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Original Research Article

AN OSTEOLOGICAL STUDY ON MORPHOMETRY OF FORAMEN TRANSVERSARIUM OF SUB AXIAL VERTEBRAE AND ITS VARIATIONS

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ABSTRACT

Introduction: Cervical vertebrae are having foramen transversarium in their transverse process. Foramen transversarium's dimensions and its variations are important for clinicians while handling vertebro basilar insufficiency cases and also useful for spinal surgeons in spinal decompression procedures like foraminectomy, foraminotomy

Materials & Methods: The present study was done in 90 sub axial vertebrae (C_3 to C_7) which was collected from Rajah Muthiah Medical College, Chidambaram. Among 90, 56 were typical type and 34 were seventh cervical vertebrae. Damaged vertebrae were excluded. Antero posterior length, transverse length & depth of foramen transversarium were measured using double tipped compass and digital vernier caliper. Double foramens and absent foramens were noted.

Result: The average antero posterior length of foramen transversarium of typical cervical vertebrae and seventh cervical vertebrae were 5.45 mm ± 0.12 mm and 5.66 mm ± 0.88 mm respectively. The average transverse length of foramen transversarium of typical and seventh cervical vertebrae was 6.72 mm ± 0.22 mm and 6.76 mm ± 0.08 mm respectively.

Conclusion: Anatomical knowledge on the dimensions of foramen transversarium and its variations are important for clinicians and neurologists for the various clinical conditions and spinal decompression procedures.

KEY WORDS: Double foramen transversarium, Bubble shaped foramen transversarium, sub axial cervical vertebrae.

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INTRODUCTION

Cervical vertebrae are unique as they have foramen transversarium(FT) in their transverse process. The foramen transversarium is formed by fusion of costal element with body and true transverse process of vertebrae [1].

Due to variations in the formation, Double FT, Bubble shaped FT may occur. The FT gives passage to vertebral artery, veins and sympathetic plexus; usually vertebral artery does not pass

through 7th cervical vertebrae's FT because of its developmental difference. Vertebral artery developed by fusion of longitudinal anastomosis of cervical inter segmental arteries. Inter segmental part regresses except the 7th Inter segmental one [2].

The posterior part of brain depends on the circulation of basilar artery which in turn formed by fusion of two vertebral arteries. The vertebral artery has tortuous course. It originates from 1st part of subclavian artery and ascends through the foramen transversarium of all cervical vertebrae except C_7. Then it curves behind the lateral mass of atlas and ascends through foramen magnum accesses the cranial cavity.

The dimensions of foramen transversarium are very important for foraminotomy procedures, where IV disc or a bony spur is pressing on a nerve as it exits through the foramen, a foraminotomy may be done. This is making the opening of the foramen larger, so the nerve can exit without being compressed.

A narrowing of the foramina indicates narrowness of vessels (Chaudhari ML[3] et al). So these variations in the foramen size, double foramen transversarium causes vertebro basilar insufficiency during head rotation .These causes vertigo, giddiness, headache in those patients. Our present study will give detailed knowledge about dimensions and variations of foramen transversarium. This will be useful for neurologists in various spinal fixation and decompression procedures. This will also be useful for clinicians and radiologists to interpret radiological images.

MATERIALS AND METHODS

90 Dry sub axial cervical vertebrae (C_3 - C_7) were collected from Rajah Muthiah Medical College, Chidambaram. Damaged, malformed and fractured vertebrae were excluded from the study. 180 Foramen transversarium of two sides of 90 vertebrae has been taken for study. Among 90 vertebrae 56 belongs to typical type; 34 belongs to seventh cervical vertebrae. All the foramen transversarium were observed for any anatomical variations. The antero posterior length, transverse length and depth of the Foramen transversarium were measured using double tipped compass and digital vernier caliper and double tipped compass.

RESULTS

Fig. 1: Dimensions of foramen transversarium of a typical cervical vertebra.

APL – Antero posterior length TL – Transverse length

Fig. 2: Bubble shaped foramen transversarium of a seventh cervical vertebra.

Fig. 3: Double foramen transversarium of a typical cervical vertebra.

Foramen transversarium of both sides of 90 sub axial vertebrae were studied. The antero posterior length, transverse length and depth of foramen transversarium of both sides have been measured (Figure 1). The average anteroposterior length of foramen transversarium of typicalcervical vertebrae and seventh cervical vertebrae were 5.45 mm ± 0.12 mm and 5.66 mm ± 0.88 mm respectively (table 1 and table 2). The average transverse length of foramen

transversarium of typical cervical vertebrae and seventh cervical vertebrae were 6.72 mm ± 0.22 mm and 7.06 mm ± 0.08 mm respectively (Table 1 and Table 2).The depth of foramen transversarium of typical cervical vertebrae and 7th cervical vertebrae were 3.37 mm ±0.8 mm and 2.93 mm ± 0.6 mm respectively (Tab. 1 and Tab. 2).

Table 1: Dimensions of foramen transversarium of typical cervical vertebrae.

Parameter (in millimeter)	Right Side (mean ± sd)	Left Side (mean ± sd)
Transverse length	6.72 ± 0.22	6.66 ± 0.42
AP Length	5.45 ± 0.12	5.56 ± 0.48
Depth	3.37 ± 0.8	3.45 ± 0.75

Table 2: Dimensions of foramen transversarium of seventh cervical vertebrae.

