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CERVICAL VERTEBRAL SYNOSTOSIS: AN OSTEOLOGICAL STUDY

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ABSTRACT: INTRODUCTION: Congenital anomalies affecting the craniovertebral or cervical region are common. Among these congenital anomalies the important ones are the fused cervical vertebrae which can be due to either congenital or acquired causes. Fused cervical vertebrae can be asymptomatic or it can produce a myriad of clinical symptoms from mild to severe. Hence a knowledge of the prevalence of these variations are essential. **METHOD:** 147 dry adult human skulls with 280 adult, dried cervical vertebrae were observed in this study for evidence of fusion. The morphologic details of the fusion were also noted. **RESULTS:** The total prevalence of fusion of cervical vertebrae was 1.4% which included fusion between occiput and atlas, atlas and axis vertebra, axis and third cervical vertebra and fusion between the typical cervical vertebrae. **CONCLUSION AND SUMMARY:** Fused cervical vertebrae limit neck movements and cause signs of nerve or spinal cord compression. Evaluation of patients who need surgeries of the head and neck region should involve radiographic examination of the cervical region to prevent accidental intra-operative and post-operative complications.

KEYWORDS: Block vertebrae, Occipitalisation of atlas, Klippel-Feil Syndrome, Vertebral synostosis.

INTRODUCTION: The cervical vertebrae in humans are the smallest of the moveable vertebrae, and are characterized by the presence of foramen transversarium. The first, second and seventh have special features whereas, the third, fourth and fifth cervical are almost identical, and the sixth, while typical in its general features, has minor distinguishing differences.¹ Congenital anomalies at craniovertebral or cervical region are common.² Among these congenital anomalies the important ones are the fused cervical vertebrae (FCV).³ FCV can be congenital or acquired.^{4,5} Congenitally fused vertebrae result because of failure of resegmentation of sclerotomes.⁶ Diseases such as Tuberculosis, Juvenile rheumatoid arthritis and trauma can result in acquired fusion of vertebrae. Congenital block vertebrae may lead to syndrome manifestations such as Klippel-Feil syndrome or may cause spine deformations such as Scoliosis.⁷ FCV can also result in limitation of the neck movement or the muscular weakness, atrophy and neurological sensory loss.^{8,9} Hence knowledge of FCV is important in diagnosis of above mentioned clinical conditions. The present study was undertaken to estimate the prevalence of such FCV and to study their morphological details.

METHODS: After obtaining the institutional ethical committee clearance a total of 280 dried adult cervical vertebrae and 147 dried adult skulls were studied over a period of 9 months (August 2013 to April 2014) in the department of Anatomy, Adichunchanagiri Institute of Medical Sciences, BG Nagar. Only cervical vertebrae were included for the study. Broken vertebrae were excluded from the study. The cervical vertebrae for studied for the evidence of partial or

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complete fusion. The bases of skulls were examined for the atlantooccipital fusion. The prevalence of fusion was expressed in terms of percentage.

RESULTS: The total prevalence of fusion of cervical vertebrae was 1.4%. The prevalence of all other fusion are described in the table no. 1.

Sl. No	Type Of Fusion	Number	Percentage
1	Atlanto-occipital fusion	1	0.68
2	Atlanto axial fusion	1	0.36
3	Fusion between Axis and C3	1	0.36
3	Fusion between typical cervical vertebrae	2	0.72

Table No. 1: prevalence of FCV

One skull among the 147 showed a very rare anomaly; fusion between the occiput, atlas and the axis vertebrae (Figure 1). The lateral mass of the atlas had fused with the occipital condyles with forward displacement of the posterior arch of atlas. The foramen transversarium of the atlas showed an angular shift and were not in the same axis. The superior articular facet of the axis had fused with the lateral mass of the atlas. The odontoid process had fused with the anterior arch of atlas with a small piece of bone.



Fig. 1: Lateral view of the craniocervical region showing fusion between the occiput, lateral mass of the atlas and superior articular facet of the axis vertebra

The fusion between Axis and C3 vertebra was complete (Figure 2). However in case of fusion between the typical cervical vertebrae (Figure 3 and 4), one was complete and the other partial.



Fig. 2: Anterior view of fused axis and third cervical vertebra

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Fig. 3: Partial fusion of typical cervical vertebrae (anterior view)



Fig. 4: Partial fusion of typical cervical vertebrae (posterior view)

DISCUSSION: FCV are associated with clinical and embryological importance. This fusion may be congenital or acquired.^{4,5} It is important to identify the cause of FCV – whether it is congenital or acquired or pathologic condition. Acquired FCV is generally associated with diseases like tuberculosis, other infections, juvenile rheumatoid arthritis and trauma. Clinical symptoms may vary from asymptomatic to myelopathy, limitation of the neck movement, or the muscular weakness, atrophy and neurological sensory loss or associated with Klippel-Feil syndrome.⁵ Congenital FCV is one of primary malformations of chorda dorsalis.^{10,11,12} A combination of environmental and genetic factors mainly during the third week after conception is thought to be the main causative factor for this anomaly.¹³

All these abnormalities may lead to, shortening of spine in the cervical region; the trapezei are unduly prominent giving rise to a webbed appearance; limited neck motion; Osseous malformation; pain, burning sensations and cramps; signs of nerve compression.¹⁴

Prevalence of cervical vertebral fusion in Lithuanian population was 2.6%, 6.25% in cervical, 4.16% in Indian population.¹⁵ In the present study the prevalence was 1.4%. The most common vertebrae showing fusion is the lumbar. The sequence of presentation of cervical vertebral synostosis is: C5-C6, C1-C2, C4-C5 followed by C6-C7 fusion.¹⁶

Embryological significance: para-axial mesoderm undergoes segmentation to form somites. The somites in turn divide into three parts: sclerotome, myotome and dermatome. The sclerotomes give rise to vertebral column. Vertebral column is formed from the sclerotome of the somites.¹⁷ 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 associated with pax gene.¹⁸

CONCLUSION: FCV result because of abnormal segmentation and resegmentation of sclerotomes. Apart from the lumbosacral region, cervical vertebrae are the most common vertebrae to show abnormal fusion; congenital or acquired. Because of the variety of symptoms they produce knowledge of prevalence of FCV is important to Surgeons, Neurologists and Orthopedicians. Even Anesthesiologists need to be aware of such anomaly to prevent extension injury to the cervical vertebral column during intubation.

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