

Morphometric Analysis and Incidence of Accessory Foramen Transversarium in a Population in Eastern Turkey

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ABSTRACT

The aim of this study is to reveal the incidence and morphometric features of the accessory foramen transversarium in the population in eastern Turkey. In the study, a total of 125 cervical vertebrae of unknown gender and age, located in the Anatomy Department of Ataturk, Erzincan Binali Yıldırım and Kafkas University Medical Faculties, were used and accessory foramen transversarium was detected in 22 (17.6 %) of these cervical vertebrae. In this study, the area, vertical and horizontal diameters of the accessory foramen transversarium were measured for the first time. It was determined that the accessory foramen transversarium with the largest area was in C3-C6 (6.8 mm²) and the smallest area was in C7 (1.06 mm²). It was determined that the largest vertical diameter was C7 (2.38 mm), the smallest one was C3-C6 (0.91 mm), the largest horizontal diameter (3.66 mm), and the smallest (1.6 mm) were C3-C6. In addition, accessory foramen transversariums were typified. One foramen arcuate was also detected during the examinations. As a result, osteometric measurements of the accessory foramen transversarium were revealed. We think that these data will be an important reference in head and neck surgery, in the clinical approach of a. vertebralis, and in the evaluations of radiologists in the neck region.

KEYWORDS: Accessory foramen transversarium, Cervical vertebra, Foramen arcuate

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INTRODUCTION

There are 7 cervical vertebrae in the cervical part of the columna vertebralis. One of the most important features that distinguishes cervical vertebrae from other vertebrae is that they have foramen transversarium. Although the foramen transversarium is always present in the first six cervical vertebrae, sometimes the foramen transversarium is absent in the 7th cervical vertebra or it is seen as divided into two by a thin bone. From the foramen transversarium of the first six cervical vertebrae a. vertebralis, v. vertebralis and plexus sympathicus pass, while only v. vertebralis from the 7th cervical vertebra passes, and therefore the foramen transversarium of the 7th cervical vertebra is small¹⁻³. Embryological factors, variations in the a. vertebralis and pathological conditions in the anatomical structure of the spine may cause differences in the anatomical structure of the foramen transversarium. One of the anatomical variations seen in the foramen transversarium is the accessory foramen

transversarium⁴⁻⁵. Accessory foramen transversarium can be found in different numbers and shapes, unilateral or bilateral, below or above the foramen transversarium^{6,7}. Such variations in the foramen transversarium may cause neurological disorders such as vertebrobasilar insufficiency, headache, migraine, and fainting attacks. Numerous studies have been conducted on both the foramen transversarium and the accessory foramen transversarium in different populations⁸⁻¹¹. However, there is no study in the literature that includes the area, morphometric features and typing of the accessory foramen transversarium as in this study. The aim of this study is to reveal the incidence and osteometric features of the accessory foramen transversarium.

MATERIALS AND METHODS

This study was carried out on a total of 125 cervical vertebrae of unknown gender and age, located in the Anatomy Department of Ataturk, Erzincan Binali Yıldırım and Kafkas

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University Medical Faculties, located in the east of Turkey. Cervical vertebrae were divided into four groups as C1, C2, C3-C6 and C7. In the study, first of all, cervical vertebrae with accessory foramen transversarium were detected. Accessory foramen transversariums in these cervical vertebrae were examined and photographed (Figs. 2 and 3).

The photographs taken were transferred to Image J and the horizontal and vertical diameters and areas of the accessory foramen transversarium were measured (Fig 1). The study of Sheik Abdul et al. ⁵ was taken as reference for typing accessory foramen transversariums.

