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Original Research Article

Vertebral Synostosis and its Clinical Importance

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Abstract

Introduction: Introduction: Fusion of the vertebrae known as vertebral synostosis or vertebral block. It is a interest of the anatomist but also to surgeons, neurologist, orthopedician, radiologist, anaesthetics and for forensic medicine also. Any defect in the development causes anomalies and neurological sign and symptoms. Various vertebral anomalies have been reported by different authors such as Sacralisation, Lumbarisation, Occipitalisation, absence of posterior elements of vertebral arch and vertebral synostosis. ***Methods:*** The present study was conducted on 400 dry adult human vertebrae of unknown age & sex obtained from department of Anatomy of medical college of Gujarat the Department of Anatomy. ***Result:*** Fusion of the first right rib with the first thoracic vertebrae. Axis vertebrae fuse with the third cervical vertebrae. Five Thoracic vertebrae in one thoracic spines,were fuseb along with one right rib and four left rib fused with thoracic vertebrae. Two typical thoracic vertebrae fuse in one thoracic spine. Seven vertebrae fuse with each other, lower thoracic and upper lumber vertebrae fuse with each other. Twelth rib fuse with the twelth thoracic vertebrae in one spine. Sacralisation of L5was observed in one spine. ***Conclusions:*** Knowledge about any deviation from the normal anatomy of vertebral column can lead to major or minor complications affecting the different system of the body. Fused vertebrae limit movements and cause signs of nerve or spinal cord compression. This variation must be noted by surgeons, neurologist, orthopedician, radiologist, anaesthetics.

Keywords: Vertebral synostosis, vertebral anomaly, Vertebral column, Sacralization, Lumbarisation.

INTRODUCTION

The vertebral column provide support to the body and also acts as a pathway for the spinal cord. Therefore for the spinal cord to work efficiently it is mandatory that the vertebral column follows a normal pathway of development [1]. The paraxial mesoderm is divided by number of transverse cleft or series in to mesodermal somites. The vertebral column is derived from the sclerotomes of somites. The vertebral column usually consists of 33 vertebral segments. Any defect in the developments causes congenital vertebral anomalies like Klippel-Feil syndrome, spina bifida, abnormal spinal curvatures like scoliosis etc. which can caus neurological and vascular deficits. But these deficits can also be acquired due to arthritis, tuberculosis of spine, injury, infections, juvenile rheumatoid arthritis etc. fusion of vertebrae can lead to pressure and alteration of the spinal cord and cerebrospinal fluid. The fusion of two or more vertebrae is a congenital anomaly of vertebral column may occur in the cervical, thoracic & lumbar [2-4].

Congenital anomalies of the vertebral column are of interest not only to the anatomist but also to surgeons, neurologist, orthopedician, radiologist, anaesthetics and for forensic medicine also. Various vertebral anomalies have been reported by different authors such as Sacralisation, Lumbarisation, Occipitalisation, absence of posterior elements of vertebral arch and vertebral synostosis [5]. These anomalies may be associated with pain, muscular weakness of limbs and sensory deficits, interference with neck movement, Spinal deformities, less mobile pelvis leading to painful and obstructed labour. The fusion of two or more vertebra is called as vertebral synostosis or block vertebrae, which is more common in the cervical region followed by thoracic & lumbar region [6].

MATERIALS AND METHODS

The present study was conducted on 400 dry adult, human vertebrae of unknown age & sex obtained from department of Anatomy of medical college of Gujarat.

RESULT

Fusion of the first right rib with the first thoracic vertebrae (Case-1). Axis vertebrae fuse with the third cervical vertebrae (Case-2). Five Thoracic vertebrae in one thoracic spines, were fused along with one right rib and four left rib fused with thoracic vertebrae. (Cases-3). Two typical thoracic vertebrae fuse in one thoracic spine (Case-4). Seven vertebrae fuse with each other, lower thoracic and upper lumber vertebrae fuse with each other (Case-5). Twelth rib fuse with the twelth thoracic vertebrae in one spine (Case-6). Sacralisation of L5 was observed in one spine (Case-7).

Case-1 (Figure-1) Fusion of the first right rib with the first thoracic vertebrae.

