

ORIGINAL RESEARCH

Osteological analysis of transverse foramen in cervical vertebra**Jyoti Bhardwaj¹, Paras S. Shrimankar², Devanshi J Vaishnav³, Harsha B. Rathod⁴**¹Senior Resident, Department of Anatomy, GMERS Medical College, Morbi, Gujarat, India.²Associate Professor, Department of Anatomy, B.J. Medical College, Ahmedabad, Gujarat, India.³Tutor, Department of Anatomy, Government Medical College, Bhavnagar, Gujarat, India.⁴Assistant Professor, Department of Anatomy, B.J. Medical College, Ahmedabad, Gujarat, India.**ABSTRACT**

Background: The cervical vertebrae sharing one common characteristic feature of transverse foramen affecting each transverse process. **Materials and Methods:** A total of 782 cervical vertebrae (Typical-494 & Atypical-288) of unknown age and sex were analysed to see double transverse foramen collected from Anatomy Department, B.J. Medical College, Ahmedabad. **Results:** Out of 782 cervical vertebrae, the double transverse foramen were found in 70 (9%) vertebrae. Among those 70 cervical vertebrae, 47 (6%) vertebrae were typical and 23 (3%) were atypical cervical vertebrae. Out of 47 typical vertebrae 32 (4.1%) vertebrae presented unilateral double transverse foramen with 23 (3%) on right side and 9 (1.2%) on left side. 15 (2%) typical cervical vertebrae were noted with bilateral double transverse foramen. Among 23 atypical cervical vertebrae 4 (0.5%) atlas (C₁) vertebrae were having unilateral double transverse foramen with 2 (0.3%) on right side and 2 (0.3%) on left side. There were no bilateral double transverse foramen on atlas vertebrae. 19 (2.4%) seventh cervical vertebrae (C₇) showed double transverse foramen, among which 14 vertebrae were having unilateral double transverse foramen with 4 (0.5%) on right side and 10 (1.3%) on left side. Remaining 5 (0.6%) seventh cervical vertebrae presented bilateral double transverse foramen. No double transverse foramen were found on axis vertebrae (C₂). **Conclusion:** Presence of double transverse foramen in cervical vertebrae can lead to neurological and hearing disabilities as they are related with vertebral artery variations. The variation is important for neurosurgeons and radiologists and anatomists. **Key words:** Cervical vertebrae, double transverse foramen, vertebral artery.

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INTRODUCTION

The cervical vertebrae, seven in number have one common characteristic feature of transverse foramen affecting each transverse process.¹ The transverse foramen is a result of the special formation of cervical transverse process. It is formed by the vestigial costal element fused to the body and the true transverse process of the vertebrae. The transverse process is closed laterally by the costo-transverse bar, a thin plate of bone connecting the rib element to the original transverse process.² These foramina transmit vertebral artery, vertebral vein and sympathetic fibres from the inferior cervical ganglion except seventh cervical vertebra which transmits only vertebral vein.³ These foramina are known to have

variations with respect to the shape, size and number which may lead to complaints like headache, migraine, fainting, blackout due to low blood pressure in the vertebral artery and vertebrobasilar insufficiency.⁴ Its surgical anatomy and morphology is useful to the operating spine surgeons during screw fixation procedures and to radiologists while doing CT and MRI.

MATERIALS AND METHODS

The present study was conducted in the department of Anatomy at B.J. Medical College, Ahmedabad. A total number of 782 cervical vertebrae (Typical - 494, Atypical - 288) of unknown age and sex were collected and observed for the presence of double transverse foramen on both sides. Defective bones were excluded from the study. Vertebrae with double transverse foramen were photographed. The data was compiled and analysed.

RESULT

Out of 782 cervical vertebrae, the double transverse foramen were found in 70 (9%) vertebrae. Table-1 is showing that among those 70 cervical vertebrae, 47 (6%) vertebrae were typical and 23 (3%) were atypical cervical vertebrae. Out of 47 typical vertebrae 32 (4.1%) vertebrae presented unilateral double transverse foramen with 23 (3%) on right side and 9 (1.2%) on left side. 15 (2%) typical cervical vertebrae were noted with bilateral double transverse foramen. Among 23 atypical cervical vertebrae 4 (0.5%) atlas (C₁) vertebrae were having unilateral double transverse foramen with 2 (0.3%) on right side and 2 (0.3%) on left side. There were no bilateral double transverse foramen on atlas vertebrae. 19 (2.4%) seventh cervical vertebrae (C₇) showed double transverse foramen, among which 14 vertebrae were having unilateral double transverse foramen with 4 (0.5%) on right side and 10 (1.3%) on left side. Remaining 5 (0.6%) seventh cervical vertebrae presented bilateral double transverse foramen. No double transverse foramen were found on axis vertebrae (C₂). Therefore, unilateral double transverse foramen were more common than bilateral double transverse foramen. Also typical cervical vertebrae with right sided unilateral double transverse were in majority.

