Research Article

Morphological and morphometrical study of transverse foramina of atlas, axis, and vertebra prominens and their clinical implications

M. Ashritha, Karthik Ganesh Mohanraj*

ABSTRACT

Introduction: Atlas is a ring of bone and consists of a lateral masses connected by a short anterior arch and a long posterior arch. The transverse processes project laterally from the lateral masses and longer than that of the other cervical vertebrae except the seventh. Axis consists of dens or odontoid process projecting superiority from its body. It acts as a pivot for rotational process of the atlas. C7 transverse foramina are small and do not transmit the vertebral artery. C7 anterior tubercle is small, possesses a cervical rib. **Materials and Methods:** A total of 40 dry human atypical cervical vertebrae were obtained from the Department of Anatomy, Saveetha Dental College and Hospitals and were evaluated. The size, shape, diameter, and localization of transverse foramina of atlas, axis, and vertebra prominens are analyzed. **Results:** From the above data, we obtain the exact measurements of the transverse foramina for atlas, axis, and C7. The right transverse foramen is larger than the left transverse foramina in atlas and axis. Similarly, the left transverse foramen is larger than the right transverse foramina in C7. The shapes of the foramina seemed to be mostly round and oval in shape. **Conclusion:** There were significant changes in the transverse foramina on the left and right side in atlas, axis, and C7. Hence, morphological structures were also determined.

KEY WORDS: Atlas, Axis, Morphometry, Odontoid process, Transverse foramina, Vertebra prominens

INTRODUCTION

The atlas is regarded to be the first cervical vertebrae, axis is the second cervical vertebrae, and C7 is the seventh cervical vertebrae. The atlas lies between the axis vertebrae and cranium. It lacks a body, spine, and even the odontoid process and, hence, articular discs and not present either superior or inferior to it. Axis has a special feature which is the odontoid process. It is important for the surgeons to know the variations of these vertebrae in interpreting computed tomography and magnetic resonance imaging scans.[1]

Morphometrical and anomalous variations are crucial for the neurosurgeons to be aware as they need to determine the etiology, vascular variations in the atlanto-occipital regions.[2] Earlier researches have told that there is a relation between the atlas morphology with the head and neck.[3] For the posterior approaches of the cervical spine are very important.[4] Atlas is formed by the anterior and posterior bars when they come across the position of the vertebral artery during the age of 3–4 years.[5]

It has also been proved that the shape and size of the foramina correlate with the tortuosity and the size of the vertebral artery, indirectly depending on the loading forces and stresses in the neck.[6] Bony erosion impedes the complete formation of the transverse foramina and causes the tortuosity of the vertebral artery.[7] It is observed that the pathological conditions occur when the shape and size of the transverse foramina have lot of variations.[8] The C7 transverse foramina do not transmit vertebral artery but instead transmit small veins.[9] The trans-articular and trans-pedicular screw fixation have been used for the cervical column stabilization.[10] The most frequent syndromes are the diseases of the spinal column at the cervical and lumbar region. It has been noticed that there had been a lot of researches regarding the odontoid process as

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Department of Anatomy, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

***Corresponding author:** Karthik Ganesh Mohanraj, Department of Anatomy, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, 162, Poonamallee High Road, Chennai - 600 077, Tamil Nadu, India. Phone: +91-9940545168. E-mail: karthikganesh.0446@gmail.com

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there are frequent fractures occurring in that area. The morphometrical parameters can be obtained from the cadavers directly.[11]

MATERIALS AND METHODS

The study involves a total of 40 dry human atypical cervical vertebrae which were used from the Department of Anatomy, Saveetha Dental College and Hospitals. These were, hence, used for evaluation. The shape, size, diameter, and the localization of the transverse foramina of atlas (C1), axis (C2), and vertebra prominens (C7) will be evaluated with the morphometrical parameters. With the help of the Vernier calipers and the rulers, the diameter and localization of the foramina are measured. All the observations were noted, tabulated, evaluated, and represented graphically.

