

Fused Cervical Vertebrae: A Case Series

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ABSTRACT

Vertebral fusion is the fusion of bodies and the various elements of the vertebral arch of adjacent vertebrae. Such vertebral fusion usually is seen in cervical and lumbar region, more so between the second and third cervical vertebrae, usually asymptomatic; but may also result in features suggestive of neurological compression and might also present difficulty in procedures like endotracheal intubation. This present case series involving three cases discusses the presentations and possible consequences of such vertebral fusions. The three Fused Cervical Vertebrae (FCV) studied were all different with respect to the degree and site of fusion. With respect to fusion of vertebral bodies, complete fusion was seen in two specimens and the other had only partial fusion. This series aimed at documenting the varied spectrum of vertebral fusions and the need for earlier detection so as to avoid the anticipated age related complications like degeneration of adjacent segments and neurological deficits. The observations made in this series and the comparative analysis with other articles show that the mode of vertebral fusions are very different in each specimen and thus their clinical presentations might also vary across numerous signs and symptoms for each individual and hence cannot be generalised.

Keywords: Compression, Synostosis, Vertebral fusion

INTRODUCTION

Among the seven cervical vertebrae, first (C1), second (C2) and seventh (C7) are classified as atypical owing to their unique morphology and the remaining third to sixth (C3-C6) are considered typical vertebrae. These vertebrae are subject to numerous congenital anomalies like ponticulusposticus, osodontoidum and vertebral fusion to name a few [1]. FCV have been documented at two levels between: C2 and C3, C6 and C7 [2-4]. Vertebral fusions may be congenital isolated or part of Klippel Feil syndrome or acquired as a result of degenerative diseases, tuberculosis or trauma. Fused cervical vertebrae are said to have an incidence of 0.4%-0.7% [5].

The occurrence of FCV may be asymptomatic or may result in compressive symptoms like neck pain, difficulty in movements of neck and occasionally motor or sensory deficits. Because of such varying clinical spectrum, the diagnosis of this condition is usually an incidental radiographic finding [6]. Former studies on FCV have stressed upon the need to know about it for instances requiring endotracheal intubation to avoid neck injuries [2,5]. The present series brings into view a case series of three such FCV to stress upon the need for early detection and proper counselling of the patient regarding the condition and the expected complications, so as to avoid them and to improve the quality of life.

CASE SERIES

Three cases of FCV were studied in the Department of Anatomy PSG Institute of Medical Sciences and Research, Coimbatore, Tamil Nadu, India. Ethical approval was obtained and submitted (order number: 21/369). While collecting vertebrae for osteology demonstration for 1st year MBBS students, three block vertebrae were identified, each showing varying degrees of fusion between axis and the third cervical vertebra. The FCV were studied for their body, lamina, pedicle, transverse process, spinous process and foramina transversarium. The specimens were photographed from different angles.

Case 1

The bodies of axis (C2) and third cervical vertebra (C3) were partially fused at the lateral aspects. From front, the bodies of C2 and C3

were not fused. With respect to the vertebral arch elements, only the proximal part of laminae of the corresponding sides of C2 and C3 were fused. All other vertebral arch elements were unfused [Table/Fig-1].



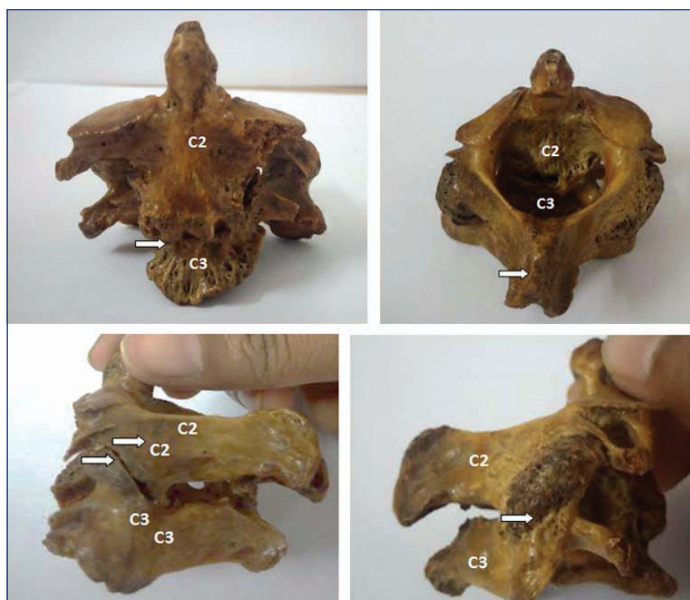
[Table/Fig-1]: Case 1 showing lateral fusion of vertebral bodies and proximal laminae on both sides between C2 and C3. White arrows show the sites of vertebral fusion. (C2: second cervical vertebra; C3: third cervical vertebra).