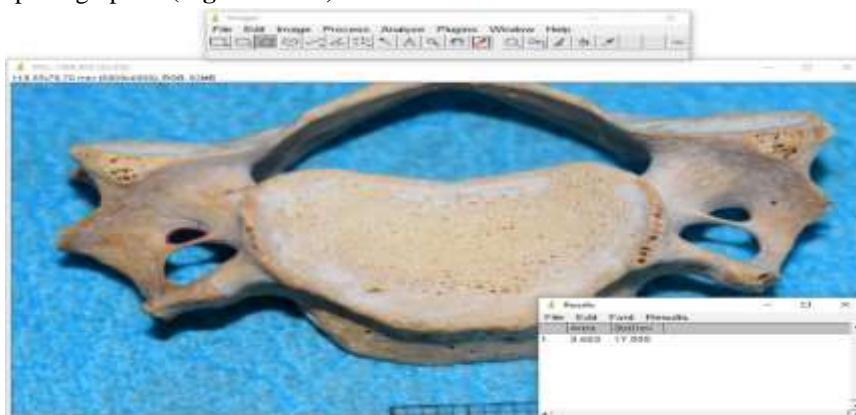


Fig 1. Image J measurement

RESULTS

A total of 125 typical and atypical cervical vertebrae were analyzed in the study, and accessory foramen transversarium was detected in 22 (17.6 %) of these vertebrae. One arcuate foramen was also observed in C1 (atlas) (Fig 2.). The area,

vertical and horizontal diameters of this arcuate foramen were measured as 7.34 mm², 1.88 mm and 4.66 mm, respectively. Accessory foramen transversarium was detected in 3 (13.63%) of 22 C1s, 15 (28.3%) of 53 C3-6s, and 4 (25%) of 16 C7s (Tablo I) .

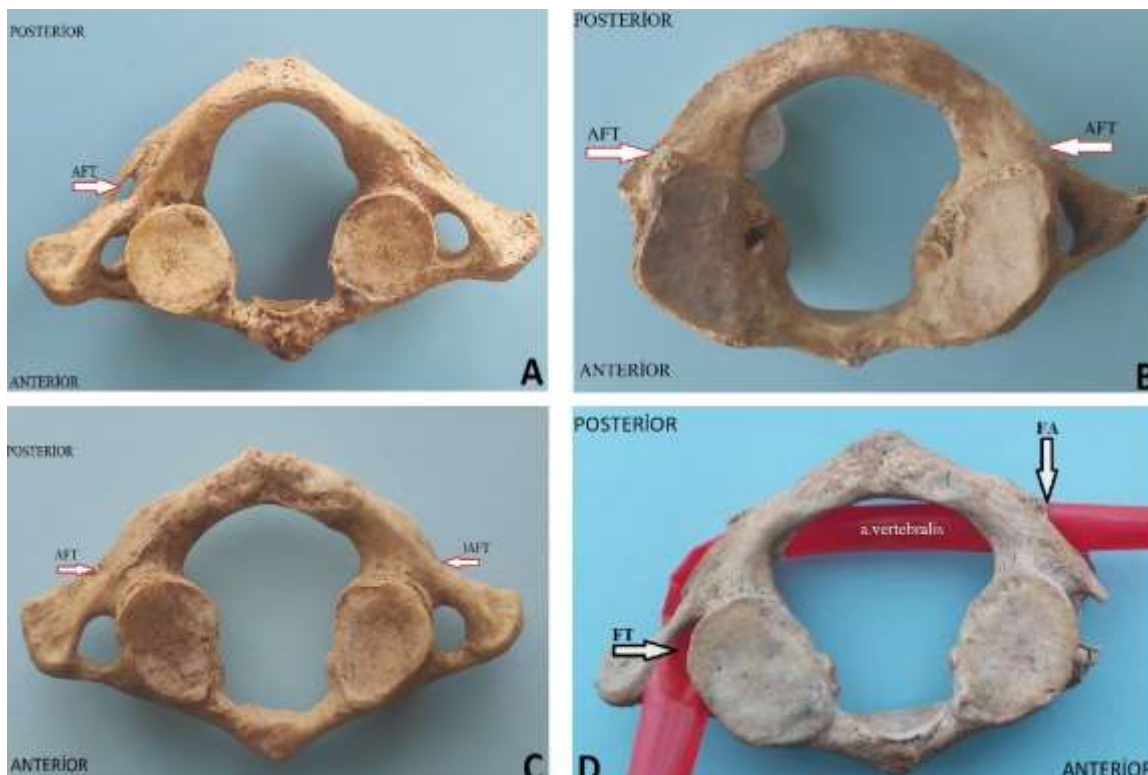


Fig 2. 1.cervical vertebrae (atlas). FT: Foramen transversarium, AFT: Accessory foramen transversarium, IAFT: Incomplete accessory foramen transversarium, FA: Foramen arcuate

Accessory foramen transversarium was not detected in 18 C2 specimens. Among the cervical vertebrae with accessory foramen transversarium, it was determined that the largest area was in C3-C6 (6.8 mm²) and the smallest one was in C7 (1.06 mm²). Among the cervical vertebrae with accessory

foramen transversarium, the largest vertical diameter is in C7 (2.38 mm), the smallest vertical diameter is in C3-C6 (0.91 mm), the largest horizontal diameter (3.66 mm) and the smallest (1.6 mm) was detected in C3-C6 (Tablo II).

