



## A Study of Fusion of Cervical Vertebrae: An Osteological Study

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### Abstract

**Introduction:** Fusion of Vertebral column are common findings in both radiological studies and in anatomical studies. In present study was focussed only on the fusion of the cervical vertebrae.

**Aims and Objectives:** The present study is to study the fused cervical vertebrae and its clinical aspect.

**Materials and Methods:** The present study was conducted on 200 dry cervical vertebrae of both the sexes in Department of Anatomy, Subharti Medical College, Swami Vivekanand Subharti University, Meerut, Uttar Pradesh. The bones were carefully studied and digitally photographed.

**Results:** In the present study the incidence of fused cervical vertebrae was 0.5% (01 out of 200). Out of seven cervical vertebrae the fusion were only seen in C2-C3 Vertebrae.

**Conclusions:** The overall incidence of the fused cervical vertebrae in the present study were only 0.5%. The fusion of cervical vertebrae is commonly associated with Klippel-Feil Syndrome, Crouzon's syndrome and Chorda Dorsalis. The fusion of the cervical vertebrae causes restricted and painful neck movements and can cause sudden death also. The knowledge of such fusion is important for anatomists, neurosurgeons, radiologists, orthopaedic surgeons, neurologists, physiotherapists and even orthodontists. The knowledge of the fusion of cervical vertebrae is important for anaesthetist while doing endotracheal intubation where extension of the neck is done.

**Keywords:** Fusion; Cervical Vertebrae; Crouzon's Syndrome

### Introduction

Cervical vertebrae are seven in number and divided into typical and atypical cervical vertebrae. The first cervical vertebrae also called as Atlas, second cervical vertebrae as Axis, and Seventh as Vertebrae Prominens have special features and thus considered as Atypical Cervical Vertebrae, whereas the third, fourth, fifth and sixth cervical vertebrae (C3, C4, C5, C6) are almost identical when compared and are termed as Typical Cervical Vertebrae. The first

cervical vertebrae (atlas) form an important joint with the occipital bone and with the second cervical vertebrae. Axis vertebrae is different from other cervical vertebrae by the presence of Odontoid process or Dens and project cranially from the superior surface of the body of the vertebrae. The Axis vertebrae also known as epistropheus forms the pivot upon which the first cervical vertebrae (Atlas) which carries the head rotates. The atlas and axis vertebrae support the head on the lower cervical spine providing for consid-

erable mobility in flexion, extension, rotation and lateral bending. The C3 vertebrae is typical with features similar with other typical cervical vertebrae [1]. Congenital anomalies are common in the vertebral column [2].

In the fusion of the cervical vertebrae, the two fused vertebrae appear not only structurally but also functionally as one vertebra [3]. The fusion of the cervical vertebrae may be congenital or acquired [4,5]. The congenital fusion of the second cervical vertebrae or axis vertebrae with the third cervical vertebrae limits the movements between these bones and because of this reason the third cervical vertebrae also called as vertebrae critica by Cave [6]. Sometimes this anomaly may be asymptomatic but sometimes may also appear with serious manifestations like myelopathy or may be associated with syndromes such as Klippel Feil Syndrome [5,7,8], Crouzon's Syndrome [9]. Sometimes may be associated with restricted neck movements [10]. Sometimes may be associated with muscular weakness, atrophy and neurological sensory loss [11]. Severe pain in the neck region and sudden death may occur due to these anomalies [12]. These anomalies have a clinical importance as well and evaluation must be done by X-ray or Magnetic Resonance Imaging for preventing any further damage during surgery or physiotherapy.

### Aims and Objectives

The aims and objectives of the present study is to study the fused cervical vertebrae and its clinical importance.

### Materials and Methods

Total 200 dried human adult cervical vertebrae were studied in department of anatomy, subharti medical college, Meerut. Out of 200 cervical vertebrae, fusion was reported in only one (C2-C3). Fused C2-C3 Vertebrae was studied in detail and digitally photographed.

