



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

Manoj P Ambali^{*1}, Surekha D Jadhav²

¹Department of Anatomy, Krishna Institute of Medical Sciences, Deemed University, Karad - 415110, Maharashtra, India

²Department of Anatomy, Dr Vitalrao Vikhe Patil Foundation's Medical Collage, Ahmednagar - 414111, Maharashtra, India

Article History:

Received on: 25 May 2020

Revised on: 27 Jun 2020

Accepted on: 29 Jun 2020

Keywords:

Foramen
Transversarium,
Seventh cervical
Vertebrae,
Accessory Foramen,
Vertebral Artery,
Vertebral Vein

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.

*Corresponding Author

Name: Manoj P Ambali

Phone: +91 9890959798

Email: ambman65@rediffmail.com

ISSN: 0975-7538

DOI: <https://doi.org/10.26452/ijrps.v11i3.2791>

Production and Hosted by

IJRPS | www.ijrps.com

© 2020 | All rights reserved.

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 vertebrae 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 %)

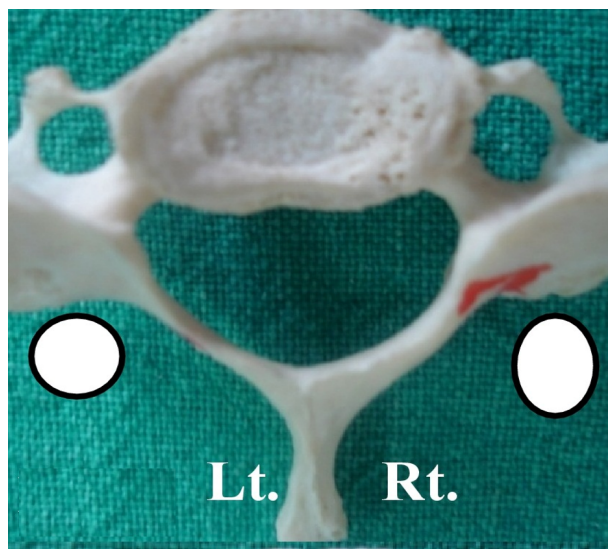


Figure 1: Showing Type1 (Round) and Type 2 (Elliptical - antero-posterior) foramen transversarium

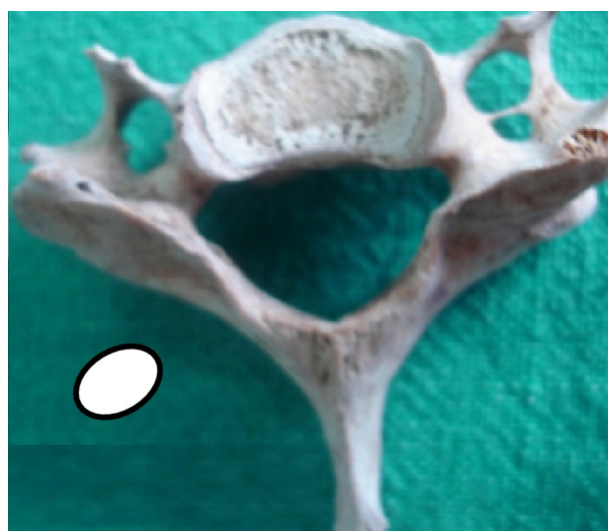


Figure 2: Showing Type 4 (Elliptical- oblique: rt-lt) & Accessory Foramen Transversarium (AFT) foramen transversarium

vertebrae.

