

## Study of Accessory Foramen Transversarium in Cervical Vertebrae

Shital T. Shah\*, Kiran Arora\*, Kanan P. Shah\*\*

### Abstract

**Introduction:** Foramen transversaria are located on transverse processes of each cervical vertebra and transmit the vertebral artery, vertebral vein, and sympathetic nerves. These foramina are known to exhibit variations in size, shape and numbers and may be absent, incomplete or duplicate, which may lead to various symptoms. Their etiology is related with the variations in the course of vertebral artery due to developmental reasons. **Objective:** The present study was conducted to find the incidence of accessory foramina transversaria in the cervical spine. The recognition of these variations provide accurate and safety for the posterior surgical approaches of the cervical spine. **Methodology:** 210 dry cervical vertebrae of both sexes were studied in the Department of Anatomy, GCS Medical College, Ahmedabad. During our study we excluded all broken, damaged cervical vertebrae and observed the variations of foramen transversarium both in right and left transverse process of each cervical vertebra. **Result:** Variations in foramina were found unilaterally as well as bilaterally. 34 (16.19%) out of total 210 vertebrae studied presented accessory foramen transversarium. **Conclusion:** Variations in foramina may indicate, the variation in course of vertebral artery. The present study has important clinical implications for head and neck and vascular surgeons and radiologists

**Key Words:** Foramen transversarium, cervical vertebrae, accessory foramen transversarium-unilateral, bilateral

### Introduction

Foramen transversaria are located on transverse processes of each cervical vertebrae and transmit the vertebral artery, vertebral vein, and sympathetic nerves. These foramina are known to exhibit variations in size, shape and numbers and may be absent, incomplete or duplicate, which may lead to various symptoms. Their etiology is related with the variations in the course of vertebral artery due to developmental reasons. The recognition of these variations provide accurate and safety for the posterior surgical approaches of the cervical spine.<sup>(1)</sup>

The cervical vertebrae are characterized by the presence of foramen transversarium on their transverse processes. The foramen transversarium transmits the vertebral artery, vertebral vein and sympathetic fibers from inferior cervical ganglion.<sup>(2)</sup> Foramen transversarium of C<sub>7</sub> vertebra transmits only the vertebral vein. The foramen transversarium develops because of special development of cervical transverse

process, vestigial costal elements fuse with the body & true transverse process of vertebra. It displays anterior and posterior roots or bars which terminate laterally as anterior and posterior tubercle. The roots are connected laterally to the foramen by intertubercular lamellae of bone.<sup>(3)</sup> Double foramina transversarium is a rare condition and this type of variation may affect the course of vertebral artery. Variation in the number and size of foramen transversarium of cervical vertebra may result in headache, migraine and fainting attacks due to compression of vertebral artery. The vertebral vessels in such situations may give rise to vascular insufficiency.<sup>(4)</sup> Surgical anatomy and morphology is useful to the operating spine surgeons and radiologist while doing computed tomography and magnetic resonant imaging scans. Maintaining the vertebral artery is an important concern during cervical spine surgeries since even minor lesions will lead to serious hemorrhage or death. There are anatomical studies under taken to minimize such accidental intra operative lesions of these arteries.<sup>(5)</sup> The objective of the present study was to find the incidence of accessory foramina transversaria in the cervical spine.

### Methodology

210 cervical vertebrae of human of both the sexes were studied from Department of Anatomy, GCS Medical

\* Assistant Professor, Department of Anatomy, GCS Medical College Hospital & Research Centre, Ahmedabad, Gujarat, India

\*\* Associate Professor, Department of Anatomy, Smt.NHL Municipal Medical College, Ahmedabad, Gujarat, India.

Correspondence : smittusharshah@gmail.com

College, Ahmedabad. Number of foramen transversarium present on transverse process of all these vertebrae were observed macroscopically and photographed. The data was tabulated and analysed.

**Results**

34 out of total 210 vertebrae selected for the study presented accessory foramen transversarium.

Unilateral Accessory Foramen Transversarium: Found in 20 out of 34 cases of accessory foramen. Out of that complete foramen transversaria were present in 12 vertebrae and incomplete foramen in 8 vertebrae. Out of 12 cases of complete accessory foramen transversaria, 4 were present on the right side and 8 were present on the left side. Similarly, out of total 8 cases of incomplete accessory foramen transversaria, 6 were found on the right side and 2 on the left side. (Table 1).