Case 2

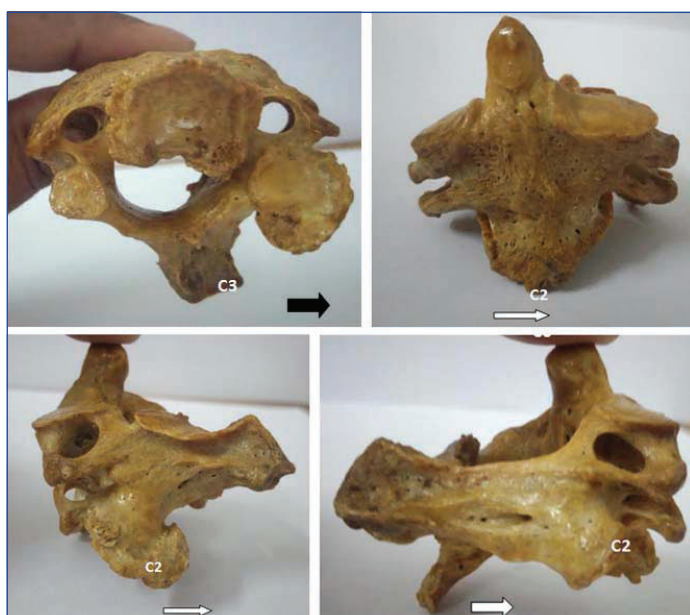
The bodies of C2 and C3 were completely fused anteroposteriorly. With respect to the vertebral arch elements, laminae of the corresponding sides and the spinous processes of C2 and C3 were fused. All other vertebral arch elements were unfused [Table/Fig-2].

Case 3

The bodies of C2 and C3 were completely fused anteroposteriorly. With respect to the vertebral arch elements, the pedicles, laminae and the spinous processes of the corresponding sides of C2 and C3 were fused throughout their extent. The right inferior articular process of C3 was much expanded [Table/Fig-3].



[Table/Fig-2]: Case 2 showing complete fusion of vertebral bodies; fusion of laminae and spinous processes of C2 and C3. White arrows show sites of vertebral fusion (C2: second cervical vertebra; C3: third cervical vertebra).



[Table/Fig-3]: Case 3 showing complete fusion of vertebral bodies and pedicles, laminae and spinous processes of C2 and C3. The right inferior articular process of C3 is seen to be much expanded (black arrow). White arrows show sites of vertebral fusion (C2: second cervical vertebra; C3: third cervical vertebra).

DISCUSSION

The para-axial mesoderm gets segmented to give rise to somites on either side of developing neural tube. The vertebral column is formed from the sclerotome of the somites. The body, posterior arch and transverse process of C2 vertebra is derived from second cervical sclerotome, tip of dens is derived from cranial half of 1st cervical sclerotome. Failure of normal segmentation of the cervical somites during four to eight weeks of intrauterine period results in fusion of cervical vertebrae [1,7]. Congenital fusion of vertebrae is most commonly seen in the cervical region although it may involve other segments of vertebral column also. Sacrum is an example of normally occurring block vertebrae [2].

The fusion of vertebrae seen in the present case series could be an isolated feature or a part of the Klippel Feil syndrome having vertebral defects, cardiopulmonary anomalies, renal anomaly and short stature or vertebral defects, Anal atresia, Cardiac defects, Tracheo-oesophageal fistula, Renal anomalies and Limb abnormalities (VACTERL) association with vertebral defects, anal atresia, cardiac defects, tracheoesophageal fistula, renal anomalies, and limb abnormalities [8]. Congenital FCV is one of the

primary malformations of chorda dorsalis [9]. Clinical symptoms such as shortening of cervical spine, limited neck motion, pain, burning sensations, cramps, bone malformation, hypoaesthesia, anaesthesia, paralysis, fibrillations and reduced deep reflexes can be caused by the fusion of vertebrae.