Parameter (in millimeter)	Right Side (mean ± sd)	Left Side (mean ± sd)
Transverse length	6.76 ± 0.08	6.78 ± 0.48
AP Length	5.66 ± 0.88	5.55 ± 0.72
Depth	2.93 ± 0.6	2.98 ± 0.45

Table 3: Comparison of prevalence of double foramen transversarium in various studies.

Name of Author	Sample Size	Unilateral Double FT(%)	Bilateral Double FT(%)	Total Double FT(%)
Riddhish patel et al [4]	865	4.04	4.62	8.67
Murali Manju et al [5]	363	1.04	0.3	1.7
Vivek singh malik et al [6]	300	12.33	8.81	21.14
Chaudhari MI et al [3]	95	14	8	22
Present study	90	4.44	6.66	11.11

There was no significant difference between right and left side.

The incidence of double foramen transversarium (Figure 3) on both sides of typical cervical vertebrae was noted in 5.5% of cases. The incidence of double foramen transversarium on both sides of seventh cervical vertebrae were noted in 1.11% of cases. Absent foramen transversarium on left side of seventh cervical vertebrae were noted in 4.44% of cases. Unilateral bubble shaped foramen transversarium of typical vertebrae were noted in 7.77% of cases. Unilateral bubble shaped foramen transversarium of seventh cervical vertebrae were noted in 4.44% of cases. Bilateral bubble shaped foramen transversarium of typical vertebrae were noted in 1.11% of cases. Bilateral bubble shaped foramen transversarium (Figure 2) of seventh cervical vertebrae were noted in 3.33% of cases.

Absence of foramen transversarium on one side of typical cervical vertebrae were noted in 2.2%of cases. Absence of foramen transversarium on one side of seventh cervical vertebrae were noted in 4.4%of cases.

DISCUSSION

Morphometry of foramen transversarium of cervical vertebrae are important for spinal surgeons during decompression procedures like foraminectomy, foraminotomy.

The posterior part of brain depends mainly on two vertebral arteries for their circulation. These vertebral arteries are tortuous in course. They are unequal in size in about 75% of cases [7]. Stenosis of vertebral artery with head rotation causes vertebro basilar insufficiency results in Bow- Hunter's stroke [8].

Many Authors have studied the dimensions of foramen transversarium using CT, dry specimens [9,10]. Present study showed that the average APL of foramen transversarium in typical cervical vertebrae was 5.45 mm ± 0.12 mm. The Average APL of foramen transversarium in seventh cervical vertebrae was 5.66 mm ± 0.88 mm. It was in variance with Yesender et al study [11]. According to Yesender et al the average TL of Foramen transversarium in typical vertebrae was 4.88 mm ± 0.70 mm [11].

Present study showed that average TL of foramen Transversarium of typical cervical vertebrae and seventh cervical vertebrae were 6.72 mm ± 0.22 mm, 6.76mm ± 0.08 mm respectively. These varied with previous studies.

In Richa Gupta et al study [10], the average APL of foramen transversarium was minimum at C_3, Maximum at C_6. Transverse length of foramen transversarium was minimum at C_3 and maximum at C_5. But in the present study AP length of foramen transversarium was minimum at C_3 and maximum at C_4, transverse length of foramen transversarium was minimum at C_6 and maximum at C_7. There results varied from previous study.

According to Riddish et al [5] study, double foramen transversarium on both sides of typical cervical vertebrae were found in 10.4% of cases. In the present study it was found in 5.55% of cases. Duplication of foramen transversarium in

atypical cervical vertebrae was about 6.06% of cases. But in the present study it was found in 1.11% of cases.

In murali manju et al [5] study, out of 363 typical & atypical cervical vertebrae presented, an double foramen transversarium found in 1.6% vertebrae. In present study double foramen transversarium on both sides of typical cervical vertebrae was found in 5.55% of cases. Double FT on both sides of seventh cervical vertebrae was found in 1.11% of cases. These results were varied with previous study.

Presence of accessory FT observed in this present study represents further clinical importance of abnormal transverse foramen morphology. Duplications of extra cranial vertebral artery have been reported in previous studies [12-15]. Primitive dorsal aorta does not regress together with two inter segmental arteries that connect to the vertebral artery; this arrangement may give rise to duplication of vertebral artery [16].

Failure of occlusion of inter segmental arteries may be responsible for duplication of vertebral artery carry more risk of thrombus formation & embolization [7].

In present study 4.44% of specimens of C_7 did not have FT on one side,2.22% of specimens of typical cervical vertebrae did not have FT on one side. These results were in concurrence with previous studies.

In present study bubble shaped FT (both unilateral and bilateral) of typical cervical vertebrae were observed in 8.8% of cases. Bubble shaped FT(both unilateral and bilateral) of seventh cervical vertebrae were observed in 7.77% of cases. The narrowing of FT may cause vertebro basilar insufficiency and thrombus formation especially with head rotations. The narrowing may be due to cervical spondylosis (ketan R [18] et al). Symptomatic vertebral artery stenosis may be caused by osteophytes that compresses the vertebral artery anteriorly from uncinate process or posteriorly from facet complex [19].

Translaminal screwing during spinal fixation surgeries may decreases the size of FT in lower cervical spine level.

CONCLUSION

In present study there are many variations found in FT dimensions. These results will be useful for various spinal surgeries like spinal fixation procedures, decompression procedures. This also be helpful for orthopaedicians and neuro physicians to interpret the vertebro basilar insufficiency cases.

ABBREVIATIONS

FT - Foramen transversarium
APL - Antero posterior length
TL - Transverse length.

Conflicts of Interests: None

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