Case-2 (Figure-2) was that of a block vertebra in which there was fusion between C2 &C3 with fused spines and laminae, bodies fused completely on the anterolateral aspect and completely posteriorly. Foramen transversarium of both vertebrae were present. Right and left intervertebral foramen was present, articular processes completely fused spines and laminae.

Case-3 (Figure-3) was the fusion between five thoracic vertebrae, with fusion of the one right rib with vertebrae and four left rib with vertebrae, complete fusion of the part of the head and neck with the body and transverse process of vertebrae. Bodies of vertebrae partially fused with one another on left side. Intervertebral foramen were present on both side.

Case 4 (Figure-4) the fusion was between Two typical thoracic vertebrae both the cases showed completely fusion of their bodies, with no other part fused, superior and inferior articular process were fused.

Case-5 (Figure-5) fusion between left twelth rib and twelth vertebrae on left side, rib fused with the body and transverse process.

Case-6 (Figure-6) fusion between seven vertebrae, fusion of the thoracic and lumbar vertebrae. Lower three thoracic vertebrae fuse with each other and lumbar vertebrae, in right side with one rib and left side with two ribs. Four lumbar vertebrae fuse with each other and with corresponding thoracic vertebrae. The bodies were completely fused with sbulging at the level of fusion. Bulging is more in lumbar region.

Cases-7 (Figure-7), Complete or partial fusion between 5th lumbar vertebra and first sacral segment of the sacrum was observed. Superior articular facet fused with first sacral segment. Right and left transverse process completely fused with ala.

