

GENERAL STUDY OF BONY SYNOSTOSIS IN HUMAN SKELETON

Dhapate S.S. and *Chavan S.B.

Department of Anatomy, SRTR Government Medical College,
Ambajogai/MUHS Nashik Maharashtra, India

**Author of Correspondence*

ABSTRACT

Coalition and fusion of adjacent bones in different regions of human body have been known for several centuries. But only within last five decades these have been associated with certain clinical entity. These bony anomalies have been frequently overlooked, especially in young patients presenting with symptoms of local relentless pain, stiffness and diminished range of movements. It is not uncommon to see the fusion of two adjacent bones as an incidental finding in adulthood. But an occurrence of fusion of two different bones in two different parts of body in the same individual is a rare phenomenon and has been reported very rarely. The current study is an attempt to extrapolate a similar incidental finding of 'Tarsal Coalition' of the left Talus and Calcaneus and 'Cervical Fusion' of the second and third cervical vertebra and the fourth and fifth cervical vertebra observed in the same individual by undertaking a retrospective study of 100 skeletons. Furthermore, an attempt was made to correlate the case of such unusual fusions in the same individual which may be congenital or acquired with the advancing age.

Keywords: Tarsal Coalition, Cervical Fusion, Synostosis

INTRODUCTION

The following study showed two unusual fusions of bones between two different regions of skeleton in the same individual. These were 'The Cervical Fusion' and 'The Tarsal Coalition.'

Cervical vertebrae are seven in number. The C3, C4, C5, C6 are typical vertebrae, whereas C1 (Atlas), C2 (Axis) and C7 (Cervicæ Prominens) are atypical. The C2 vertebra is different from other by the presence of Dens (Odontoid process) which projects cranially from the superior surface of the body. The axis acts as an axle for rotation of atlas and head around the dens. The C3 vertebra is a typical with the features similar to other cervical vertebrae. Congenital anomalies at cranio-vertebral or cervical region are occasionally seen (Gray's Anatomy, 1996).

Among these congenital anomalies the important ones are the fused cervical vertebrae (FCV). Congenital fusion of axis with the third cervical vertebrae limits the movements between these bones and because of this the third vertebrae was given the name as "*vertebrae critica*" by Cave (1937).

The fusion of C2 with C3 vertebra may be associated with neurological signs and symptoms. Severe neck pain and sudden unexpected death may occur due to these abnormalities (Tiwari *et al.*, 2002).

As sacrum is a well known example of 'Block Vertebrae' which is formed by the union of 5 sacral vertebrae, if we follow same principle for C2-C3 fused vertebrae, it can be given the name of *cervical sacrum* (Tiwari *et al.*, 2002).

Conwell *et al.*, (1983) defined tarsal coalition as an abnormal union between two or more bones. This union leads to restriction or limitation of the subtalar joint movements. The subtalar coalition may lead to primary and secondary signs of coalition which may be visualized on standard radiographs. The most reliable sign of a coalition is the 'C sign' (Lateur, 1994). The frequency of tarsal coalitions is unknown, but the literature reports a range of 1% to 2% (Schleffman, 1987).

MATERIALS AND METHODS

This study began with the incidental finding of two unusual bony fusions which were discovered in the skeleton of an unknown individual, which was undertaken for the Medico-Legal Examination in SRTR GMC Ambajogai. Later, the study was extrapolated to Cervical Vertebra, Talus and Calcaneus bones of 100 human skeletons which were collected from Marathwada region of Maharashtra. Of all the bones

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studied fusion of cervical vertebra was observed only in one skeleton. Similarly, coalition between Talus and Calcaneus was observed only in the same skeleton. The bony fusion observed was photographed at various profiles i.e. Superior, Inferior, Medial & Lateral. The observations were documented and presented in the following study.

RESULTS AND DISCUSSION

Observations

Following were the noteworthy findings in the entire skeleton which was under study:

The two bony fusions seen in the skeleton under study were cervical fusion and tarsal coalition:

The cervical fusion was seen at two different locations i.e. Axis and the C3 vertebra and the C4 and C5 vertebra. The Axis vertebra was not entirely fused with the C3 vertebra. Fusion is seen only at the lower border of pedicle and lamina with the C3 vertebra whereas the body, spinous process and transverse process are not fused. But the body shows marginal fusion at the dorsal aspect close to the vertebra canal. Similarly, in the case of C3 and C4 vertebra the fusion is seen only at the lower border of C4 vertebra with the C5, whereas the body, spinous process and the transverse process are free from each other. Yet another additional finding is the presence of accessory foramen transversarium in C3, C4 and C5 cervical vertebrae.