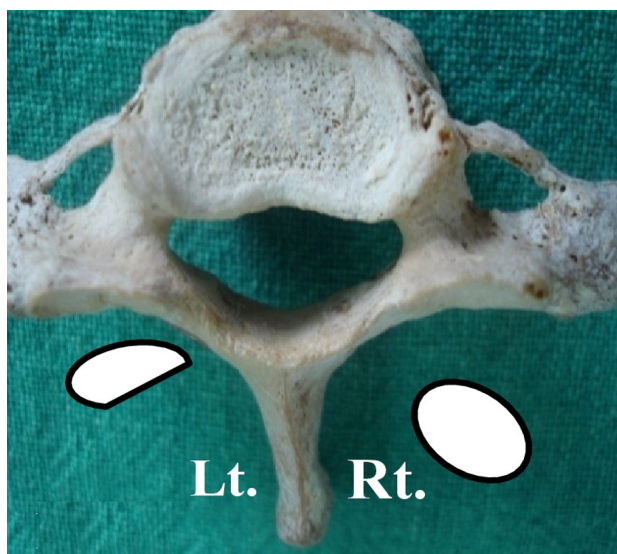
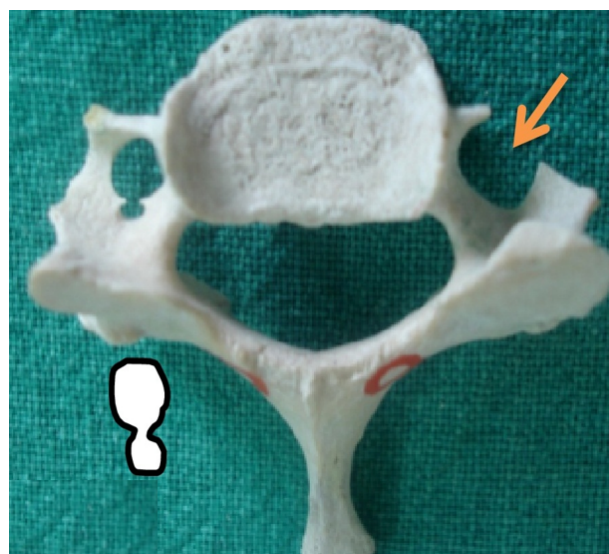
AFT was present in 45 (28.84%) 7th cervical vertebrae. Single AFT (Figure 2, Figure 6, Figure 8) were present in 33(21.15%) during bilateral AFT (Figure 9, Figure 10) in 12(7.69%) vertebrae. We observed unilateral absence (Figure 11) of FT in one vertebra. Spicules were observed in 19 (12.17 %) out of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

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-lt	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

**Figure 3: Showing Type Elliptical (oblique: Lt-rt) and Type 6 (Semicircle/ 'D') foramen transversarium****Figure 4: Showing Type 7 (Dumbbell) and Incomplete foramen transversarium**

et al., 1978) and it may affect the anatomical course of the vertebral vessels, which may cause pathological conditions like vertebra-basilar insufficiency. It happens due to the weight of vertebral deftly course during neck types of progress and outlined by neck torment, cerebral torment, migraine and passing out catch (Foramen *et al.*, 2011). The FT is formed by the fusion of coastal element of cervical transverse processes with a transverse part of developing vertebra. During this process, vertebral vessels and sympathetic nerve are trapped between these two processes. Hence, the course of vertebral vessels plays an essential role in the formation of FT (Murlimanju

et al., 2011).

Works of literature describing the detailed study of 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 vertebrae (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).



Figure 5: Showing Type 8 (Heart) foramen transversarium

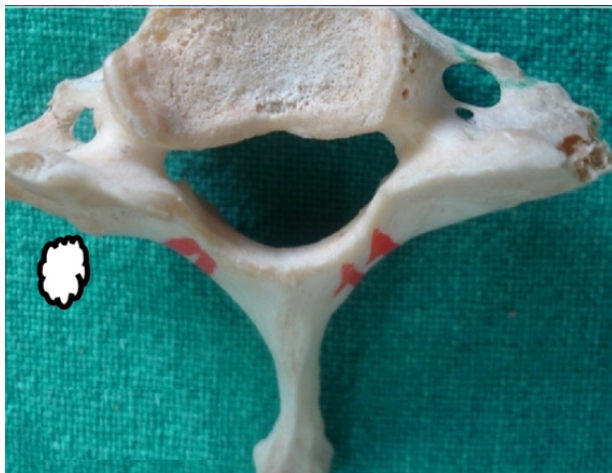


Figure 6: Showing Type 9 (Irregular) & Accessory Foramen Transversarium (AFT)

