

Full Length Research Paper

Double foramen transversarium in cervical vertebrae: A morphological study

Ridhdhish Patel¹, Ritika Patel¹, Mital Patel²

¹P.G.Student, Department of Anatomy, M.P.Shah Govt. Medical College, Jamnagar, India.

²Professor & Head, Department of Anatomy, M.P.Shah Govt. Medical College, Jamnagar, India.

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The aim of the study was to evaluate the incidence of duplication foramen transversarium in cervical vertebrae. It may affect the course of vertebral artery which leads to neurological symptoms. The variations in incidence of duplication were important for the spine surgery and radiological approach. A total number of 865 (346 atypical and 519 typical) dried cervical vertebrae were studied in the department of anatomy, M. P. Shah Govt. Medical College, Jamnagar, Gujarat, India. Morphological examinations of all cervical vertebrae were done for incidence of duplication of foramen transversarium on both sides. The duplication of foramen transversarium was found most commonly bilateral (4.62%) than the unilateral (4.04%). The study also showed that unilateral duplication was found more on right side (2.31%) than left side (1.73%). The incidence of double foramen transversarium in typical cervical vertebrae (10.04%) was higher than the atypical cervical vertebrae (6.06%). So the present study provided useful data for the surgical and radiological diagnostic approach in cervical spine procedure.

Key words: Foramen Transversarium (FT), Accessory Foramen Transversarium (AFT), cervical vertebrae, spine surgery, morphology.

INTRODUCTION

The cervical vertebrae are the smallest of the moveable vertebrae and are characterized by a foramen in each transverse process (Figure-1). In all cervical vertebrae except seventh foramen transversarium transmits the vertebral artery, vertebral vein and a branch from the cervicothoracic ganglion (Standing S et al., 2005).

The surgical anatomy of the foramen transversarium and vertebral artery are important to the neurosurgeons and radiologists (Agrawal D et al., 2012). The variation of foramina transversarium is also important for surgeon during posterior cervical surgery (Kaya S et al., 2011).

The compression or other pathology of vertebral artery may lead to neurological symptoms and at times hearing disturbances (Chandravadiya C et al., 2013). The double foramen transversarium is a rare anatomical variation and this may affect the course of vertebral artery and may be distorted (Katikireddi RS et al., 2014).

The aim of the study was to investigate the frequency of duplication of the foramen transversarium in vertebrae and to discuss the clinical importance of this foramen.

MATERIALS AND METHODS

The present study was conducted in the department of Anatomy, M. P. Shah Govt. Medical College, Jamnagar, Gujarat. A total number of 865 dried cervical vertebrae

*Corresponding author E-mail: ridhdhish_patel@yahoo.com



Figure 1. Foramen transversarium in typical cervical vertebrae.



Figure 2. Left unilateral duplication of foramen transversarium in typical cervical vertebrae.

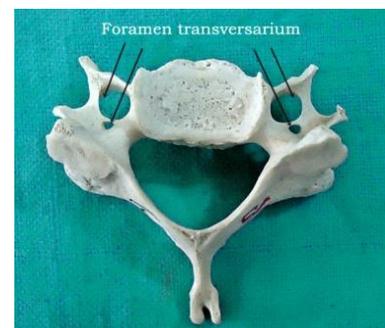


Figure 3. Bilateral duplication of foramen transversarium in typical cervical vertebrae.

were studied, out of them 557 were loose cervical vertebrae and 308 were from known male and female cervical vertebrae. The total numbers of atypical cervical vertebrae were 346 and typical vertebrae were 519. All the cervical vertebrae were examined macroscopically for the existence of the double foramen transversarium on both the sides (Figure-2,3,4 & 5). The vertebrae that had pathological changes and defective were excluded from the present study. The data were collected on a standardized collection sheet. The variant vertebrae were photographed with the digital camera.

RESULTS

Out of 865 cervical vertebrae, 75 (8.67%) vertebrae showed the accessory foramina. Among them unilateral duplication was found in 35 (4.04%) cervical vertebrae. Out of them right unilateral duplication was found in 20 (2.31%) and left duplication was found in 15 (1.73%) cervical vertebrae. While bilateral duplication was found in 40 (4.62%) cervical vertebrae. Thus, incidence of bilateral double foramen transversarium was more common than the unilateral one.