### Results

Total 200 dried human cervical vertebrae were studied and only one fusion was noticed in second and third cervical vertebrae. So out of 200 cervical vertebrae only one fused cervical vertebra was seen in C2-C3. The incidence of the present study is 0.5%.

The fused cervical vertebra in the present study was completely fused on the under surface of the axis vertebrae and upper surface

of that of the third cervical vertebrae. The odontoid process of the axis vertebra was stunted, conical and clearly seen.

The fusion of the bodies of the two vertebrae is complete. The anterior surface of the body of the third cervical vertebra is much prolonged inferiorly like that of a normal axis vertebra.

The transverse processes have not fused and are separated on both the sides. Transverse foramina of the axis and the third cervical vertebra on both the sides are present. The spinous process of both the vertebra are present in which the spinous process of axis is bifid and that of the third cervical vertebra is non bifid. The spinous processes are partially fused but the laminae and the adjacent articular processes are completely fused. The right and left foramen transversarium are present in both C2 and C3.

### Discussion

Fusion of cervical vertebrae is not a rare finding. Fusion of the cervical vertebrae includes fusion of the facets, neural arch fusion and block vertebrae. Block vertebrae is used to describe the partial or complete fusion either cartilaginous or bony, of either two or more vertebrae [13]. The fusion may be congenital or acquired [14]. Congenital fused cervical vertebrae are one of the primary malformations of the chorda dorsalis [15] which is believed to be due to the defects of the development of the occipital and cervical somite [3,16]. Cause of the fused cervical vertebrae is combination of environment and genetics which occurs during the third week after conception [17]. Acquired fused cervical vertebrae may be associated with tuberculosis, juvenile rheumatoid arthritis and trauma etc. [18].

These abnormalities are also associated with or lead to various clinical signs and symptoms like shortening of spine in the neck region. Trapezius muscle are unduly prominent laterally and give a webbed appearance, neck movement is restricted, scoliosis, kyphosis and torticollis. Various signs of peripheral nerve irritation such as pain, burning sensations and cramps, various signs of peripheral nerve compression like hypoesthesia, anaesthesia, paralysis, weakness, reduced deep reflexes and fibrillations [12]. Patients with craniosyntosis are associated with various skeletal anomalies in the region of cervical spine [9,20,21].

In the present study out of 200 cervical vertebrae fusion of vertebrae was present only in one specimen (C2-C3). The fused ver-

tebrae were axis and third cervical vertebra. The overall incidence of fused cervical vertebrae in the present study was 0.5%. Same findings were present in previous study conducted by Shand AR on 700 patient's spines in orthopaedic hospital in which the fusion was noticed in C2-C3 Vertebrae and the incidence was 0.5% [22]. Prevalence of fused cervical vertebrae in Lithuanian population was 2.6% [24]. Sharma M, Baidwan S, Jindal AK, Gorea RK studies showed 6.25% of fused cervical vertebrae [23].

## Conclusion

In the present study the overall incidence of the fusion of cervical vertebrae is 0.5% in which the fusion was present in second and third cervical vertebrae. Fusion of cervical vertebrae is associated with various congenital syndromes like Klippel Feil Syndrome, Crouzon's Syndrome, and Chorda dorsalis. The fusion of vertebrae and associated anomalies give rise to various symptoms and signs like Restricted neck movements, severe neck pain, and sometimes associated with sudden death of the patient. Fusion of cervical vertebrae evaluation must be done by X-ray or MRI for preventing serious damage like osteoarthritis by early diagnosis and treatment. The knowledge of the fusion of cervical vertebrae is important academically for anatomists, clinically and surgically for radiologists, orthopaedic surgeons, neurosurgeons, and orthodontists' surgeons. During endotracheal intubation the anaesthetists must be aware of fusion of cervical vertebrae to prevent any damage during extension of the neck.

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