Table 1: Distribution of double transverse foramen in various cervical vertebrae

Type	Unilateral double transverse foramen		Bilateral double transverse foramen	Total
	Right	Left		
Atlas	2 (0.3%)	2 (0.3%)	-	4 (0.51%)
Axis	-	-	-	-
Typical	23 (3%)	9 (1.2%)	15 (2%)	47 (6.01%)
C ₇	4 (0.51%)	10 (1.3%)	5 (0.6%)	19 (2.4%)
Total	29 (3.7%)	21 (2.7%)	20 (2.6%)	70 (9%)

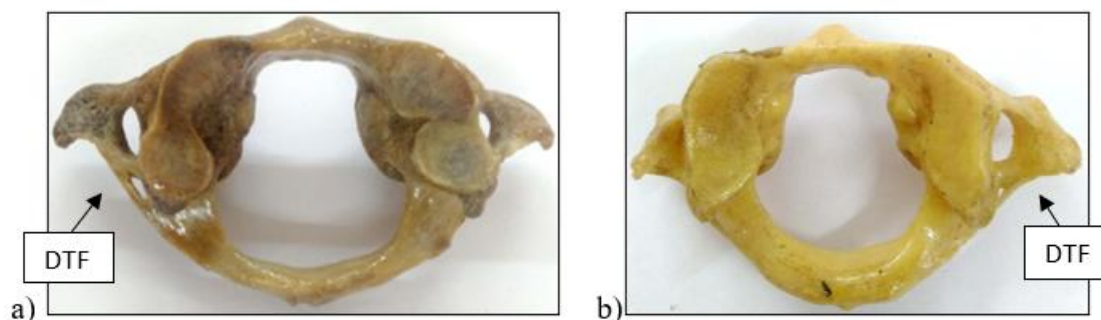


Figure 1: Atlas vertebrae showing unilateral double transverse foramen (DTF)
a) left side b) right side

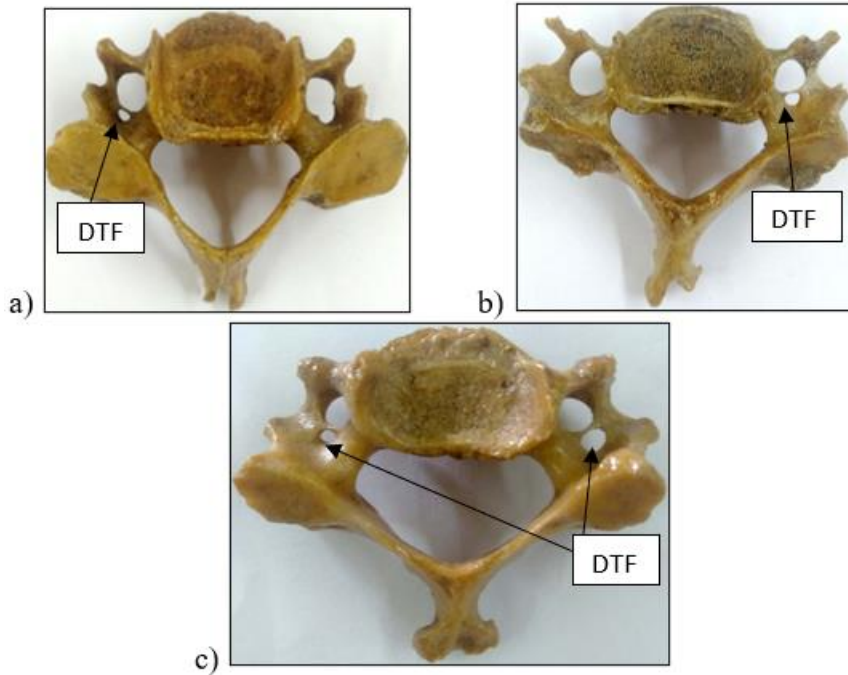


Figure 2: Typical cervical vertebrae showing unilateral double transverse foramen (DTF) a) left side, b) right side, c) bilateral double transverse foramen

