https://doi.org/10.46351/jas.v32i1pp38-44

JAS Journal of Anatomical Sciences (U.P. Chapter of Anatomical Society of India)

Case Series

VERTEBRAL SYNOSTOSIS AND ITS CLINICAL IMPORTANCE – A CASE SERIES

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ABSTRACT

Synostosis/ block vertebrae/ fusion of vertebrae occurs due to congenital fusion or due to spinal diseases like tuberculosis, juvenile rheumatoid arthritis, traumatic conditions. The synostosis may be either complete or incomplete or may be either acquired or congenital. The fused vertebrae function as one vertebra, and are usually asymptomatic until adulthood, where degenerative changes occur, and nerve root compression symptoms are noticed. This study aimed to find incidence of vertebral synostosis in population of Garhwal region of Uttarakhand. In the present study a total of 575 vertebrae were examined for presence of block vertebrae/ synostosis/ fusion and found a total of 08 cases (Incidence = 1.39%) out of which we found mostly in cervical region – 04 out of 08 cases (Incidence = 0.69%), followed by thoracic region – 03 out of 08 cases (Incidence = 0.52%) and cervicothoracic region – 01 out of 08 cases (Incidence =0.17) This is the first study for vertebral synostosis in Garhwal region of Uttarakhand, to the best of our knowledge.

Keywords: Block, Ossification, Synostosis, Vertebrae

INTRODUCTION

Synostosis of vertebrae occurs due to congenital fusion or may be due to spinal diseases like tuberculosis, juvenile rheumatoid arthritis, and traumatic condition. A synostosis or block vertebra means fusion of vertebrae.

Anatomical defects have been reported which include sacralization, lumbarization, occipitalization, lack of posterior vertebral arch and spinal synostosis. Fusion of successive vertebral segments may lead to block spines, block vertebrae, vertebral synostosis or spinal fusion, which may lead to limited or restricted movements, degenerative

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Date of Receiving: 24 Nov 2023
Date of Acceptance: 06 Jan 2024

disc changes and associated neurological deficits which are visible clinically. The synostosis may be complete or incomplete, acquired or congenital [1].

The vertebral column is flexible because it contains many small bones – vertebra, in between vertebrae resilient intervertebral disc is present. The vertebra articulate with each other at synovial zygapophysial joint which provide flexibility to vertebral column [2].

A typical vertebra consists of a vertebral arch, vertebral foramen, body, transverse process and a spinous process. Vertebral body is massive and provides strength to vertebral column. The vertebral arch is present posterior to the body and is formed by two right and left pedicles and laminae. The walls of vertebral foramina are form by vertebral arch and posterior surface of vertebral body. The vertebral notches are present superior and inferior to each pedicle between the superior and inferior articular processes posteriorly and the corresponding projections of the body anteriorly [2].

Congenital vertebral synostosis (CVS) is a rare developmental condition which occurs due to segmentation or metamerism process failure. Block vertebrae or vertebral synostosis result from incomplete vertebral fusion. CVS can be isolated or may be due to syndromic manifestations like Klippel-Feil syndrome. Acquired vertebral synostosis (AVS) is due to some pathology like fibrodysplasia or progressive juvenile rheumatoid arthritis or following infection such as tuberculosis or is post-surgical or post-traumatic [3].

There are usually two congenital fused cervical vertebrae (CFCV) and more than two are present rarely. They constitute a single unit functioning as one vertebra. Until adulthood, these are usually asymptomatic, where degenerative changes such as arthritis, disc hernias occur adjacent to CFCV level and nerve root compression symptoms are noticed [4].

The upper part of cervical spine has highest frequency of synostosis, which decreases gradually downwards [5]. Formation of osteophytes on the adjacent levels is one of the secondary effects of CFCV [6]. The aim of present study is to report incidence of cases of vertebral synostosis in population of Garhwal region of Uttarakhand.

CASE SERIES

Eight cases of vertebral synostosis were observed in the vertebrae present in the museum of Department of Anatomy, GDMC, Dehradun, Uttarakhand. The present study was done after obtaining ethical clearance from institutional ethical committee (IEC/GDMC/2020/91). Gender and age could not be specified. Vertebrae having synostosis were observed and photographs were taken.