In present study, out of 865 cervical vertebrae 519 were typical. In which, duplication was found in 54 (10.40%) typical cervical vertebrae. Unilateral duplication was found in 21 (4.04%) typical cervical vertebrae, 11 (2.11%) in right side and 10 (1.92%) in left side (Figure-2). Bilateral duplication was found in 33 (6.35%) typical cervical vertebrae (Figure-3). Thus, the incidence of bilateral double foramen was higher than the unilateral in typical cervical vertebrae.

In present study, out of 865 cervical vertebrae 346 were atypical. In which, duplication was found in 21 (6.06%) atypical cervical vertebrae. Unilateral duplication was found in 14 (4.04%) atypical cervical vertebrae, 9 (2.60%) in right side (Figure-4) and 5 (1.44%) in left side. Bilateral duplication was found in 7 (2.02%) atypical cervical vertebrae (Figure-5). Thus, the incidence of unilateral double foramen was higher than the bilateral in

atypical cervical vertebrae, which was more common on right side.

The incidence of unilateral duplication in typical cervical vertebrae was 4.04% and in atypical cervical vertebrae 4.04% which was almost similar. The incidence of bilateral duplication in typical cervical vertebrae was 6.35% and in atypical cervical vertebrae 2.02%, showed higher incidence rate in typical cervical vertebrae. (Table-1)

Incidence of double foramen transversarium in known male typical cervical vertebrae were 2.63% in right unilateral and 5.92% in bilateral. While incidence of double foramen transversarium in C7 cervical vertebrae were 4.38% in right unilateral, 0.87% in left unilateral and 1.75% in bilateral.

While in known female cervical vertebrae the incidence of double foramen transversarium was found only in left unilateral typical cervical vertebrae that was 4.16%, which was absent in case of known male cervical vertebrae. It showed that the incidence of foramen transversarium in known male cervical vertebrae was higher than the female. (Table-2)

DISCUSSION

Taitz C et al. (1978) reported that the foramen transversarium transmits vertebral artery and vein in all cervical vertebrae except seventh. Since the vertebral vessels are responsible for the formation of the foramen transversarium, it can be assumed that variations in the course of the vertebral vessels will cause variation in foramen transversarium vice versa variations of the foramen transversarium can be useful in estimating the variations of the vessels. An absence of foramen transversarium could mean absence of the vertebral artery or the artery running along the transverse process and not through the foramen transversarium. A narrowing of the foramina may indicate narrowness of the vessels. Double foramen transversarium could mean duplicate



Figure 4. Right unilateral duplication of foramen transversarium in atypical cervical vertebrae (C7).

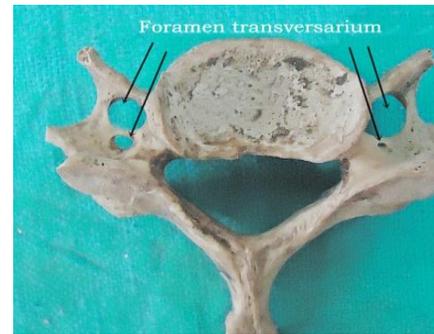


Figure 5. Bilateral duplication of foramen transversarium in a typical cervical vertebra (C7).

	No. of vertebrae examined	Vertebrae with unilateral double FT			Vertebrae with bilateral double FT	Total
		Right	Left	Total		
Typical cervical vertebrae	519	11 (2.11%)	10 (1.92%)	21 (4.04%)	33 (6.35%)	54 (10.40%)
Atypical cervical vertebrae	346	9 (2.60%)	5 (1.44%)	14 (4.04%)	7 (2.02%)	21 (6.06%)
Total	865	20 (2.31%)	15 (1.73%)	35 (4.04%)	40 (4.62%)	75 (8.67%)

Table 1. Showing the incidence of double foramen transversarium in typical and atypical cervical vertebrae unilaterally and bilaterally

vertebral arteries.