**Table 1: Details of unilateral accessory foramen transversarium**

Unilateral accessory foramen transversarium		
Accessory Foramen Transversarium	Right	Left
Complete (Total 12)	4	8
Incomplete (Total 8)	6	2
Total	10	10



UNILATERAL COMPLETE (RIGHT) ACCESSORY FORAMEN TRANSVERSARIUM



UNILATERAL INCOMPLETE (RIGHT) ACCESSORY FORAMEN TRANSVERSARIUM



BILATERAL COMPLETE ACCESSORY FORAMEN TRANSVERSARIUM



BILATERAL INCOMPLETE ACCESSORY FORAMEN TRANSVERSARIUM

Bilateral Accessory Foramen Transversarium: Found in 14 out of 34 cases of accessory foramen. Out of that complete accessory foramen transversaria on both sides were found in 10 cases. In 3 cases, the foramen were found to be complete on one side and incomplete on other side (Table 2). Incomplete accessory foramen transversaria on both sides were found in 1 cases only and the foramen was posterior side. Complete variety was further divided into anterior and posterior depending upon their position on transverse process. The anterior variety was found in 2 cervical vertebrae and posterior variety was found in 8 cases.

**Table 2: Details of 3 Mixed (both complete and incomplete) type of accessory foramen**

Mixed (complete & incomplete accessory foramen transversarium)		
ALL POSTERIOR(TOTAL-3)		
No. of Vertebrae\	Right	Left
2	Incomplete	Complete
1	Complete	Incomplete

**Discussion:**

In our study accessory foramen transversaria were found in 34(16.19%) cervical vertebrae out of 210 total vertebrae studied. Unilateral accessory foramen transversaria were found in 20(9.52%) cervical vertebrae. In 12 vertebrae, the accessory foramen transversaria were complete. In 8 vertebrae, accessory foramen transversaria were incomplete. Bilateral accessory foramen transversaria were found in 14(6.67%) cervical vertebrae.

The vertebral vessels are responsible for formation of the foramen transversarium. It can be assumed that variations in the course of vertebral vessels will cause variation in foramen transversarium. In the same manner, variation of foramen transversarium can be useful in estimating the variations of vessels. Narrowing of foramina may indicate narrowness of vessels. Double foramen transversarium could mean duplication of vertebral artery.<sup>(6)</sup> More so, the accessory foramina may be present to compartmentalize the contents of foramen transversarium. El Shaarway et al<sup>(7)</sup> observed that accessory foramen transversaria were more common in lower cervical vertebrae mostly in C6.

Das Srijit<sup>(8)</sup> reported two cases of double foramen transversarium in 132 human cervical vertebrae. C Tatizet Al<sup>(6)</sup> (1978) studied 36 spines and reported 34 vertebrae which were having double foramen transversarium. Jarostaw Wysocki et al<sup>(9)</sup> studied 100 vertebral column and reported divided foramen most frequent at the level of vertebra C<sub>6</sub> (45.6%) and rarest at the level of vertebra C<sub>3</sub> (2.8%). Accessory foramen transversarium were reported in lower cervical vertebra mostly in C<sub>6</sub> (70%).

Anatomically, the foramen transversarium is described to be divided by fibrous or bony bridge separating the artery and the vein.<sup>(10)</sup> Mostly we found large anterior and the small posterior (that enclose a branch of inferior cervical ganglion and vertebral vein) foramen is called as accessory foramen. The vertebral nerve ascends from the stellate ganglion up to the level of C3, two branches from this nerve are formed running towards the sixth spinal nerve, and one of these branches passes through the foramen transversarium.<sup>(11)</sup> Double foramen transversarium may be correlated by duplicate vertebral artery. Bifid or duplicate origins of vertebral artery have

been reported.<sup>(12)</sup> Duplication implies that a vessel has two origins that follow a more or less parallel course for a variable distance. The vertebral artery is developed from the fusion of the longitudinal anastomosis which links the cervical inter segmental arteries that branch off from the dorsal division of somatic inter segmental artery in the neck region. These inter segmental arteries eventually regress except for the seventh artery which forms the proximal portion of the subclavian artery and beginning of the vertebral arteries. Sim et al.<sup>(13)</sup> described that sometimes there occur failure of the controlled regression of this portion of the primitive dorsal aorta along with the two inter segmental arteries which lead to the double origin and duplication of the vertebral arteries. The bilateral occurrence of these failures is the reason behind the bilateral duplication of the vertebral arteries.<sup>(14)</sup> Since the vertebral vessels are the factors behind the formation of foramen transversaria, it can be assumed that the variations in the presence and course of the vertebral arteries will manifest as variations of the foramen transversaria. In contrast, variations in foramen transversaria can be useful in estimating variations of the vessels.<sup>(14)</sup>

**Conclusion:**

Out of 210 cervical vertebrae, we found accessory foramen transversarium in 34 vertebrae. It is found that unilateral accessory foramen transversaria are more common which is followed by the bilateral occurrence that is in accordance with the previous studies. The anatomy and morphology of foramen transversarium is useful to the operating spine surgeons and radiologists in the interpretation of radiographic films.<sup>(15)</sup> Compression or spasm of the vertebral artery is manifested not only by neurological symptoms but also by hearing disturbances.

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