# POSTERIOR ARCH OF ATLAS WITH ABNORMAL FORAMINA IN SOUTH INDIANS

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## ABSTRACT

Atlas is the first cervical vertebra with a groove for the vertebral artery on the posterior arch. We found an abnormal foramina on the posterior arch. The size of the foramina were measured by sliding caliper. The vertebral artery is vulnerable to compression in its course between foramen transversarium and the foramen magnum during extreme rotation of the head and neck. This situation may be aggravated by the presence of posterior or lateral bridge of the Atlas and result in compromised blood flow. The incidence of the bony ring formed by posterior bridging has been demonstrated in Atlases of various races across the world, which varies between 1.875% to 29.2%. In an examination of twenty eight South Indian Atlases it was found in 10.7% of the cases. The presence of this bony bridging should be taken in to account during a surgical manipulation of the cervical spine.

**Key words**: Atlas, foramina, vertebral artery, posterior arch

## INTRODUCTION:

The posterior arch of Atlas vertebra bears a groove for vertebral artery and dorsal ramus of first cervical spinal nerve. The vertebral artery in its course from the foramen transversarium to the formation of basilar artery in the cranial cavity is vulnerable to damage or distortion from external factors like bony or ligamentous structures. The retro-articular canal of the Atlas vertebra (formed by posterior bridging) is one such example which may cause external pressure on the vertebral artery as it passes from the foramen transversarium of the Atlas to the foramen magnum. The retroarticular canal is formed by the bony spurs (ponticles) arising from the posterior surface of lateral mass and the posterior arch of Atlas. Many times the foramen can be incomplete. Various authors have reported in South Africans, American whites and blacks and other regions of India. Incidence of this anomalous bony ring which has been referred to as "retrolenticular vertebral artery ring" (Lamberty, 1973)[1] together with unnamed foramina in a collection of first cervical vertebrae of South Indian origin is studied here.

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## MATERIALS AND METHODS:

A collection of 28 macerated Atlas vertebrae of adult size of unknown sex but of a mixed South Indian origin has been examined for this study. The superior surface of the posterior arch of Atlas was examined close to the superior articular facet (the lateral mass) for the presence of bony bars. Wherever there was a formation of complete bony ring, the length of the bony bar and the size of the bony ring thus formed was measured to the nearest millimeter with a sliding caliper. The bony spurs in cases of incomplete rings were also measured in a similar way.

## OBSERVATION:

Out of 28 Atlas vertebrae we came across, three Atlas vertebrae with abnormal foramina on the posterior arch.

Atlas 1.

Left side complete bony ring with the incomplete ring on the right side were observed (fig.1).

Length of the left bony bar ----11mm

Diameters of the left bony ring ---- 8mm transverse, 7mm vertical

Length of the Right spicule from -- Lateral mass---- 3mm, Posterior arch---- 4mm

Atlas 2.

Bilateral incomplete bony rings. 2 spicules each from lateral mass and posterior arch were noticed bilaterally (fig. 2).

Length of the left spicules-- lateral mass----

**Figure 1:** Left side complete bony ring with the incomplete ring on the right side.

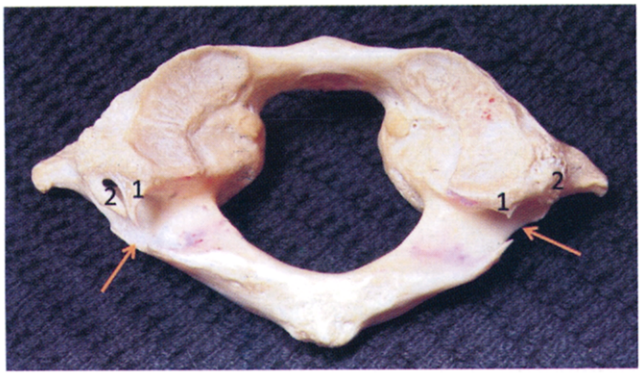


**Figure 2:** Bilateral incomplete bony rings with superior (1) and inferior (2) spicules from lateral mass. Spicules from posterior arch on either side of the arrow.