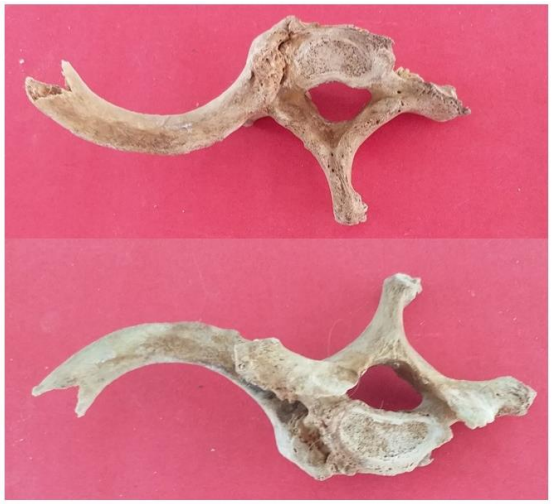

Fig-1: Fusion of first rib with first thoracic vertebrae

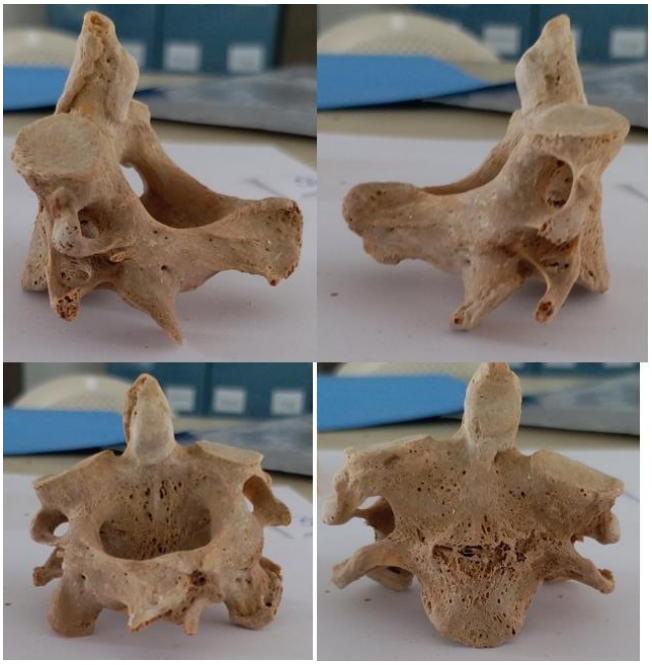

Fig-2: Fusion of C2 and C3

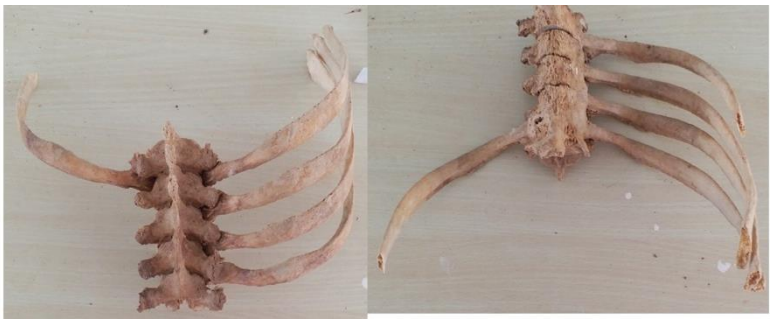

Fig-3: Fusion of five adjacent thoracic vertebrae with ribs

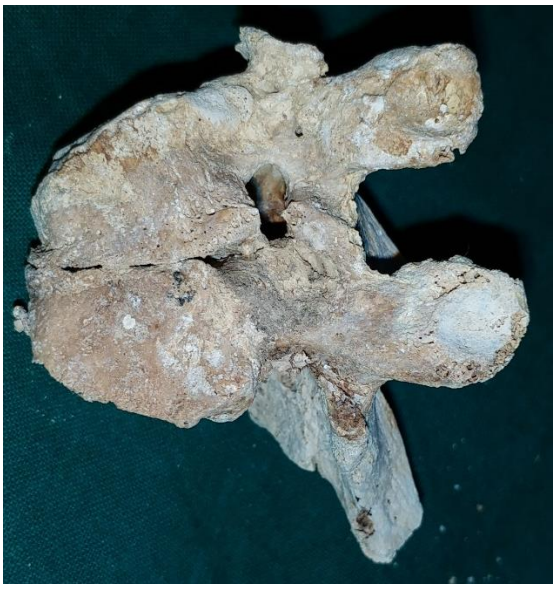

Fig-4: Fusion of two thoracic vertebrae

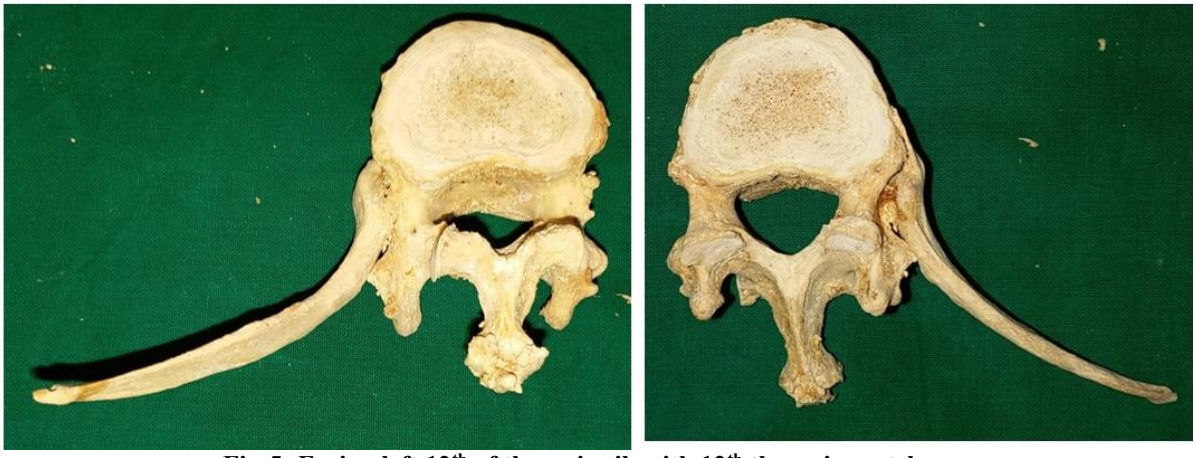

Fig-5: Fusion left 12th of thoracic rib with 12th thoracic vertebrae

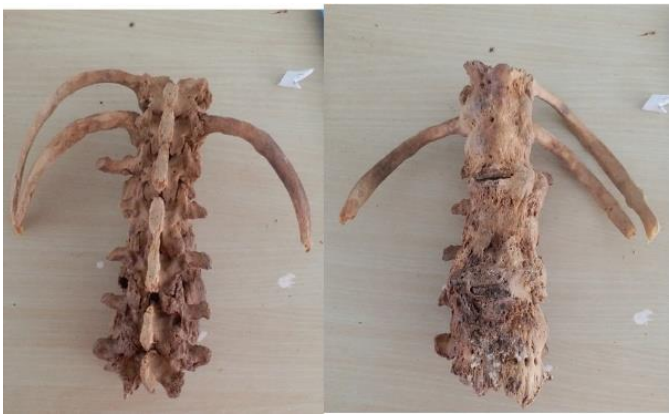

Fig-6: Fusion of seven vertebrae and ribs

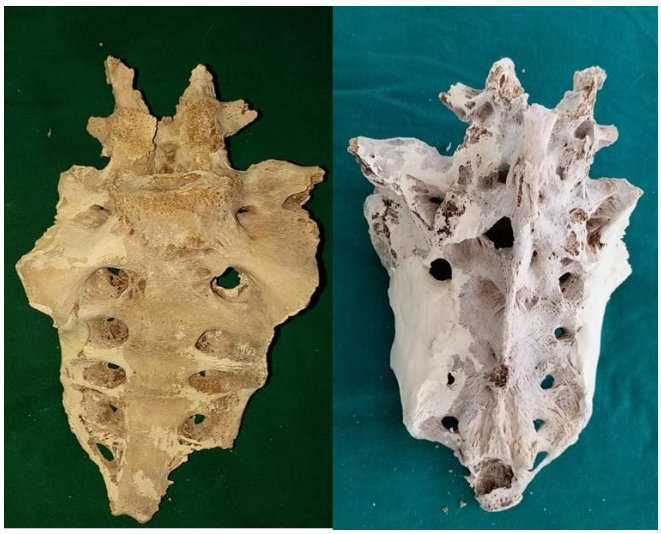

Fig-7: Fusion of fifth lumbar vertebrae with sacrum

DISCUSSION

In our study we find fusion between cervical vertebrae, between ribs and thoracic vertebrae unilaterally and bilaterally, between thoracic vertebrae, between thoracic, lumbar vertebrae and ribs and between fifth lumbar vertebrae and sacrum.

Kulkarni *et al*., identified three different specimens of fused vertebrae were identified. Assimilation of Atlas: Fusion of atlas with basiocciput. Cervical Vertebral Synostosis: Fusion of cervical vertebrae at 6th and 7th level. Thoracic Vertebral Synostosis: Fusion of thoracic vertebrae at 1st and 2nd level [1].

In one study axis vertebra, Shankar VV *et al*., shows fused with the 3rd cervical vertebra with

complete fusion of vertebral body, arches and spine which could have resulted in interference with neck movement, or muscular weakness, atrophy and neurological sensory loss [5].

