

Research Article

# Anatomical Variations in Foramen Transversarium of Typical Cervical Vertebrae and Clinical Significance

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**Abstract**

**Objectives:** To observe anatomical variations in the foramen transversarium of typical cervical vertebrae.

**Methods:** We studied 220 dry typical (C3-C6) cervical vertebrae of both sexes. During our study we excluded all broken/damaged cervical vertebrae and observed the variations of foramen transversarium present in both transverse processes of each cervical vertebra.

**Results:** We found double foramen transversarium in 31 (14.09%) vertebrae. Among these 21(9.54%) vertebrae were having bilateral and 10 (4.54%) vertebrae had unilateral double foramen transversarium. In the case where the foramen transversarium was double, one was main foramen transversarium and other was accessory foramen transversarium. We also found and noted variations in accessory foramen transversarium like bilateral and complete, bilateral but incomplete, unilateral complete, unilateral incomplete and these were observed in 18(8.1%), 3(1.3%), 6(2.7%), 4(1.8%) vertebrae respectively.

**Conclusions:** Anatomical knowledge of these variations are helpful for spine surgeons in preoperative planning and for preventing injury of vertebral vessel along with sympathetic nerves during cervical surgical approaches.

**Keywords:** Typical Cervical Vertebrae, Foramen Transversarium, Variations, Accessory Foramen, Vertebral Vessel

## 1. Introduction

There are 7 cervical vertebrae in the neck. All of the cervical vertebrae are having a typical feature that is presence of a foramen bilaterally in their transverse process and so named as foramen transversarium. Foramen transversarium gives way to vertebral artery, vertebral vein and a sympathetic plexus of nerves around them. Among these cervical vertebrae typical cervical vertebrae is the term given to those vertebrae having a typical bifid spine along with foramen transversarium, and first two C1, C2 and last one C7 are atypical cervical vertebrae. The deformation and variations of this foramen may affect the anatomical course of vascular and neural structures, and consequently may cause pathological conditions. Double FT or "FT bipartite" is a rare condition and is seldom reported in the literature<sup>1</sup>. Variations in foramen transversarium are predicting the variation in course and branching pattern of vertebral artery, vein and sympathetic nerves. The objective of present study to observe variations in foramen transversarium of typical (C3-C6) cervical vertebrae.

## 2. Materials & Methods

220 dry typical cervical vertebrae (C3-C6) of both sexes were obtained from the Department of Anatomy, Career Institute of Medical Sciences and Hospital, Lucknow, Uttar Pradesh. During our study we excluded all broken/damaged cervical vertebrae and observed the variations of foramen transversarium present in both transverse process of each cervical vertebra.

## 3. Results

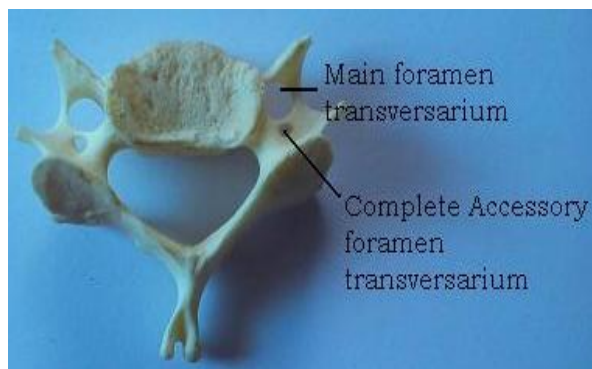
We studied the foramen transversarium of 220 dried typical cervical vertebrae (C3-C6) and found double foramen transversarium in 31 (14.09%) vertebrae. Among them 21(9.54%) vertebrae (Figure 1&2) had bilateral and 10 (4.54%) vertebrae (Figure 3,4) had unilateral double foramen transversarium. In the double foramen transversarium one which is larger is main foramen transversarium and other, smaller is accessory foramen transversarium. We also observed variations in accessory foramen transversarium and our finding shown in table 1.

