-shaped skull and no other health problems or complications. If multiple sutures close prematurely, brain growth can be restricted. This can lead to increased pressure in the skull, impaired brain development, seizures, blindness, and / or intellectual disability. Craniosynostosis may occur as a single abnormality (isolated

craniosynostosis) or it may occur as one feature of one of many syndromes. Most cases of isolated craniosynostosis occur randomly and have no known cause. In some cases, isolated craniosynostosis is due to a mutation in any of several genes, with autosomal dominant inheritance. When craniosynostosis is a feature of a larger syndrome, the cause and inheritance pattern depend on the syndrome the person has. However, most syndromic causes of craniosynostosis are autosomal dominant. Craniosynostosis can also be associated with a metabolic disease such as rickets, or hyperthyroidism[7,9]. The present study attempted to measure length of coronal suture and to find out skull with absences of coronal suture.

MATERIALS AND METHODS

We studied the skulls for the purpose to find skulls with absence of sutures, we have studies skulls collected by students for their osteology study purpose, 500 skulls were examined over 5 years period in different medical and dental institutions. Total 500 skulls were used for study, coronal suture length measured by thread method, distance between Nasion to bregma and midsupra-orbital rim to coronal suture were measured. We have found only one skull with absence of left coronal sutures. We have examined the skull in different norma.

RESULTS

The length of coronal suture was 24.8±1.4cm length, the distance between nasion to bregma was 126.7 ±10.25 mm and Midsupraorbital rim to caronal suture was 102.76±8.64mm(Table.1) Out of 500 skulls 1 skull found with absence of left coronal suture, the incidence is 0.2%. we have studied the different normas of the skull, norma frontalis, normal basalis, norma occipitalis, norma verticalis and recorded the features of skull. The skull belongs to female, age about 40-45 and belongs to south Indian origin. The countour of the cranial vault is a broad ovoid with the narrow pole in front and the broad pole behind. Cranial asymmetry is slight and of the normal type. Wormarian bones not found in between any sutural meeting point in bregma , lambda, pterion and asterion. The skull exmined in different normas and recorded the features(Fig 1). Norma verticalis features – There is complete fusion of metopic suture. The sagittal suture is not straight to posterior and it is curved to meet lamda sutural meeting point. The existence of coronal sutures were observed. The parital eminence was prominent. The parital eminence was prominent. The parital tubercles are present. The distance between rhinion to the lambda was 90mm. there is a transverse ridge in the vertex which becomes fainter and in distinct on either side and apparently delimits the frontal bone, this transverse ridge is 40mm from nasion.

Norma lateralis features – Face is in proportion to the head. The orbits are round. The transverse axis of the orbit is parallel with the Frankfurt horizontal. There is prominence of the nasal bone at the lower point. The superciliary arches and frontal eminence are prominent. The forehead is broad and flat from side to side and from above and downwords. Nasal septum is defected to the right all the sutures of the face and orbit were found normal. Norma lateralis appears normal and is showing H shape pterion and asterion is normal. There is no abnormality found in norma lateralis.

Norma occipitalis features – the features are normal and it shows bulged external occipital protuberance and well marked highest and superior nuchal lines observed. Muscular impressions were appreciated. External occipital crest was well marked. Mastoid process was with grooves and canals. Mastoid foramina are normal.

Norma basalis features – well developed hard palate was found and cruciate suture was well appreciated. Other sutures are in norma basalis were normal. Left carotid canal and jugular foramen were larger than right. Mastoid process was well developed and Styloid process is well developed and in normal length shows well developed styloid apparatus(Fig 1). The endocranial capacity of the skull with help of seed mustard seed method is 1145cc. The other following is follows.

Length – breadth index	- 91.42
Breadth – height index	- 95.63

Length – auricular height index	- 82.31
Trasverse fronto -parital index	- 83.67
Superior facial index	- 56.18
Orbital foramen index	- 93.78
Orbital index	- 103
Alveolar index	- 113.45
Nasal index	- 57.36
Palatal index	- 79.18
Gnathic index	- 97.64

Fig. 1: The skull showing absence of left coronal suture.

