Anatomical Variations of Foramen Transversarium of 7th Cervical Vertebrae and Its Clinical Significance

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ABSTRACT

Cervical vertebrae have a cardinal part that is a closeness of foramen transversarium and through it passes the vertebral course, vertebral vein and sharp plexus of nerves. The vertebral course enters the foramen transversarium of C6 and this way, the FT of C7, which transmits just the vein and nerve, might be near nothing or even occasionally absent. A vertebral channel may enter through C7 in 2% cases as necessities be combinations of this foramen may affect the anatomical course of vascular and neural structures, and this way may cause over the top conditions. The explanation behind the investigation was to watch the anatomical mixes in the foramen transversarium of seventh cervical vertebrae. Present work was carried on 156 dry seventh cervical vertebrae of cloud sex and age. We observed each foramen transversarium for shape, symmetry, number or accessory foramen and spicules. We observed nine different types of shape of foramen transversarium. Round shapes of foramen were present in 28.75%, accessory foramen in 28.84% and spicules in 12.17% of vertebrae also noted incomplete FT in 5 vertebrae. Disclosures of present evaluation may be helpful for a radiologist in the comprehension of X-segments, dealt with tomograms and scans for spine specialists in preoperative arranging and for blocking injury of a vertebral vessel near to sharp nerves during the careful cervical approach.

INTRODUCTION

The cervical vertebrae present important anatomical features which distinguish it from thoracic or lumbar vertebrae. One of the distinctive features of the cervical vertebrae is the presence of a foramen transversarium (FT) in the transverse process, which has anterior and posterior bars that terminate laterally as anterior and posterior tubercles. The bars are connected laterally to the foramen by the cost transverse bar (Gray et al., 2005). FT of the cervical vertebra transmits the vertebral artery (VA), vertebral vein and sympathetic fibres from the inferior cervical ganglion (Mcminn, 1994). Generally, VA enters the foramen transversarium of C6 and the FT of C7, which transmits only the vein and nerve, maybe nothing or even missing. FT of seventh cervical vertebra sometimes shows the anatomical variations such as it may be absent bilaterally or unilaterally, incomplete, small or double. Variations of FT may be one of the causes of vertebral vascular insufficiency leading to neurological symptoms like...
headache, migraine, fainting attacks (Foramen et al., 2011).

Accessory foramen transversarium (AFT) is another foramen apart from main FT in the transverse process of cervical vertebrae which is smaller in size than the primary foramen and lies posterior to the standard FT. Usually, it is found in the sixth cervical vertebra and less frequently in other cervical vertebrae (Bergman, 1988). ATF or double FT is a rare variation which may affect the course of the VA. Sometimes, the FT may show abnormal bony outgrowths (osteophytes) inside it, which may irritate the sympathetic plexus (Stręk et al., 1998). The external pressure generated by the degenerative changes in the cervical spine can produce compression of the vertebral artery (Cockerill et al., 2000). Therefore the sound knowledge of anatomy and variation details of FT is vital for surgeons and radiologist. There is a lack of studies regarding the anatomical variations of FT in the 7th cervical vertebrae and its incidence. The inspiration driving this evaluation is to find the pace of the adjustments of the FT in the seventh cervical vertebra.

**MATERIALS AND METHODS**

A total number of 156 dried seventh cervical vertebrae of unknown age and sex were collected from the students of MBBS, BDS, BPTH and bone bank of our Department of Anatomy. Vertebrae having marked deformities and damaged vertebrae were excluded from the study. Each vertebra was examined macroscopically for anatomical variations of FT. We meticulously observed the presence or absence of FT, shape, complete or incomplete FT and presence of AFT on both the side. Also, appearances of bony spicules in FT were observed. Photographs of vertebrae having variations of FT were taken.

**RESULTS**

We observed a total 306 FT (Rt. -153; Lt. - 153) as in one vertebra unilateral absence of FT, and in 5 vertebra FT was incomplete unilaterally. According to the shape and direction of the primary diameter of FT, we classified it into nine types (Table 1) (Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7). Our observations were carried out according to Taitz et al. (1978). We observed each vertebra from above in an anteroposterior direction with the body of the vertebra facing the examiner. While studying the FT of the 7th cervical vertebra, we observed four additional shapes: ‘D’ (Figure 3), Dumbbell (Figure 4), Heart (Figure 5) and irregular (Figure 6). We found symmetrical FT in 57 (38 %) vertebrae.

AFT was present in 45 (28.84%) 7th cervical vertebrae. Single AFT (Figure 2, Figure 6, Figure 8) were present in 33(21.15%) during bilateral AFT (Figure 9, Figure 10) in 12(7.69%) vertebrae. We observed unilateral absence (Figure 11) of FT in one vertebra. Spicules were observed in 19 (12.17 %) out of 156 vertebrae (Figure 8) also we observed incomplete FT in 5 vertebrae (Figure 4, Figure 10).

