

CASE REPORT

Assimilation of Atlas in Indian Dry Skulls

Surekha D Jadhav¹*, Manoj P Ambali², Raosaheb J Patil², Megha A Doshi² and Priya P Roy²

¹ Department of Anatomy, Padamashri Dr. Vikhe Patil Medical College,
Ahmednagar, 414111, (Maharashtra), India

² Department of Anatomy, Krishna Institute of Medical Sciences University,
Karad, 415539, (Maharashtra), India

Abstract:

Background: A congenital fusion of the atlas to the base of the occiput is defined as assimilation of atlas. It may produce narrowing of foramen magnum which may compress the spinal cord or brain stem. Rarely, it also results in vertebral artery compression, leading to dizziness, seizures and syncope. Multiple variations of partial assimilation have been reported and may involve any aspect of atlanto-occipital articulation. Therefore the knowledge of such anomaly is essential for orthopedic, anesthetist, and clinician.

Aims and Objectives: Aim of the present study was to find the incidence of assimilation of atlas in Indian dry adult skulls of unknown sex and age for which 150 skulls were examined.

Results: Only in one skull, we observed fusion of atlas vertebra with occipital bone. The posterior arch and two superior facets of atlas had completely fused with the occipital condyles. The anterior arch had incompletely fused with occipital bone, showing nonunion in the midline. Only right transverse process was fused with occipital bone.

Conclusions: Assimilation of atlas may cause orthopedic problems and occasionally it produces neurological effects especially when

the lumen of foramen magnum is reduced. Therefore, improved knowledge on the fusion of the atlas with the occipital bone is important in clinical practice as it shows multiple variations and combinations.

Key Words: Assimilation, Atlas Vertebra, Occipital bone, Foramen magnum.

Introduction:

There are various anatomical abnormalities and variants in the region of the atlanto-occipital junction. The assimilation of atlas appears to be the most common in this region [1]. Congenital bony fusion of the atlas vertebra to the base of the occipital bone of the skull is described as assimilation of the atlas. It is also known as occipito-cervical synostosis, occipitalisation of atlas and atlanto-occipital fusion [2-3].

Motabagani and Surendra (2006) [3] quoted in their paper that, it was first described by Rokitansky in 1844 and Schuller in 1911 demonstrated this anomaly on roentgen graphically. Assimilation of the atlas may be partial or complete. Multiple variations of partial assimilation have been reported and may involve any aspect of atlanto-occipital articulation [4]. The incidence of this congenital malformation ranges from 0.08- 3%

of the general population [5, 6].

The anomalies related to atlas and occipital region have clinical importance because of presence of the 1st cervical nerve and vertebral artery. Both structures are related to the superficial aspect of atlas. Compression of vertebral artery may hamper the blood flow to brain. Similarly compression of the 1st cervical nerve may cause neurological symptoms. Clinically there is a wide variety of signs and symptoms that may be associated with assimilation of atlas [4, 5]. These include restricted movement or absence of movements of atlanto-occipital joint, muscle weakness, muscle wasting, ataxia and muscular spasticity. Rarely, diplopia, tinnitus or dysphasia has been recorded. However, an assimilation of atlas may be asymptomatic and thus found incidentally when other disease processes are being ruled out [7].

According to Yochum and Rowe (1987) [6], this disorder occurs due to faulty development between the occiput and the 1st cervical vertebra during the early embryonic weeks. Assimilation of atlas is associated with abnormalities as a result of narrowing of foramen magnum which may compress the spinal cord or brain stem [8]. However, this anatomical variation may often go unnoticed but, incidentally, reveals its presence as a radiological, operative or autopsy finding. Assimilation may also result in vertebral artery compression or even its total occlusion in bony canal, leading to dizziness, seizures and syncope [9]. The present study was carried out to find incidence of assimilation of atlas and discuss similar cases described in literature.

Material and Methods:

A total of 150 human adult skulls of Indian origin were examined. These skulls were collected from the students of first year MBBS, BDS, BPTH and Department of Anatomy, KIMSU, Karad. The skulls that had the 3rd molar erupted were considered adults. Each of the skulls was examined. The variations which were present in the atlas vertebra and occipital bone of the skull, as a consequence to the assimilation were noted.

Observations:

In only one skull, we observed the fusion of the atlas vertebra with the occipital bone. Thus the incidence of assimilation of atlas was 0.67%. The two superior facets of atlas had completely fused with the occipital condyles. The anterior arch had incompletely fused with occipital bone, showing nonunion in the midline (Fig.-1).

Fig-1. Showing Assimilation of Atlas (Antero-inferior view) and irregular shape of foramen magnum. [Red arrow shows incompletely fused anterior arch with occipital bone].



The posterior arch was completely fused with occipital bone (Fig.-2). The right and left transverse processes of atlas were normally developed and each of them containing foramen transversarium. Right transverse process was fused with occipital bone but left one was not fused. Hypoglossal canals were present on both the sides. The inferior articular facets of the atlas were asymmetrical and irregular in shape. The right lateral mass was protruding into foramen magnum (Figure-1-2). Transverse diameter of foramen magnum was 31mm and sagittal diameter 30 mm.