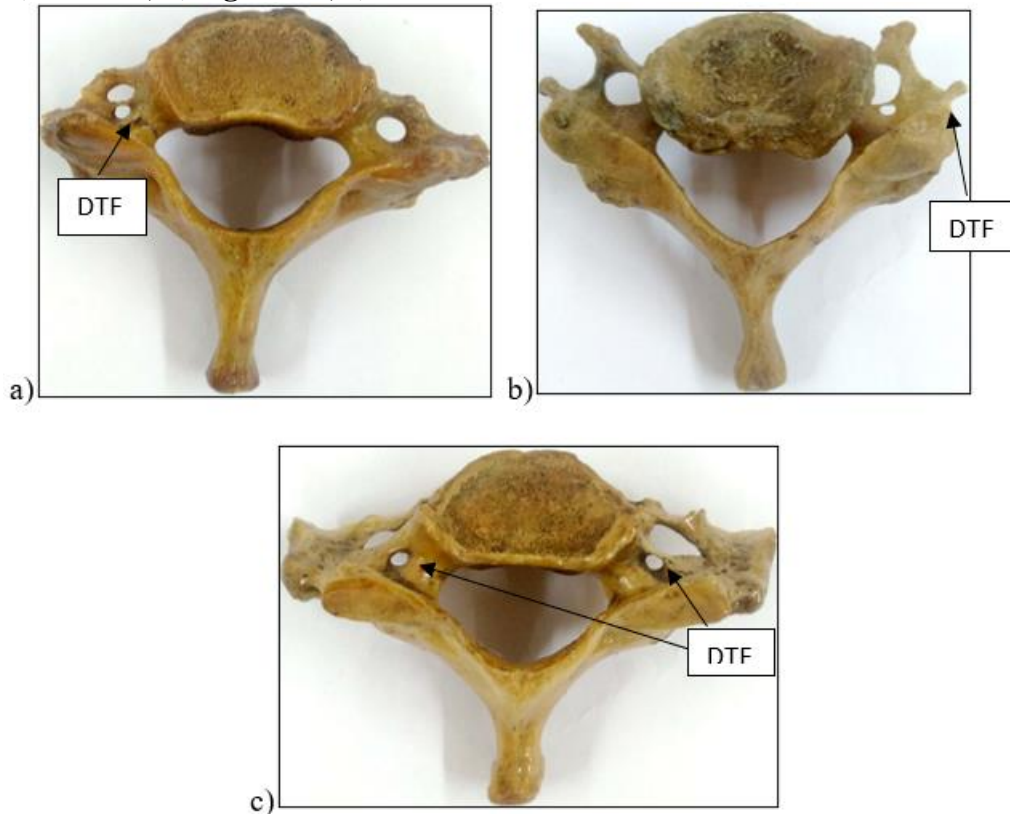


Figure 3: C₇ vertebrae showing unilateral double transverse foramen (DTF) a) left side, b) right side, c) bilateral double transverse foramen

DISCUSSION

Double transverse foramen is also known as “foramen transversarium bipartitia”.⁴ Variations (Absence, duplication or narrowing) in the course of vertebral vessels may lead to variations in these transverse foramina and vice-versa. The vertebral vessels supply the cervical part of the spinal cord, spinal ganglion, meninges and duramater in the posterior cranial fossa.⁵ The present study showed 70 vertebrae with double transverse foramen out of 782 cervical vertebrae. Among these 70 vertebrae, unilateral double transverse foramen were found in 50 (6.4%) vertebrae and bilateral double transverse foramen found in 20 (2.6%) vertebrae. These observations showed that unilateral double transverse foramen is more common than bilateral double transverse foramen which is similar to all previous studies except Sharma et al⁷ and Patra et al⁹. In the current study, cases of typical cervical vertebrae with double transverse foramen were more on right side as compared to left side. No significant observations seen with atypical cervical vertebrae. Taitz et al² showed that double transverse foramen found only in 34 (7%) cervical vertebrae. Das et al⁶ has reported only 2 cases of double transverse foramen among 132 cervical vertebrae.

Table 2: Comparison of studies about incidence of double transverse foramen

Authors	Total no. of cervical vertebrae	Total Vertebrae containing double transverse foramen	Unilateral double transverse foramen	Bilateral double transverse foramen
Taitz et al ²	480	7%	-	-
Das et al ⁶	132	1.5%	-	-
Sharma et al ⁷	200	8%	3.5%	4.5%
Chandravadiya et al ⁸	210	4.76%	3.8%	0.95%
Chaudhary et al ⁵	133	23.15%	14.73%	8.42%
Rathnakar et al ³	140	5.7%	3.6%	1.42%
Patra et al ⁹	150	22%	10.67%	11.33%
Akhtar et al ⁴	174	14.36%	11.49%	2.87%
Present study (2019)	782	9%	6.4%	2.6%

CONCLUSION

In our study we analysed the presence of double transverse foramen in 70 cases, among which unilateral double transverse foramen were more common than the bilateral double transverse foramen. The anatomy and morphology of transverse foramen is clinically significant as the compression or other pathology may lead to neurological symptoms and at times hearing disturbances.⁵ Understanding of this type of variation is important for the neurosurgeons and radiologists during diagnostic and therapeutic interventions. These variations also provide educational benefit to anatomists.

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