**DISCUSSION**

Variations in FT concerning its size, shape, number, presence or absence of foramina are common (Taitz et al., 1978) and it may affect the anatomical course of the vertebral vessels, which may cause patholog-
Table 1: Different types of foramen transversarium and their percentage

| Type of foramen          | Percentage | Total percentage |
|--------------------------|------------|------------------|
|                         | Rt.n=153   | Lt.n=153         | %              |
| Type 1 round             | 27.42(42)  | 30.06(46)        | 28.75          |
| Type 2-Elliptical (antero-posterior) | 21.56(33)  | 19.60(30)        | 20.48          |
| Type 3-Elliptical Transverse | -          | -                | -              |
| Type 4-Elliptical Oblique:rt-It | 23.52(36)  | 20.91(32)        | 22.22          |
| Type 5-Elliptical Oblique:lt-rt | 18.95(29)  | 15.68(24)        | 17.32          |
| Type 6-Semicircle ‘D’    | 4.57(7)    | 6.53(10)         | 5.55           |
| Type 7-Dumbbell          | 1.96(3)    | 1.96(3)          | 1.96           |
| Type 8-Heart             | 0.65(1)    | 0.65(1)          | 0.65           |
| Type 9-Irregular         | 0.65(1)    | 3.92(6)          | 2.28           |
| Type 10-Leaf             | 0.65(1)    | 0.65(1)          | 0.65           |

FT of the seventh cervical vertebra are very few. Many researchers have been conducting studies on random cervical vertebrae. Taitz et al. observed more number of types 4 and 5 FT in the seventh cervical vertebra, but the present study found more number of types 1 and 4 (Taitz et al., 1978). However, the current study reported ten different kinds of shapes of FT of seventh cervical vertebra (Table 1). Durge et al. studied 106 seven cervical vertebrae for presence and variations of AFT. They observed AFT in 32.35%, which is more than those found in the present study (Durge et al., 2017). Murlimanju et al. observed AFT in 1.6% typical and atypical cervical vertebrae (Murlimanju et al., 2011).
In the present study, AFT was present unilaterally in 33 (21.15%) and bilaterally in 12 (7.69%) vertebrae. Research conducted by Durge et al. observed AFT bilaterally in 15 and unilaterally in 18 vertebrae (Durge et al., 2017). It has been reported that more number of AFT was present on the left side while Durge et al. (2017) and Aggarwal and Gupta (2014) found more on the right side as compared to left. The present study observed an equal number of AFT on the right and left side. Zibis considered the anatomical courses of action of the foramen transversarium in cervical vertebrae close by the broad study. They concluded that the presence of a double foramen with disproportion in the diameter might indicate a splitting of the vertebral artery.
and it’s renewed joining (Zibis et al., 2016). Abdul et al. studied the foramen transversarium of typical (n=82) and atypical (44) cervical vertebrae. They also observed different shapes of FT of the seventh cervical vertebra as the current study (Sheik-Abdul et al., 2018). Variations observed may be because of racial and sample size used in these studies.

Durge et al. found a unilateral absence of FT in 2 seventh cervical vertebrae and bilaterally in one while present study reported unilateral absence of FT in one and did not observe a bilateral absence of FT (Durge et al., 2017). Spicules were observed in 19 (12.17 %), which may irritate the sympathetic nerve and leads to vertebra-basilar insufficiency. Literature report that when the anteroposterior diameter of FT greater than a transverse diameter, then there is less risk of vertebral artery compression syndrome. Also, it is well accepted that narrowing of FT may lead to the formation of atheromatous plaques in a vertebral artery and it may give the formation of thrombosis or emboli or reflex spasm which predisposing to vertebrobasilar insufficiency (Epstein, 1969; Foramen et al., 2011).

Findings of the present study may be helpful for a radiologist in the interpretation of X-rays, computed tomograms and scans and orthopaedic surgeon during posterior approaches of cervical spines. Knowledge about FT will significantly affect the success rates of physicians in the diagnosis and treatment of diseases associated with this region and benefit related surgical interventions by avoiding possible complications. It is essential to know the anatomical variations of FT for surgeons, neurologists, radiologists and anatomists who study and work in this region.

**CONCLUSION**

The present appraisal consolidates a wide degree of shapes and game plans of FT of seventh cervical vertebrae, some of which have not been beginning late nitty-gritty recorded as a printed rendition. It is crucial to have a precise knowledge to understand the FT and the relationship it has with vessels so that there is a greater chance of preventing poor cervical surgery outcome. VA usually enters FT of 6th cervical vertebra in 90%, but it may enter through C7 in 2% cases. Deformities and anatomic variations of the foramina affect the course of vertebral vessels and nerves, which may cause various clinically pathological symptoms. Having good knowledge of the anatomy and variations of bone structures will benefit clinical diagnosis and treatment of diseases in this region. Our study has provided a detail data about variations in shape and number of FT as well as AFT of seventh cervical vertebra, which would be useful in better understanding. Moreover, the common occurrence of variations found in FT and AFT highlights the importance of detailed preoperative radiological evaluation to rule out any of these common anatomical variations for a better surgical outcome.

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**Conflict of Interest**

Nil.

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