Table 1: Showing measurements of Coronal sutures.

Measurement	Value
Length of coronal suture	24.8±1.4cm
Distance between nasion to bregma	126.7 ±10.25 mm
Midsupraorbital rim to caronal suture	102.76±8.64mm.

DISCUSSION

Absence of coronal suture was not observed in recent studies in dry skulls. This study is unique presentation to understand craniosynostosis. Craniosynostosis is a common malformation occurring in ~4 per 10,000 live births in which the sutures between skull bones close too early, causing long-term problems with brain and skull growth. Infants with craniosynostosis typically require extensive surgical treatment and may experience many perioperative complications, including hemorrhage and re-synostosis. The etiology of coronal nonsyndromic craniosynostosis is not well understood, although the published literature suggests that it is a multifactorial condition. About 5-14% of coronal craniosynostosis patients have a positive family history, with a specific genetic etiology identified in >25% of nonsyndromic craniosynostosis cases, suggesting a strong genetic component in the pathogenesis of this birth defect. The causes for nonsyndromic craniosynostosis and its phenotypic heterogeneity remain largely unknown. An international team of investigators will generate large genomic and gene expression datasets on samples from patients with nonsyndromic craniosynostosis[10].

According to study of David Johnson, genetic workup should be an integral part of the management of craniosynostosis as it contributes both to risk assessment for the family and prognostic information for the patient. Although the molecular bases of the common craniosynostosis syndromes have been defined, it is likely that a single molecular aetiology remains to be identified in a further 10–15% of individuals. Whole genome assessment of copy number changes and DNA sequencing are likely to identify further predisposing loci, and consideration should be given to other mechanisms of disease such as mosaicism and imprinting defects. Although surgery is expected to remain the mainstay of management for the foreseeable future, the identification of signalling pathways pathologically activated in the cranial suture, such as the RAS-ERK pathway activated by Apert syndrome mutations raises the possibility of the use of adjuvant medical therapies in the future[11,12].

According to study of Seok-Gu Kang and Joon-Ki Kang, centers with the appropriate vision and infrastructure are necessary to optimize the care of patients with craniosynostosis, as well as to enhance scientific knowledge and education about this disease. Several investigations have evaluated the roles of various growth factors and cytokines in determining the fate of sutures. Fibroblast growth factors (FGFs) are particularly important, as mutations in their receptors have been implicated in many craniosynostosis syndromes. Mutations in three of the four known FGF receptors have been associated with premature pathologic suture fusions. Recent advances in developmental biology and genetics have identified some of the events governing suture fate, highlighting multiple axes of cellular signaling with the potential for clinical manipulation. Such knowledge and comprehension may facilitate

therapeutic translations, ultimately enhancing or perhaps even replacing contemporary modalities for treating craniosynostosis[13,14,15].

According to Nawaporn Techataweewa study [16], the preferred location for siting a burr hole using the classical free-hand technique for frontal ventriculostomy, known as Kocher's point, cranial morphology has the possibility of compounding the difficulty in optimizing the location of the burr hole. This study aimed to assess the average nasion-bregma distance and mid-supraorbitalrim to coronal suture distance in the Thai population as a first step in improving the accuracy for location of the burr hole in Thai patients. It provides mean values for consideration in the free-hand technique for ventricular catheter placement, which is still the standard method of ventriculostomy. The results of both cadaveric and dry bone measurements indicate that frontal bones are significantly longer in the sagittal plane for all parameters in Thai males than in Thai females. Comparison of the right and left sides shows the right side is significantly longer in the sagittal plane than the left in both sexes in the dry skull sample. Although this does not appear to be the case in the cadaveric samples, this may be a reflection of the smaller sample size and the results from the large dry skull can be taken as the most accurate. The studies on morphological and morphometric features of skulls will ,helpful for understanding cranial morphology[17,18,19].

The present study results were in corelation with this study. The present study made an attempt to enhance update knowledge about craniosynostosis and coronal suture.

Conflicts of Interests: None

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