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Table I. Location of accessory foramen transversariums in cervical vertebrae

Vertebrae	N	AFT	Single	Double	Incomplete	Complete
C1	22	3 (% 13.63)	1 (%4.54)	2 (% 9.09)	1 (% 4.54)	4 (% 18.18)
C2	34	-	-	-	-	-
C3-6	53	15 (% 28.3)	7 (% 13.2)	8 (%15.09)	5 (%9.43)	18 (% 33.96)
C7	16	4 (%25)	3 (% 18.75)	1 (%6.25)	2 (%12.5)	3 (% 18.75)

Table II. Osteometric measurements of accessory foramen transversariums in cervical vertebrae

Vertebrae	Area (mm ²)		Horizontal diameter (mm)		Vertical diameter (mm)	
	Max	Min	Max	Min	Max	Min
C1	2.38	1.24	2.59	1.87	0.97	0.82
C3-6	6.8	1.39	3.66	1.6	2.25	0.91
C7	4.01	1.06	3.4	1.72	2.38	1.75

A total of 33 foramen, 11 single and 11 double, were detected in the cervical vertebrae with accessory foramen transversarium. It was determined that the number of incomplete holes was 8 and the number of complete holes was

25 (Fig 3.). Most holes were observed in C3-C6. C3-C6 cervical vertebrae were found to have both double and single, complete and incomplete holes.

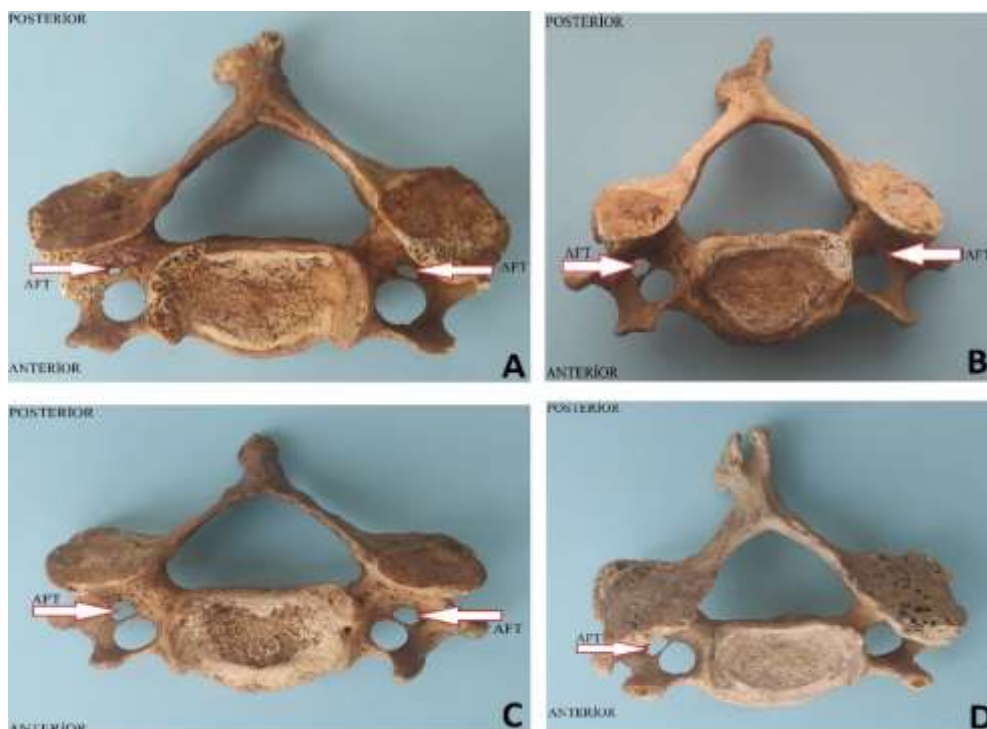


Fig 3. Cervical vertebrae. Accessory foramen transversariums AFT: Accessory foramen transversarium

When the accessory foramen transversariums were examined in terms of shape, it was observed that 10 of them were elliptical, 8 of them were double bubble, 7 of them were round, 3 of them were leaf, 2 of them were irregular, 2 of them were triangular and 1 of them was rectangular.