Different vertebral anomalies such as hemi-vertebrae, block vertebrae butterfly vertebrae, transitional vertebrae, and in extreme cases spina bifida can cause compression of the spinal cord and alterations of the shape and number of vertebrae [6, 7].

Nagaraj Mallashetty *et al.,* studied two sets of the thoracic vertebra having ossification of the anterior longitudinal ligament indicating 5.88%. And found one set of fused thoracic vertebrae T5, T6, T7 and T8. they reported that the bodies of upper ten thoracic vertebrae were fused together due to ossification of the anterior longitudinal ligament [8].

Vadgaonkar *et al* reported fusion of the typical thoracic vertebrae and lumbar vertebrae. In One specimen, fusion between the two typical thoracic vertebrae. The second specimen, fusion among the three typical thoracic vertebrae. The third specimen shows fusion between the twelveth thoracic vertebrae and the first lumbar vertebra [9].

Erdil *et al*., observed five clinical cases of congenital fusion of cervical vertebrae by x ray and MRI. They identified fusion between two vertebrae in two cases, in two cases fusion between two vertebrae at two different leveland in one case fusion between three cervical vertebrae [10].

Nivedha Viswanathan et al identified a case of fusion of three typical thoracic vertebrae, partially fused body and pedicle laminae, processes were unfused [11].

Yogesh Yadav *et al.*, the axis was fused with 3rd cervical vertebra. Body, laminae spines, pedicles and transverse processes of C2 and C3 were completely fused on both anterior and posterior aspects. Foramen transversarium were present on both the vertebrae [12].