The present study showed that the incidence of double foramen transversarium was 8.67% out of 865 vertebrae. Unilateral double foramen transversarium was found in 4.04%, in which 2.31% on right side and 1.73% on left side. Bilateral double foramen transversarium was found in 4.62%. Thus the present study showed the unilateral duplication of foramen transversarium was more common than the bilateral. Taitz C et al. (1978) reported that the incidence of double foramen transversarium in 3 Vertebrae out of 480. While Archana Sharma et al.(2010)

reported that the double foramen transversarium both unilaterally and bilaterally in 16 vertebrae out of 200 cervical vertebrae.

Kaya S et al. (2011) found that double foramen transversarium was in 22.7% out of 262 study sample. The duplication was unilateral in 13.6% vertebrae and bilateral in 9% vertebrae which were similar to the present study. Divya Agrawal et al. (2012) reported that the 8 cervical vertebrae had anomalous foramen transversarium. 4 of them had double foramen transversarium unilaterally (3 on the right side) whereas in 2 cases, bilateral double foramen transversarium were present. This result was in accordance with present study. Study conducted by Laxmi chandravadiya et al. (2013) reported, the incidence of double foramen transversarium was 4.76% out of 210 cervical vertebrae among them unilateral duplication was found in 3.80% of total and bilateral duplication was found in 0.95% of total, similar to present study. Chaudhari MS et al. (2013) was in agreement with present study, who reported 23.15% double foramen transversarium out of 133 cervical vertebrae among them unilateral duplication was found in 7 typical cervical vertebrae and 7 found in 7th cervical vertebrae. Bilateral duplication was found in 5 cervical vertebrae and 3 found in 7th cervical vertebrae. Thus, unilateral double foramen was more common than bilateral one which was similar to present study. Katikireddy RS et al. (2014) observed that the incidence of double foramen transversarium was 3% out of total 100 dried cervical vertebrae. Unilateral double foramen transversarium was seen in 2% vertebrae, in which 1% on right side and 1% in left side. Bilateral double foramen transversarium was seen in 1%. B.V. Murlimanju et al. (2010) noticed that out of 363 vertebrae, only 6 (1.6%)

Gender	Type	No. of vertebrae examined	Vertebrae with unilateral double FT			Vertebrae with bilateral double FT	Total
			Right	Left	Total		
Male	Typical cervical vertebrae	152	4 (2.63%)	0 (0%)	4 (2.63%)	9 (5.92%)	13 (8.55%)
	C7 vertebrae	114	5 (4.38%)	1 (0.87%)	6 (5.26%)	2 (1.75%)	8 (7.01%)
Female	Typical cervical vertebrae	24	0 (0%)	1 (4.16%)	1 (4.16%)	0 (0%)	1 (4.16%)
	C7 vertebrae	18	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total		308	9 (2.92%)	2 (0.64%)	11 (3.57%)	11 (3.57%)	22 (7.14%)

Table 2. Showing the incidence of double foramen transversarium in typical and atypical known cervical vertebrae unilaterally and bilaterally respective to genders

vertebrae showed the accessory foramen. Only 1(0.3%) vertebrae showed the bilateral foramen and remaining 5(1.4%) had unilateral foramen. Among the unilateral cases, 4 were present on right side and only one was on left side, results were in contrast with present study. Pretty Rathnatar et al. (2013) found accessory foramen transversarium in 5.7% of total 140 vertebrae, unilateral (3.6%) being more common than bilateral (1.42%), results were in contrast with present study.

CONCLUSION

In the present study, double foramen transversarium was found in 8.76% out of 865 cervical vertebrae. The incidence of total unilateral cervical vertebrae was 4.04% and 4.62% in total bilateral cervical vertebrae. Which showed that bilateral double foramen transversarium was more common than unilateral. The study also showed that the incidence of double foramen transversarium was more common in right side (2.31%) than the left side (1.73%). The incidence of double foramen transversarium in typical cervical vertebrae (10.04%) was higher than the atypical cervical vertebrae (6.06%). Thus, the

morphological study of foramen transversarium is useful for the orthopaedicians in conducting the spine surgery and guiding radiologist in interpretation of CT scan and MRI. Therefore, the present study provided a useful set of data for the surgeon and radiologist to help them in conduction of surgical and diagnostic approach on cervical spine.

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