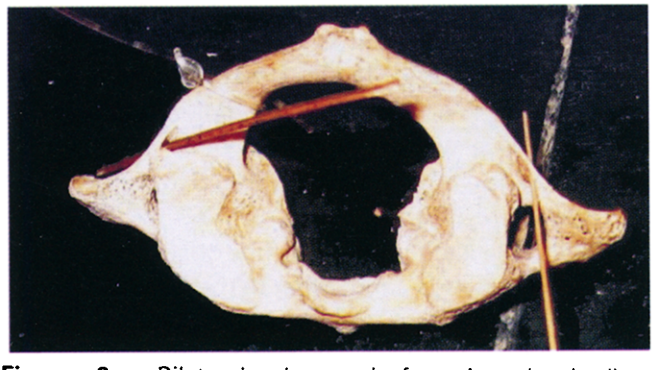

**Figure 3a:** Bilateral abnormal foramina (probed) - superior view of atlas

**Figure 3b:** Inferior view of atlas showing bilateral abnormal foramina on posterior arch

superior spicule (1)-- 5mm, inferior spicule (2)-- 7mm, Posterior arch---- One below each superior and inferior spicules and both were---- 2mm in length.

Length of the right spicules-- lateral mass---- superior spicule (1) -- 2mm, inferior spicule (2) -- 5mm. Posterior arch---- one below each superior and inferior spicules and both were---- 5mm in length.

Atlas 3.

Abnormal foramina (probed) were noticed bilaterally situated just posterior to each transverse process, on the outer aspect of the posterior arch (fig. 3 ). The foramina were of almost same size bilaterally and were smaller than the foramen transversarium. The bony bar was extending from the posterior aspect of the transverse process to the outer aspect of the posterior arch. Length of bony bars---- 7mm (both sides)

Diameters of the ring---- 3mm transverse, 2mm vertical.

The groove for the vertebral artery was normal.

## DISCUSSION :

Atlas vertebra shows the highest variability among the cervical vertebrae (Wysocki et al 2003)[2]. The reported variations of Atlas include partial or total fusion of Atlas vertebra with the occipital bone (Nayak 2008, Nayak et al 2005)[3,4]. Other recorded variations include the split superior articular process (47.8%), split posterior (3%) or anterior (1%) arches, and the presence of some accessory bony arches embracing the vertebral artery[2]. The posterior bridging of the Atlas is considered as a nonmetric trait of the infracranial skeleton (Finnegan 1978)[5].

Mechanism of formation of this bony ring is not clearly understood but a number of theories have been proposed : ossification of the connective tissue surrounding the vertebral artery, late ossification of the lower edge of the atlanto occipital membrane (Asvat 1994)[6]. Some authors have suggested that this trait is familial rather than age related (Setby et al 1995, Saunders and Popovich 1978)[7,8]. The incidence of this trait is reported as 10-14% [1,9,10]. Ossenfort found it in 12% of the American Whites and 12% of the American blacks (Asvat 1994)[6]. Taitz and Nathan (1986)[11] in their examination of Atlas vertebrae of different population groups found 25.9% with

partial bridging and 7.9% with complete ring. Asvat (1994)[6] in a study of black and white South African Atlases showed an incidence of 13.5%, of these 44.4% was bilateral and 55.5% was unilateral. Saunders and Popovich (1978)[8] have studied the incidence of this trait with 147 families and found it in 29.2%. The Atlas bridging appeared at an average age of 10.7 years.

Mitchell (1998)[12] in her study of South African Atlases could demonstrate this trait in 6% of the cases. The posterior bridging of the Atlas has also been demonstrated radiologically in 220 subjects (104 boys and 116 girls) of 8-25 years of age. The presence of a bony ring for the vertebral artery was found in 18 (8.1%) subjects (Farmann et al 1979)[13]. A few studies are available in the literature on the incidence of this trait among Indians (Pal and Routal 1987, Gupta et al 1979)[14,15]. The percentage of incidence ranges between 1.875% to 11.40%. In the present study the incidence was found to be 3 out of 28 cases (10.7%). This shows that the incidence of this trait varies with ethnic groups within a geographical area. A similar finding was demonstrated in the examination of Atlas vertebrae of different tribal groups of South Africa[6]. The foramina that we have reported here might fall under retroarticular / retrotransverse / retrolenticular vertebral artery ring in 1st and 2nd Atlas vertebrae. In 3rd Atlas vertebra the foramina is quite away from the vertebral groove, so we are not very sure about the structures passing through it since it was noted in a dry bone.

## CONCLUSION :

Vertebral artery is vulnerable to compression during extreme rotation of the head and neck, within the bony confines of the posterior bridge and result in compromised blood flow. Hence such anatomical factors should be taken in to account during a surgical manipulation of the cervical spine[12]. The knowledge of these foramina may be important for the orthopedic surgeons, radiologists, neurosurgeons, and anthropologists.

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