Ajay N *et al*., found one set of Atlanto-occipital fusion, one set Atlanto axial fusion, one Fusion between Axis and C3, and two set of Fusion between typical cervical vertebrae [13].

Bheem Prasad et al, Among 34 vertebral columns, from 408 thoracic vertebrae, they observed two sets of fused thoracic vertebrae, one set of two and one set of four fused thoracic Vertebrae. There was a one case of thoracic typical vertebra where a typical rib was fused with it. According totheir study, found presence of one set of fused 4th and 5th thoracic vertebrae (2.94%), one set of 5th to 8th thoracic vertebrae (2.94%). Out of 34 sets of vertebral columns, 2 sets of fused thoracic vertebrae 5.88%. 2 sets of fused thoracic vertebrae present ossification of the anterior longitudinal ligament [14].

Kubavat D *et al*., presented study of sacralisation of the fifth lumbar vertebra among Gujarati population is 11.1 %, which is more in males than female [15].

Md. Khaleel Ahmed *et al*., fusion of typical thoracic vertebra between T3 & T4 was found and symmetric fusion of vertebra near the junction of fusion of both lamina and spinous processes, there is a groove with over hanged linear crest on both sides, which demarcates the fusion of both the bodies of thoracic vertebrae. As a result of fusion, there is absence of superior facet of lower vertebra and inferior facet of upper vertebra. The costal facets are seen on either side of the body near its junctions. The inter-vertebral foramen is persisting and size is reduced [16].

Somanath Deepa *et al*., identified Fusion between typical cervical vertebrae in 1.2%, Fusion between typical thoracic vertebrae in1.2%, Fusion between T11 and T12 Vertebrae in 1.2%, Fusion between typical lumbar Vertebrae in 1.2%, Fusion between last lumbar and first sacral vertebrae in 2.4% [17].

Mudita Srivastava *et al*., studied that children with Cleft lip or Cleft Palate have more prevalence of cervical vertebral anomalies than the normal population [18].

Tiwari *et al.*, presented a case of congenital abnormal cervical vertebrae with two typical cervical vertebral laminae fused on left side along with the failure of development of pedicle, costal element and anterior tubercle of transverse process of lower cervical vertebrae [19].

Sharma M *et al.*, presented Upper Cervical vertebrae were found fused in 6.25% in three case. Two Thoracic vertebrae in two thoracic spines were fused in 4.16%in two case. Two lumbar vertebrae of one lumbar spine were fused in 2.08% in one case. Sacralisation of L5 was observed in 10.41% in five cases.Coccyx was fused to sacrum in 3 cases was 6.25% [20].

Londhe Shashikala *et al*., presented a case of left sided bone specimen showing fusion of first and second ribs. [21]

Mohd Nazeer *et al.*, presented a case of Fusion of three typical thoracic vertebrae the bodies were completely fused on right side and partially fused on left side. The articular processes, laminae and spinous processes were unfused [22].

Johansen JG *et al.,* studied Radiologically three types of vertebral fusion described: Single fused

cervical segmen seen in 25% of patients, multiple contiguous fused segments seen in 25% patients and multiple, noncontiguous fusion seen in 50% patients [23].

Beals RK *et al*., out of 218 patients with congenital vertebral anomalies demonstrated 61% of patients had associated abnormalities were cranial nerve palsy, radial hypoplasia, club feet, dislocated hip, Sprengel's deformity, imperforate anus, hemifacial microsomia, and renal and cardiac anomalies [24].

CONCLUSION

In the present study we found fusion between vertebrae, ribs and vertebrae, and vertebrae and sacrum out of 400 vertebrae. Identification of vertebral synostosis at an early age can prevent many disabilities and complications or it can be helpful for other hidden pathologies also. Although vertebral synostosis is a rare finding but it can highlight many clinical aspects. Vertebra synostosis can be congenital or acquired. Knowledge about any deviation from the normal anatomy of vertebral column can lead to major or minor complications affecting the different system of the body. Exercise therapist dealing with neck pain and radiologist dealing with abnormalities of cervical spine, must also be aware of this condition. Because of the serious consequences of this type of osseous anomaly there is a need of thorough clinical assessment and evaluation this study is also clinically important as they might be associated with genitourinary, neurological and musculoskeletal abnormalities.

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