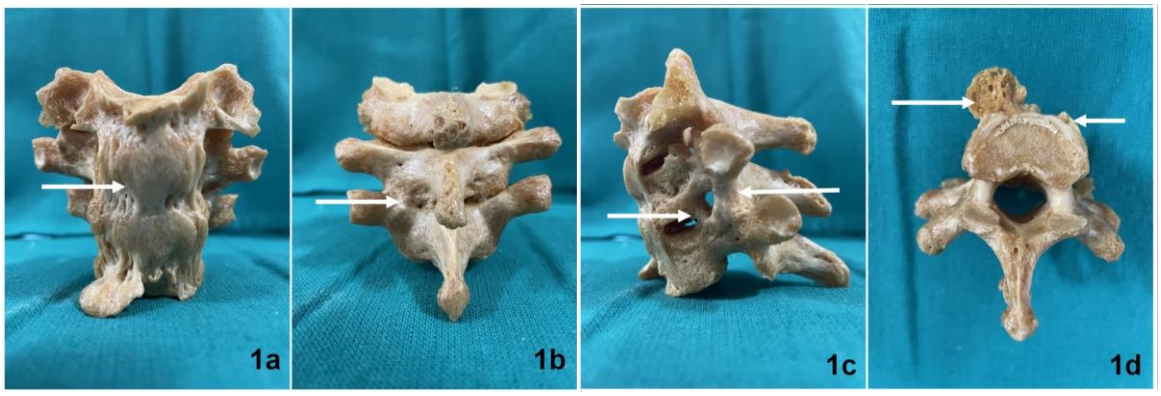

Fig. 1. a) Showing anterior view of fused vertebrae C7-T1-T2 with ossification at anterior longitudinal ligament; b) Showing posterior view with ossification between articular facets of left T1-T2 vertebrae; c) Showing left lateral view with fusion of lamina between left T1-T2 vertebrae and posterior longitudinal ligament; d) Showing superior view with osteophytes on superior margin of C7 and body of T2 vertebrae.

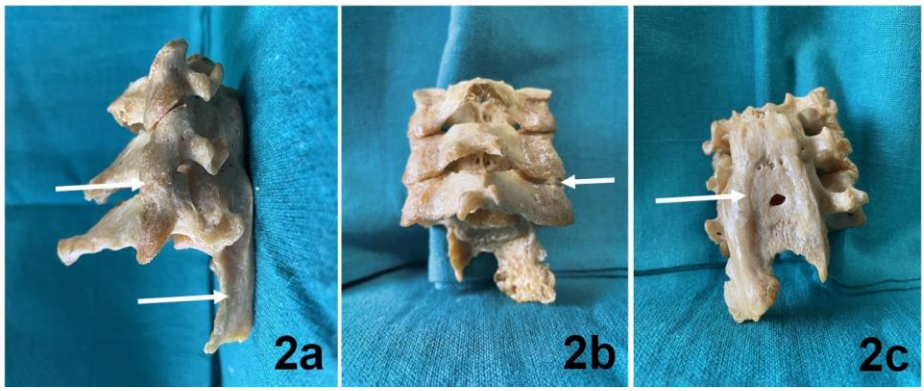

Fig. 2. a) Showing left lateral view of fused vertebrae C4-C6 with fusion of articular facets of right C5-C6 vertebrae and extended ossified anterior longitudinal ligament; b) Showing posterior view of fusion of right articular facets of C5-C6 vertebrae; c) Showing anterior view with ossified anterior longitudinal ligament.

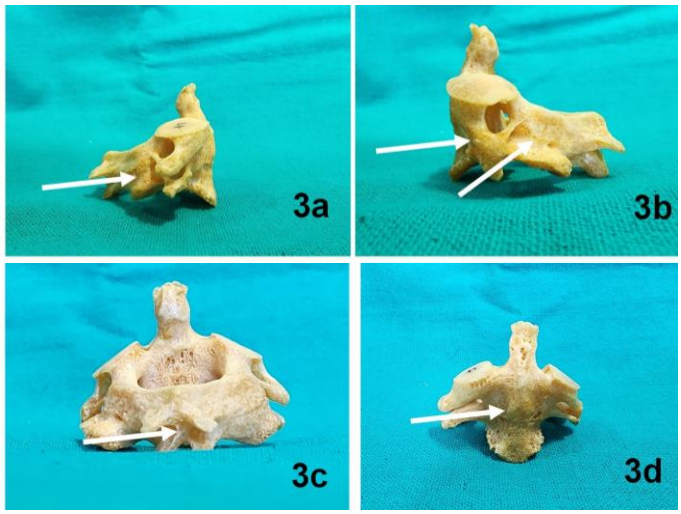

Fig. 3. Showing right lateral view of fused vertebrae C2-C3 with fusion of right lamina and articular facets; b) Showing left lateral view with fusion of left lamina and articular facets; c) Showing anterior view with ossification of anterior longitudinal ligament.

The present case series shows incidence of synostosis as 1.39%. The incidence of synostosis was found to be 0.69% in cervical, 0.52% in thoracic and 0.17% in cervicothoracic region in the present study.