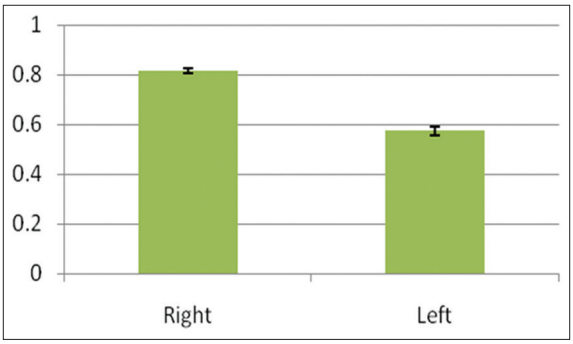

Figure 1: Diameter of the right and left transverse foramina of atlas

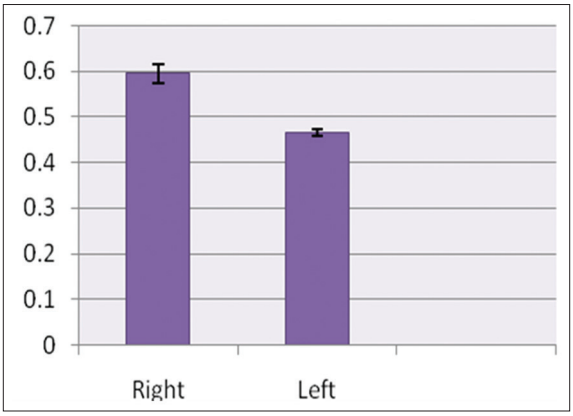

Figure 2: Diameter of the right and the left transverse foramina of axis

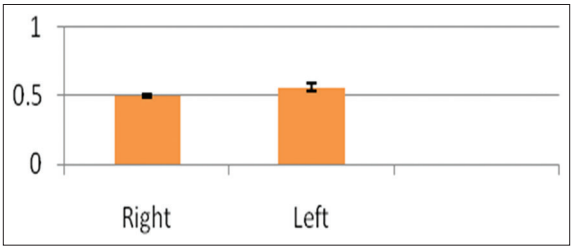

Figure 3: Diameter of the right and left transverse foramina of vertebra prominens (C7)

RESULTS

The average diameter of the right and left transverse foramina of atlas is 0.815 ± 0.011 and 0.575 ± 0.0178, respectively. The average diameter of the right and left transverse foramina of axis was 0.595 ± 0.022 and 0.465 ± 0.011, respectively. The average diameter of the right and left transverse foramina of vertebra prominens (C7) was 0.498 ± 0.010 and 0.558 ± 0.028, respectively. The analyzed data are represented graphically as bar diagram using mean ± standard deviation in Figures 1-3.

DISCUSSION

The shapes that were observed in the above specimens were found to be mostly oval or round in shape. One or two of the specimens had incomplete transverse foramina. It was noticed that the C7 has smaller foramina which indirectly indicated the absence of vertebral artery where this artery runs along the transverse process, thereby not entering into the foramen.[12]

The earlier researchers have derived that the vertebral artery covers about two-thirds of the minimum diameter of the foramen and more than half of the maximum diameter of the foramen.[13] The largest size of the foramen was observed in atlas. The incomplete foramen present in few specimens is due to the erosion of bones as the age increases.[14] Another reason for the incomplete foramina may be due to the stress and the tension caused by the running vessels passing through the foramen related to the free movements of the cervical spine.[15]

CONCLUSION

Therefore, it was observed that there were noteworthy changes on both the sides of the transverse foramina. The variations of these cervical vertebrae while operating at the level of C1 to prevent any injury or damage to the vertebral artery and hence being aware of this could prevent neurological deficit. The radiographs have knowledge of this subject to interpret the radiograph correctly in the imaging of the craniovertebral region. The spine surgeons must be careful in operating the cervical spine region so as to avoid the post-operative complications due to variations in anatomical bony structures.

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