Osseous fusion between contiguous laminae and pedicles are referred to as congenital bar. They usually occur unilaterally and hence affect the stability of the spinal alignment [10]. In this study, laminae and pedicles of axis and third cervical vertebra are fused bilaterally in all three specimens in varying degrees. This neural arch ossification could be due to the formation of congenital bars.

In case 1 of the present study, the fusion was minimal involving the lateral aspect of bodies and proximal laminae of C2 and C3 which might not have caused many neurological symptoms. In case 2 of the present study, the bodies, laminae and the spinous processes of C2 and C3 were completely fused. This might not have caused any significant posture change because of bilateral involvement except for shortening of cervical spine as a whole; however chances of occurrence of minor to major neurological compressive features were high. In case 3 of the present study, there was complete fusion of bodies and all the vertebral arch elements of C2 and C3. This could have resulted in significant cervical spine shortening and severe neurological symptoms. Also the right inferior articular process of C3 was much expanded, which could have resulted in unilateral spine instability in the next contiguous cervical joint. Unfortunately, the medical history of the donor was unknown since this is an osteological study and hence the inferences cannot be confirmed.

In a case study by Shilpa S et al., the bodies of C2 and C3 were partially fused, but the laminae of the adjacent vertebrae were not fused. Also right sided spina bifida was observed in C3 [3]. Though there were varying degrees of fusion of vertebral bodies and parts of vertebral arches of C2 and C3 in the present study, spina bifida was not observed. In a radiological study by Freitas MM and Ventura LC, C3 hemi vertebra with partial right fusion of C2 and C4 was documented [11]. No such anomaly was noted in the present study. Kaushal P and Bhukya S had reported a partial fusion C2 and C3 vertebral bodies and right vertebral arch with complete fusion of left vertebral arch, which was again very dissimilar to the present study [10]. Comparison of the findings in present case series with similar studies is shown in [Table/Fig-4] [2,3,10,11].

Authors	Place of the study	Vertebral body fusion	Vertebral arch elements fusion (laminae, pedicles, spine, transverse process)	Others
Yadav Y et al., 2014 [2]	Hapur	Complete fusion	All elements were fused on both sides	-
Shilpa S et al., 2016 [3]	Nagpur	Partial fusion	No fusion	Spina bifida seen
Kaushal P and Bhukya S, 2018 [10]	New Delhi	Partial fusion	Partial fusion on right Complete fusion on left	-
Freitas MM and Ventura LC, 2021 [11]	Almada	Partial fusion	Partial fusion of all elements on right	Right hemi vertebra seen
Present study, 2022	Coimbatore	FCV no. 1: Partial fusion FCV no. 2 and 3: Complete fusion:	FCV no. 1: Laminae fused on both sides FCV no. 2: Spines fused; Laminae fused on both sides FCV no. 3: All elements were fused on both sides	-

[Table/Fig-4]: Comparison of previous studies with the findings of present study [2,3,10,11].

Comparing various articles published on FCV shows that the degree of fusion of the various parts of the vertebrae varies significantly

between individuals thus explaining the varying presentations of symptoms likewise. According to recent report long standing congenital or acquired fusion of upper cervical vertebrae may lead to increase in the biomechanical stress of adjacent segments resulting in degenerative changes [12]. Jung C et al., suggested an increase in adjacent segment disease in patients with fused vertebrae [13].

Early diagnosis of this degenerative process due to any injury, age related changes can be helpful to prevent the progression. Surgical intervention for fused vertebrae carry high risk for morbidity and mortality, hence patient should be motivated to change the lifestyle to lead a normal life.

CONCLUSION(S)

The awareness about the complications as a result of FCV helps in anticipating these during procedures involving the cervical spine and also during anaesthetic maneuvers of neck to avoid them. Also upon earlier diagnosis of this condition, the patients can be properly counselled as to its presentations and risks, ensuring proper follow-up and improving their quality of life.

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