**Table 1: Showing study on accessory foramen transversarium of typical cervical vertebrae.**

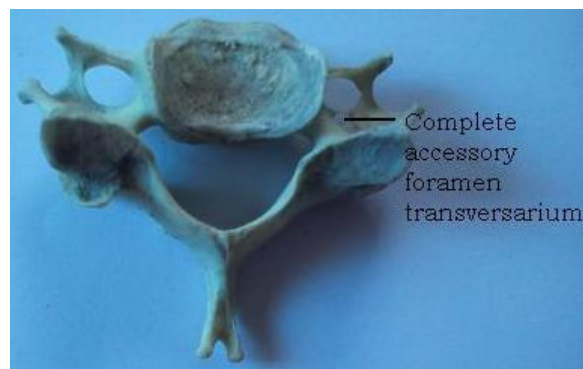
Accessory foramen transversarium		Present study	Figure No.
Vertebrae with AcFT		31(14.09%)	1,2,3,4
Vertebrae with bilateral AcFT	Complete	18(8.1%)	1
	Incomplete	3(1.3%)	2
Vertebrae with unilateral AcFT	Complete	6(2.7%)	3
	Incomplete	4(1.8%)	4

AcFT- Accessory foramen transversarium.

**Figure 1: Showing bilateral complete accessory foramen transversarium**



**Figure 3: Showing unilateral complete accessory foramen transversarium.**



**Figure 2: Showing bilateral incomplete accessory foramen transversarium.**



**Figure 4: Showing unilateral incomplete accessory foramen transversarium.**



#### 4. Discussion

Anatomical variations in foramen transversarium of cervical vertebrae have been reported by Aydinoglu *et al*<sup>1</sup>, Das *et al*<sup>2</sup>, Kaya *et al*<sup>3</sup>, Agrawal *et al*<sup>4</sup>, Murugan *et al*<sup>5</sup>, Taitz *et al*<sup>6</sup>, Sharma *et al*<sup>7</sup>, Murlimanju *et al*<sup>8</sup>, Chandravadiya *et al*<sup>9</sup>, and Rathnakar *et al*<sup>10</sup>. Investigated 222 cervical vertebrae and found that the frequency of bilateral duplication of foramen transversarium was 6.7%<sup>1</sup>. Duplication of foramen transversarium was reported by Das *et al* and Kaya *et al* in 1.5% and 22.7% cervical vertebrae respectively<sup>2,3</sup>. A study of 160 typical cervical vertebrae reported bilateral double foramen transversarium was found in 2(1.25%) vertebrae and unilateral double foramen transversarium was found in 4 (2.5%) vertebrae<sup>4</sup>. In the study conducted by Murugan *et al* on 150 cervical vertebrae, 19 (12.6%) vertebrae were found to have double foramen transversarium<sup>5</sup>. Out of the 19 vertebrae, 15(10%) vertebrae were typical and 4(2.6%) were atypical cervical vertebrae. Double foramen transversarium could mean duplicate vertebral arteries<sup>6</sup>.

In our study we found 31(14.09%) vertebrae with double foramen transversarium. Among these 21(9.54%) vertebrae were with bilateral and 10 (4.54%) vertebrae were with unilateral double foramen transversarium. A study of 200 typical cervical vertebrae reported accessory foramen transversarium in 16(8%) vertebrae. Among them 9(4.5%) vertebrae with bilateral and 7(3.5%) vertebrae with unilateral accessory foramen transversarium<sup>7</sup>. We also observed the variations in accessory foramen transversarium of cervical vertebrae and compared our observation with past studies by other Authors<sup>7,8,9,10</sup> shown in table 2.

**Table 2: Showing comparative study on accessory foramen transversarium of cervical vertebrae. AcFT- Accessory foramen transversarium**

Accessory foramen transversarium		Sharma <i>et al</i> (2010)	Murlimanju <i>et al</i> (2011)	Chandravadiya <i>et al</i> (2013)	Rathnakar <i>et al</i> (2013)	Present study
Vertebrae with AcFT		16(8%)	6(1.6%)	10(4.76%)	8(5.7%)	31(14.09%)
Vertebrae with bilateral AcFT	Complete	9(4.5%)	1(0.3%)	2(0.95%)	3(2.14%)	18(8.1%)
	Incomplete					3(1.3%)
Vertebrae with unilateral AcFT	Complete	7(3.5%)	5(1.4%)	8(3.8%)	4(2.8%)	6(2.7%)
	Incomplete				1(0.7%)	4(1.8%)

We studied 220 typical cervical vertebrae and found 9.54% vertebrae with bilateral and 4.54% vertebrae with unilateral double foramen transversarium. We also found variations in accessory foramen transversarium. Knowledge of these findings is helpful for spine surgeons in preoperative planning and prevents injury of vertebral vessels along with sympathetic nerve during cervical surgery approach.

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