

**Incidence of fusion of axis vertebrae with third cervical vertebrae in central adult Indian population**

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**Abstract**

Fusion of Axis vertebrae with third cervical vertebrae is associated with syndromes such as Klippel-Feil<sup>3,5,6</sup>, Crouzon’s syndrome, limitation of neck movement. The present study was carried out to study the incidence of fused Axis and third cervical vertebrae in central adult Indian population. This study was conducted on 43 axis cervical vertebrae. 5 axis vertebrae are found fused with C3 (third cervical vertebrae), this accounted for a total incidence of 11.6%. The knowledge of such variations is extremely important while performing surgeries in this region. Besides, early diagnosis of such variations makes the patient aware of the activities to be avoided to lower the risk of injury.

**Keywords:** Axis vertebrae, third cervical vertebrae, Crouzon’s syndrome

**Introduction**

Cervical vertebrae are seven in number. First (C1-Atlas), second (C2-Axis) and seventh (C7-cervical prominence) are considered as atypical cervical vertebrae due to special features whereas third to sixth vertebrae are almost identical with general features and therefore termed as typical cervical vertebrae. The Axis vertebrae are different from other as it bears Dens or an odontoid process, which projects cranially from superior surface of the body. The axis acts as an axle for rotation of atlas and head around the dens.<sup>1</sup>

The typical cervical vertebrae (C3-C6) have a smaller body, broader lateral dimensions, triangular large vertebral foramen which exceeds the size of the body, longer and narrower lamina, foramina transversaria in the transverse process and short bifid spine. Congenital anomalies of the cervical or craniovertebral region are common. Among these, the important ones are fused cervical vertebra [FCV]. FCV are not only structurally fused but act as a single unit functionally. Fusion of

cervical vertebrae may be congenital or acquired<sup>2,3</sup>. Congenital fusion of the axis with the third cervical vertebra limits the movements between these bones and because of this the third vertebra was given the name as vertebrae critica by Cave<sup>4</sup>

This anomaly may be asymptomatic however it also appears with neurological signs and symptoms of clinical importance, and may also be associated with syndromes such as Klippel-Feil<sup>3,5,6</sup>, Crouzon's syndrome, limitation of neck movement. Yin et al.<sup>7</sup> analyzed 87 cases with fused cervical vertebrae at C2-C3 and C3-C4 without any malformation, but Erdil et al.<sup>8</sup> reported neck pain, muscular weakness of both upper limbs and minor (but intermittent) head and neck pain.

The present study was carried out to study the fused Axis and third cervical vertebrae and its clinical importance.

#### Materials And Methods

This study was conducted on total 253 dried Human cervical vertebrae at Department of Anatomy, Shyam Shah Medical College Rewa, Madhya Pradesh India. The damaged and deformed vertebrae were excluded from the study. Six axis vertebrae were found fused with third cervical vertebra among total 43 axis vertebra. The specimen was examined in detail.

#### Result and Observations

A total of 253 dried cervical vertebrae were taken under observation, out of which 43 were Human adult axis C-2 vertebrae. In our study we observed 5 axis vertebrae are found fused with C3 (third cervical vertebrae), this accounted for a total incidence of 11.6%. In our study we found in 4 fused cervical vertebrae (C-2 and C-3) there is a complete fusion /synostosis in respect to adjacent part of bodies

,pedicles, articular processes, laminae as well as spines except in two cases only in anterior aspect between bodies of c-2 and c-3 a narrow transverse groove was seen. And in only one case out of 5 the axis vertebrae fused with C-3 showed normal characteristics except a fusion at articular processes on both sides. In all five cases of fused C-2 and C-3 vertebrae there is a separated transverse process with clearly visible foramen transversarium was observed on both the sides.



Fig.1: Normal Axis vertebra and fused Axis vertebra cervical vertebrae (C2 & C3)



Fig.2: Anterior view of fused cervical vertebrae (C2 & C3) (Arrow shows fused area of Axis vertebra with third cervical vertebra.)



Fig.3: Lateral view of fused cervical vertebrae (C2 & C3)

## **Discussion**

In vertebrate animals, a flexible column extending from neck to tail, made up of series of bones, the vertebra, carry out the function of protecting the spinal cord chiefly. In humans it additionally functions to transmit body weight in walking and standing. Cervical vertebrae of the spine consist of seven bony ring that reside in the neck between the base of the skull and thoracic vertebra in the trunk which carry the function of supporting the head, protecting the spinal cord and providing mobility to the head and neck region<sup>9</sup>. Fusion of cervical vertebrae may include facet fusions, neural arc fusions and block vertebrae. The fusion may be either congenital or acquired. Congenitally fused cervical vertebrae is one of the primary malformations associated with chorda dorsalis<sup>10-12</sup> that is believed to be due to defects taking place during the development of the occipital and cervical somites.<sup>13-15</sup> It is caused because of the combination of environmental and genetic factors which occur during the 3rd week of pregnancy.<sup>16</sup> Its diagnosis is complex in young age because it may give the appearance of a normal disc area, as the ossification of the vertebral body is not complete till adolescence and the cartilage is also not ossified.<sup>17</sup> It is important to differentiate between a pathologic condition from it being congenitally fused cervical vertebrae or acquired.<sup>18,19</sup> The later can be associated with conditions like tuberculosis, juvenile rheumatoid arthritis and trauma<sup>20</sup> and even with Klippel-Fiel Syndrome.<sup>21,22</sup> In present study out of 43 axis vertebrae ,only five are found to be fused with C-3.Overall percentage incidence of fused cervical vertebrae C-2 with C-3 in present study is 11.6% which is higher in comparison with previous study done by Sharma M, Baidwan S,

Jindal AK, Gorea RK studies showed 6.25% of cervical vertebrae fusion in 48 dried adult vertebral columns<sup>23</sup>. In another study done by Sampada P kadadi, Mallikarjun M and Jayprakash B R incidence of fused cervical vertebrae C-2 with C-3 was found 1.33%<sup>24</sup>. The prevalence of vertebral fusion in Lithuanian population was reported as 2.6% in cervical, 1.6% in thoracic and 0.5% in lumbar vertebrae.<sup>25</sup>

## **Conclusion**

According to frequency, the commonest site of block vertebrae is C2-C3 with an incidence of 0.4% to 0.7% followed by C5-C6, lumbar (L4-L5) and thoracic region.<sup>26</sup> FCV may be symptomatic or asymptomatic depending on the severity of the variation. The effects of FCV are not isolated, but exert biomechanical stress on the adjoining segments leading to their premature degeneration<sup>27</sup>. Hence, the knowledge of such variations is extremely important to radiologists for diagnosis, orthopedic surgeons, neurosurgeons etc. While performing surgeries in this region and anaesthetists doing endotracheal intubation. Besides, early diagnosis of such variations makes the patient aware of the activities to be avoided to lower the risk of injury<sup>28</sup>.

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