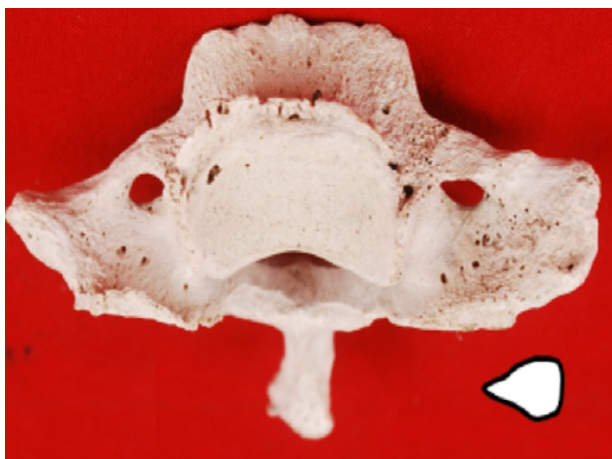


Figure 7: Showing Type 10 (Leaf) Foramen Transversarium

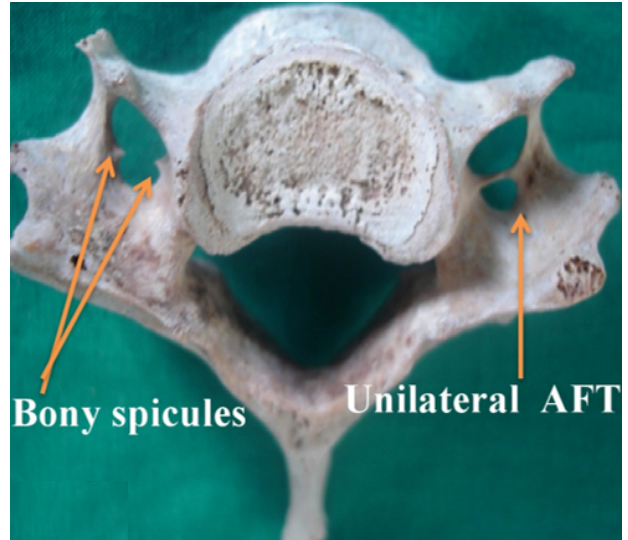


Figure 8: Showing bony spicules in left Foramen Transversarium & on right side unilateral Accessory Foramen Transversarium(AFT)

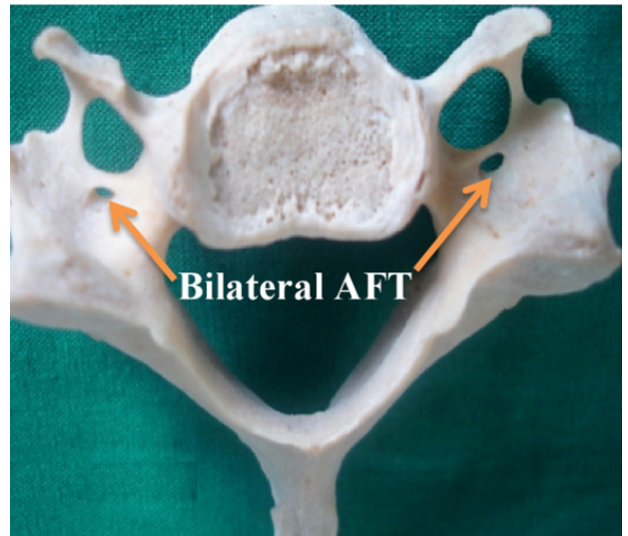


Figure 9: Showing bilateral Accessory Foramen Transversarium (AFT)

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

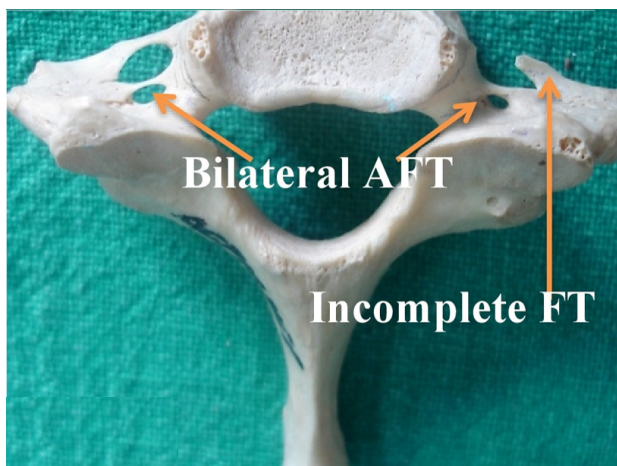


Figure 10: Showing bilateral Accessory Foramen Transversarium (AFT) & incomplete Foramen Transversarium