DISCUSSION

Human development in the embryological period should always be carefully followed. Especially in osteological development, the structure of holes, notches and crevices in the bones and the variations in the vessels and

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nerves passing through these anatomical formations should be well known by all physicians. One of these osteological variations is the accessory foramen transversarium.

The incidence of accessory foramen transversarium was determined by Das et al. ¹, 1.5%, Taitz et al. ¹¹, 7%, Sharma et al. ¹², 8%, Chaudhari et al. ¹³, 23.15%, Chandravadiya et al. ¹⁴, 4.76%, Mishra et al. ¹⁵, 14.09%, Gujar et al. ⁷, 27.33%. In our study, the incidence of accessory foramen transversarium was determined as 17.6%.

Chaiyamoon et al. ¹⁶, in their study on the Thai population, determined the incidence of unilateral, bilateral and trilateral accessory foramen transversarium as 8.41%, 25.33%, and 1.87%, respectively, in the atlas. In the study conducted by Aziz and Morgan ¹⁷ in the Egyptian population, the incidence of accessory foramen transversarium in the atlas was determined as 17.7%. In the study conducted by Rekha and Neginhal ¹⁸ on the South Indian population detected 6.54% accessory foramen transversarium. In our study, 4.54% of the atlases were unilateral and 9.09% of them were bilateral accessory foramen transversarium. Trilateral accessory foramen transversarium was not observed in the atlases analyzed in our study.

Cirpan et al. ¹⁹ found foramen arcuate in two of 13 atlases and stated the average of the area of these holes as 28.58 mm². Keser et al. ²⁰, in their study on 10 cadavers, detected 3 foramen arcuate, one bilateral and two unilateral. They measured the average height and length of these foramen arcuates as 6 mm and 6.75 mm, respectively. In our study, foramen arcuate was detected in one of 22 atlases, and the area, vertical and horizontal diameters of this arcuate foramen were measured as 7.34 mm², 1.88 mm and 4.66 mm, respectively. Accessory FT was not observed in a total of 18 dens analyzed in our study.

Medeiros et al. ⁹, found the incidence of accessory foramen transversarium to be 21.82% in the Northeastern Brazil population. This accessory stated that 59.6% of the foramen transversariums were incomplete and 40.4% were complete. According to Gujar et al. ⁷, detected the incidence of accessory foramen transversarium as 21.82%. They stated that 19.5% of these accessory foramen transversariums were incomplete and 80.5% were complete. Abdul et al. ⁵, firstly, they divided the cervical vertebrae into two parts as typical and atypical and found the complete rate of typical vertebrae to be 6.10% and 3.66% to atypical vertebrae. In the same study, they found the rate of incomplete in typical vertebrae to be 7.32%, and the rate of incomplete in atypical vertebrae as 8.54%. In our study, while the incidence of complete was determined as 18.18% in C1, 33.96% in C3-C6 and 18.75% in C7, the incidence of incomplete was determined as 4.54%, 9.43% and 12.5% in C1, C3-C6 and C7, respectively.

While 11 of the 22 accessory foramen transversarium in our study were found to be bilateral and 11 of them unilateral, this distribution was respectively determined by Rathnakar et al. ²¹, 3.6% and 1.42%,

Ramachandran et al. ²², 8.3% and 7.5%, Aggarwal and Gupta ²³, 17.24 % and 15.51%, Patil et al. ²⁴, 3.42% and 2.28%, Patra et al. ²⁵, 10.67% and 11.33%, Akhtar et al. ²⁶, 11.49% and 2.87%.

CONCLUSION

As a result, in this study, vertical and horizontal osteometric measurements, especially the area, of the accessory foramen transversarium were revealed. Knowing the morphological details of such variations will provide important contributions to both clinicians and radiologists in approaching clinical cases related to the head and neck. In addition, we think that this information obtained about the cervical vertebrae will shed light on future studies.

AUTHOR CONTRIBUTIONS

Conceptualization: YA, ABKT and BY Data acquisition: YA and ABKT Data analysis or interpretation: YA and MS Drafting of the manuscript: YA, ABKT and MS Approval of the final version of the manuscript: all authors

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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