Case 1: Cervico-thoracic synostosis was observed between C7-T1-T2 vertebrae. (Fig. 1) In these vertebrae, ossification/fusion of anterior longitudinal ligament and posterior longitudinal ligament (full length) was observed. Osteophytes were observed on the superior margin of C7 and body of T2. Fusion of articular facets – between left T1-T2 and right C7-T1 vertebrae was observed. Ossification of ligaments was observed in between the laminae of left T1-T2 and body of T1-T2.

Case 2: Cervical synostosis was observed between C4-C5-C6 vertebrae. (Fig. 2) In this case, ossification/fusion of anterior longitudinal ligament (full length), body of C4-C5, C5-C6, and of articular facet (between right C5-C6) were seen.

Case 3: Cervical synostosis was observed between C2-C3 vertebrae. (Fig. 3) and ossification was seen at anterior longitudinal ligament (full length), posterior longitudinal ligament (full length), in between laminar ligaments (bilaterally), and at spinous process (interspinale ligaments). Fusion of left transverse process, at articular facets – bilaterally was also present.

Case 4: Thoracic synostosis was observed between five typical thoracic vertebrae (exact levels could not be identified). (Fig. 4) Ossification was seen at anterior longitudinal ligament (full length), anterior and right lateral aspect. Fusion of articular facet (between right 2nd and 3rd vertebrae) was also observed.

Case 5: Thoracic synostosis was observed between two typical thoracic vertebrae (exact levels could not be identified). (Fig. 5) Ossification of anterior longitudinal ligament was also observed.

Case 6: Cervical synostosis was observed between two typical cervical vertebrae (exact level could not be identified) (Fig. 6). The ossification of anterior longitudinal ligament (full length), was seen. The fusion of right articular facet and body was also observed.

Case 7: Thoracic synostosis was observed between two typical thoracic vertebrae (exact levels could not be identified) (Fig. 7). The ossification was seen only between articular facets (bilaterally).

Case 8: Cervical synostosis was observed between C2-C3 vertebrae. (Fig. 8). The ossification of anterior longitudinal ligament (full length) and interlaminar ligament (bilaterally) was observed. Fusion occurs at spinous process, left transverse process and articular facets (bilaterally).

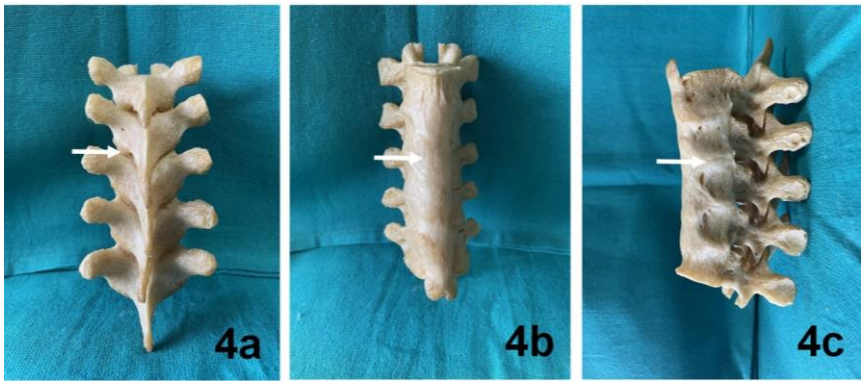

Fig. 4. a) Showing posterior view of fused vertebrae - five typical thoracic vertebrae with fusion of articular facets between 2nd and 3rd; b) Showing anterior view with ossification of anterior longitudinal ligament; c) Showing right lateral view with fusion of bodies of all vertebrae.

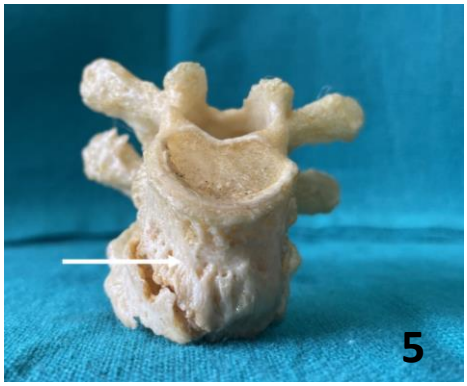

Fig. 5. Showing anterior view of fused vertebrae – two typical thoracic vertebrae with ossification of anterior longitudinal ligament.

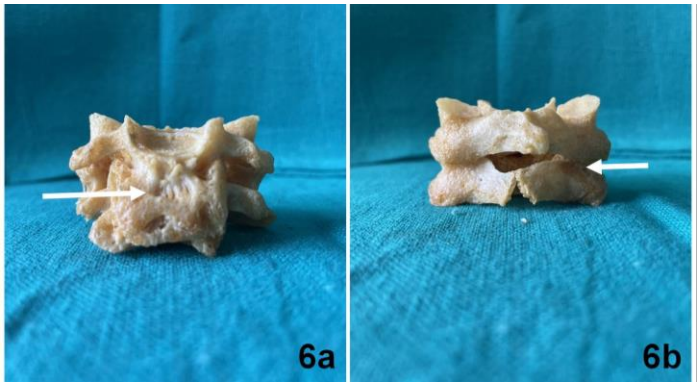

Fig. 6. a) Showing anterior view of fused typical cervical vertebrae with ossification of anterior longitudinal ligament; b) Showing posterior view with fusion of right articular facets.