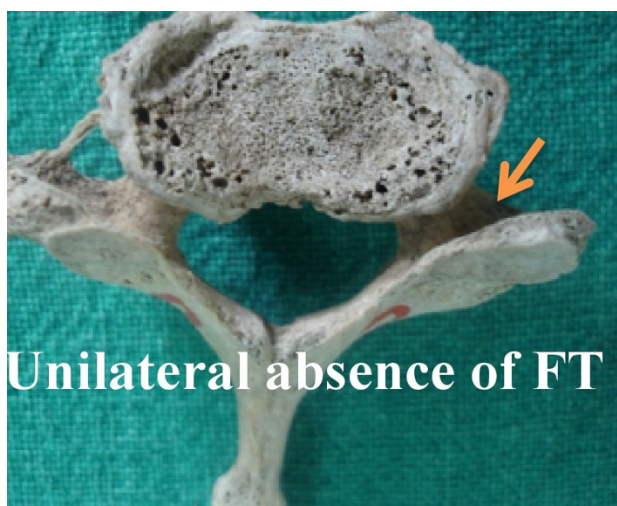


Figure 11: Showing unilateral absence of Foramen Transversarium

of a double foramen with disproportion in the diameter might indicate a splitting of the vertebral artery and its 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 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 vertebrae 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.

ACKNOWLEDGEMENT

Nothing to report.

Conflict of Interest

Nil.

Source of funding

Self.

REFERENCES

- Aggarwal, B., Gupta, M. 2014. Variations of foramen transversarium in seventh cervical vertebra. *International Journal of Basic and Applied Medical Sciences*, 4:258-262.
- Bergman, R. A. 1988. Compendium of human anatomic variation: text, atlas, and world literature. Urban & Schwarzenberg.
- Cockerill, W., Ismail, A. A., Cooper, C., Matthis, C., Raspe, H., Silman, A. J. 2000. Does location of vertebral deformity within the spine influence back pain and disability? . *Annals of the Rheumatic Diseases*, 59:368-371.
- Durge, S. V., Durge, N. W., Gosavi, S. R. 2017. Study on variations of Foramen Transversarium in 7th cervical vertebrae in the region of Andhra Pradesh - A clinical approach. *IP Indian J Anat Surg Head Neck Brain*, 3(1):21-23.
- Epstein, B. S. 1969. The spine: a radiological text and atlas. *The spine: a radiological text and atlas*, pages 730-730.
- Foramen, E. B. S. V. Ç., Varyasyonu, T., Sonucu, A. B. Ç. Ö. 2011. Double foramen transversarium variation in ancient byzantine cervical vertebrae: preliminary report of an anthropological study. *Turkish neurosurgery*, 21(4):534-538.
- Gray, H., Standring, S., Ellis, H., Berkovitz, B. K. B. 2005. The anatomical basis of clinical practice. Elsevier Churchill Livingstone.
- Mcminn, R. M. H. 1994. Last's anatomy regional and applied . In *Head and Neck and Spine*, Edinburg, London. Churchill Livingstone. Pages 523.
- Murlimanju, B. V., Prabhu, L. V., Shilpa, K., Rai, R., Dhananjaya, K. V. N., Jiji, P. J. 2011. Accessory transverse foramina in the cervical spine: incidence, embryological basis, morphology and surgical importance. *Turkish Neurosurgery*, 21(3):384-387.
- Sheik-Abdul, R., Lazarus, L., Rennie, C., Satyapal, K. S. 2018. The Foramen Transversarium of Typical and Atypical Cervical Vertebrae: Morphology and Morphometry. *International Journal of Morphology*, 36(4):1439-1446.
- Stręk, P., Reroń, E., Maga, P., Modrzejewski, M., Szybist, N. 1998. A possible correlation between vertebral artery insufficiency and degenerative changes in the cervical spine. *European Archives of Oto-Rhino-Laryngology*, 255(9):437-440.
- Taitz, C., Nathan, H., Arensburg, B. 1978. Anatomical observations of the foramina transversaria. *Journal of Neurology, Neurosurgery & Psychiatry*, 41(2):170-176.
- Zibis, A. H., Mitrousias, V., Baxevanidou, K., Hantes, M., Karachalios, T., Arvanitis, D. 2016. Anatomical variations of the foramen transversarium in cervical vertebrae: findings, review of the literature, and clinical significance during cervical spine surgery. *European Spine Journal*, 25(12):4132-4139.