Discussion:

Assimilation of atlas is one of the most common congenital osseous malformations of craniovertebral junction [1]. This anomaly exists in one per 109 adult human skulls of **Fig-2. Showing Assimilation of Atlas (Inferior view) [Red arrow showing left transverse process which was not fused. White dot shows irregular foramen magnum].**



Asian origin [3]. Jayanti et al. (2003) [9] have reported two cases of occipitalization with spina bifida of atlas. In the first case there has complete fusion of only one of the transverse process with occipital bone, and anterior arch has fused incompletely. In the second case the anterior arch of the atlas has fused with occipital bone. This skull also has showed complete fusion of only one of the transverse process with occipital bone.

Ranade et al. (2007) [8] have examined 98 Indian human skulls for assimilation of atlas and noted two cases showing various degree of assimilation of atlas. Sani et al. (2009) [10] have observed assimilation of atlas in 2 Indian skulls. Gholve et al. (2007) [7] have retrospectively reviewed all cases of occipitalization in children included in their spine database by reviewing patient charts and imaging studies, in which they have observed 24 boys and 6 girls with assimilation. Fused anterior arch of atlas has been present in 6 cases; fused lateral masses in 5 cases ; fused posterior arch in 4 cases and a combination of these in 15 cases. Nayak et al. (2005) [11] have observed a skull in which the lateral masses of the atlas have been fused with occipital bone and a foramen between the anterior arch of the atlas and basilar part of the occipital bone along with absence of hypoglossal canal. Posterior arch has been fused with squama of the occipital bone. The morphological appearance of the assimilation of the investigated skull is partly similar to the case described by Nayak et al. (2005) [11]. We have observed, fusion of right transverse process with occipital bone only and hypoglossal canals to be present on

both the sides. We have observed a foramen between the anterior arch of the atlas & basilar part of the occipital bone and we have also reported same finding (Fig.-1). Ranade et al (2007) [8] and Skrzat et al. (2010) [12] have also described partly similar cases of assimilation.

The right lateral mass has been protruding into foramen magnum because of that it has become narrow in anterior part and irregular in shape. While going through the literature we have not come across exactly similar description of any two cases of assimilation of atlas. This may be because; assimilation may involve any aspect of atlanto-occipital articulation [4].

The assimilation may reduce the foramen magnum and lead to neurological complication due to compression of the spinal cord [9, 10]. In our case, the right lateral mass has been protruding into foramen magnum but the sagittal and transverse diameters have remained within the normal range of variations; therefore, we presume that clinical symptoms associated with the spinal cord compression to be absent in our case. According to Greenberg (1968) [13] spinal cord compressions never occur when the sagittal diameter is 18 mm or more. The sagittal diameter in our case has been 30 mm and transverse 31 mm. The standard dimensions for foramen magnum range between 28-38mm for the sagittal diameter and between 25-40 mm for the transverse diameter [1].

Although the assimilation is a congenital condition, many patients do not develop symptoms until the second decade of life. This may be due to a gradual increasing degree of

ligamentous laxity and instability with aging. The onset of clinical symptoms can be sudden and precipitated by minor trauma, but death has also been reported [14]. Lopez et al (1964) [15] have reported that 3 patients with assimilation have had cervical pain and two had convulsions. Iwata et al. (1998) [16] have reported a case of atlanto-occipital fusion with unusual neurological symptoms. An important aspect of assimilation of atlas is that, it cannot be easily distinguished from Arnold Chiari Malformations as the patho-physiology of both is similar [11]. Even though the assimilation of atlas is the most common anomaly found in cranio-cervical junction, head and neck surgeons should be aware that such an anomaly may exist without any typical symptoms. Restriction or absence of movement in this articulation may be the first sign which attract the attention of surgeons regarding assimilation. The knowledge of assimilation may be of importance to orthopedic surgeons. It may be the cause of failure of cisternal puncture so may be of importance for anesthetist. Physiotherapist dealing with the neck pain and radiologist dealing with abnormalities of cervical spine must also be aware of this condition [11].

Conclusion:

Total or partial assimilation of the atlas may be noted, the latter being the most common. Multiple variations of partial assimilation have been reported and may involve any part of atlanto-occipital articulation. Most of the time, it exists without any typical symptom presentation but sometime may cause orthopedic problems or neurological effects.

The serious consequences of upper cervical spinal manipulation with this type of anomaly may occur which may be fatal. Therefore the knowledge of such anomaly is essential for orthopedicians, anaesthetists, and clinicians.

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*Corresponding Author: Dr. Surekha D. Jadhav Associate Professor, of Anatomy, PDVVP Medical College, Ahmednagar, 414111, (Maharashtra), India, E-mail: drsurekha_32@yahoo.in
Mobile No. - 09923373960