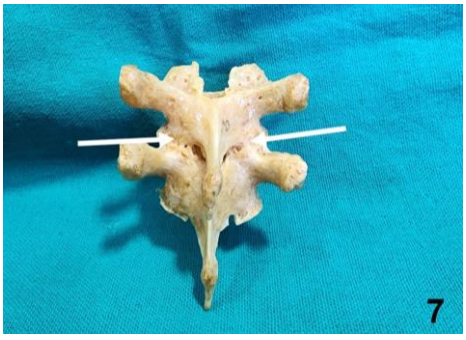

Fig. 7. Showing posterior view of fused vertebrae – two typical thoracic vertebrae with fusion of bilateral articular facets.

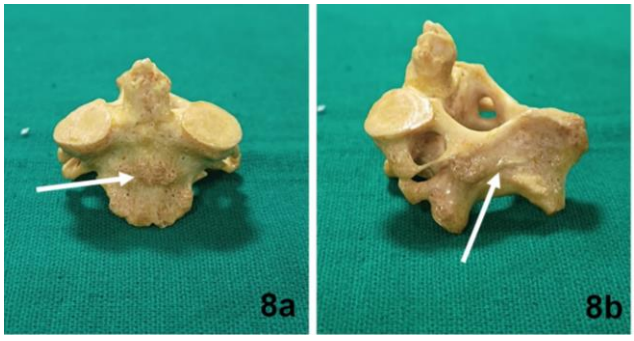

Fig. 8. a) Showing anterior view of fused vertebrae C2-C3 with ossification of anterior longitudinal ligament; b) Showing left lateral view with fusion of left lamina, articular facets and spine.

DISCUSSION

Vertebral column is the part of axial skeleton which develops from paraxial mesoderm, lateral plate mesoderm and neural crest cells. On each side of neural tube, paraxial mesoderm forms segmented series of tissue blocks known as somitomeres in the head region and somites in occipital region caudally [7].

Sclerotome is ventromedial portion of somites and forms vertebrae, during 4th week migration of sclerotome cells occurs around spinal cord and notochord and merging of cells occurs with cells from opposing somite on the other side of neural tube, followed by resegmentation, where caudal half of each sclerotome grows and fuses with cephalic half of each subjacent sclerotome [7].

If two adjacent somites or their associated mesenchyme fail to separate properly, they result into segmentation defect. A block vertebra is created when there is involvement of entire vertebral segment [8].

Vertebral fusion, in referred condition results in more biomechanical pressure in related segments leading to premature deteriorating changes at related motion segments, while during blastemal stage, environmental and genetic factors are involved in pathogenesis. Causes of CFVC may include malformations of notochord, retinoids, and decrease in local blood supply of spine in embryonic life and Klippel-Feil syndrome [6].

Sacrum is an example of normal block or fused vertebrae. The disruption of PAX-1 gene expression may result in vertebral fusion abnormalities. Acquired causes include trauma, tuberculosis, juvenile rheumatoid arthritis [1].

Vertebral anomalies are of importance to anatomists, neurosurgeons, neurologists, orthopaedicians and general surgeons. Vertebral fusion have clinical and embryological importance since the clinical symptoms vary according to degree and exact location of the fusion leading to limitation of movements, early degenerative changes and related neurological symptoms [1].

In a study by Nazeer et al, they found incidence of 0.25%, which is less than incidence of our study [9].

In a study by Masnicova et al, they found incidence of 2.6% in cervical, 1.6% in thoracic and 0.5% in lumbar vertebrae in Lithuanian population [10], whereas our study reported 0.69% in cervical, 0.52% in thoracic and 0.17% in cervicothoracic region.

In a study by Sharma et al, they found incidence of 6.25% in cervical, 4.16% in thoracic and 2.08% in lumbar region [11],

while, in the present study the incidence of synostosis is 0.69% in cervical, 0.52% in thoracic and 0.17% in cervicothoracic region.

CONCLUSION

In the present study a total of 575 vertebrae were examined for presence of block vertebrae/ synostosis/ fusion and found a total of 08 cases (Incidence = 1.39%) out of which we found mostly in cervical region – 04 out of 08 cases (Incidence = 0.69%), followed by thoracic region – 03 out of 08 cases (Incidence = 0.52%) and cervicothoracic region – 01 out of 08 cases (Incidence =0.17) This is the first study for vertebral synostosis in Garhwal region of Uttarakhand, to the best of our knowledge.

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