(A)



(B)

Figures A and B: Showing the fused Axis (C2) and C3 vertebra



(C)



(D)

Figures C and D: Showing the fused C4 and C5 vertebra and the other cervical vertebrae

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(E)



(F)

Figures E and F: Showing the free and the fused regions of the left Talus and Calcaneus

In the present study talus and calcaneus of only one skeleton showed the presence of fusion. The left Talus was fused with the left Calcaneus at following sites:

1. Between anterior and middle articular facet present on the planter surface of talus and articular facet on the dorsal surface of sustentaculum tali of calcaneum.
2. Between area behind sustentaculum tali of calcaneum and corresponding area of talus.
3. Between posterior articular facet present on the plantar surface of talus and posterior articular facet on the dorsal surface of calcaneus on its medial side upto the groove between medial and lateral tubercles on the posterior surface of talus.
4. Between lateral tubercle present at the apex of the triangular area on the lateral surface of talus and lateral margin of the non-articular area present on the dorsal surface of Calcaneus.

To further expand the study the cervical vertebra and tarsal bones of 100 skeletons were studied in Medical Colleges of the Marathwada region; so as to look out for similar anomalies, as in the above mentioned case. Thorough study of the same did not avail any significant bony anomalies in any of the skeletons studied.

Discussion

In Fused Cervical Vertebra (FCV), the fusion may be either congenital or acquired (Edril, 2003). It is difficult to identify the case of FCV- whether it is congenital or acquired without sufficient clinical data and case history to support the findings.

Normal segmentation of the sclerotomes is important for the development of a normal vertebral column. But in certain cases due to decreased local blood supply during the third to eight week i.e. embryonic period results in abnormal segmentation and formation of congenitally fused vertebrae or block vertebrae. Vertebral fusion anomalies are likely to be associated with disturbance of Pax-1 gene expression in the developing vertebral column (David, 1996).

Acquired FCV is generally associated with diseases like tuberculosis, other infections, juvenile rheumatoid arthritis and trauma.

All these abnormalities may lead to clinical signs and symptoms which are: Shortening of spine in the cervical region; limited neck movements, osseous malformation (scoliosis, kyphosis, torticollis), and signs of peripheral nerve irritation such as pain, burning sensations and cramps, signs of nerve compression such as hyperaesthesia / anaesthesia, weakness/paralysis, fibrillations and reduced deep reflexes (Tiwari *et al.*, 2002).

Coalition of the tarsal bones has been known for several centuries. But it is often overlooked as a cause of foot pain in patients presenting with complaint of non-traumatic foot pain. Baffon (1769) was probably the first to recognize the tarsal coalition, although the undated specimen in museum of Royal College of

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Surgeons of England described by John Hunter probably dated from 1760-1770. The talo-calcaneal fusion was first described by Zuckerkandl (1877).

Buckholz (1987) describes the coalitions as fibrous (syndesmosis), cartilaginous (synchondrosis), and osseous (synostosis). The most common types of coalitions are calcaneonavicular, talonavicular, calcaneocuboidal, cubonavicular and talocalcaneal. Incidence of talocalcaneal fusion is <1% to 1%. LeBoucq (1896) in the same year proposed the theory of impaired segmentation and undifferentiating of primordial mesenchymal tissue which resulted in coalitions. Pfitzner (1896) described the congenital type as an extension of an accessory ossicle into adjacent tarsal bones.

Tarsal Coalition is mostly a congenital condition. Most eventually it is inherited as a disorder of autosomal dominant inheritance (ghr.nlm.nih.gov, 2012). It occurs due to the failure of segmentation of mesenchyme with the absence of normal joint formation. It becomes a problem since it restricts the movements of other joints of foot which are disturbed. These abnormal movements increases stress on other joints of foot leading to wear and tear of joint eventually causing pain. Also, muscles in relation to these joints undergo spasm due to stress of abnormal movements leading to pain and restriction of movement of limb.

Sanghyeok *et al.*, (2013) classified talocalcaneal coalition into four different types by using CT and MRI, these are:

Type I- Linear with or without posterior hooking

Type II- Talar overgrowth

Type III- Calcaneal overgrowth

Type IV- Complete Osseous

But, the present study was done in loose skeleton of an unknown person whose relevant case history or clinical findings were not available. Thus, the findings cannot be further studied using any radiological modalities of investigation. Findings on observation show a more or less Type IV coalition in the bones.

Conclusion

While doing endotracheal intubation, extension of the neck is done. So in persons with block vertebrae in cervical region one has to take care to prevent hyperextension as it can precipitate disc prolapsed. If cisternal puncture or lumbar puncture is to be done, we should look for possibility of block vertebrae in cervical and lumbar regions respectively.

This study confirms the study of previous researcher of having an incidence of about 1% tarsal coalition in the normal population. Surgeons and Orthopedicians should thus be trained to have suspicion in mind of talocalcaneal fusion in the patients presenting with chronic ankle pain, spastic foot in middle aged individual with high physical activity and investigate accordingly to avoid missing a rare conditions as the one presented in the above mentioned study. The practice of using even X-ray or CT scan investigation in event of slight amount of doubt in condition of reduced joint mobility must be promoted always to rule out the above mentioned clinical conditions whether they are of congenital or acquired origin.

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