Research Article

Morphological and morphometrical analysis of typical cervical vertebrae and their clinical implications

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ABSTRACT

Introduction: This study is to analyze the morphological and morphometrical variations of typical cervical vertebrae and to correlate it with its clinical applications and to analyze the size, shape, prominence, and morphology of typical cervical vertebrae using morphometry. This study intends to analyze the variations of typical cervical vertebrae using morphometrical parameters and to correlate it with its clinical implications. **Materials and Methods:** In the present study, a total of 40 dry human typical cervical vertebrae (C3, C4, C5, and C6) of unknown sex and without any gross abnormality will be collected from the Department of Anatomy, Saveetha Dental College, Chennai, India, for evaluation. The height, transverse diameter, anteroposterior diameter of vertebral bodies, height and length of laminae, length and width of pedicles, length of spine, and length and width of superior and inferior articular facets were measured using vernier caliper. The results obtained were analyzed statistically, tabulated, and represented graphically. **Results:** The shape, size, and prominence, height, anteroposterior diameter, and transverse diameter of C3, C4, C5, and C6 vertebrae showed slight variations, and there was much difference in the height of left and right lamina of these cervical vertebrae. **Conclusion:** The variations in morphological and morphometrical analysis of typical cervical vertebrae may have clinical correlation. Conservative therapy includes immobilization of the neck position which will prevent muscular weakness. Although cervical myelopathy has lots of risk, during or after surgery. Therefore such extreme conditions are mostly recommended with conservative therapy.

KEY WORDS: Clinical implications, Morphology, Morphometry, Typical cervical vertebrae, Variations

INTRODUCTION

The cervical vertebrae are seven in number and are counted, with the first one (C1) closer to the base of the skull, and consecutively, vertebrae are numbered proceeding away from the skull and down the neck as C2–C7. These vertebrae are attached to the thoracic vertebrae and work together as central vertebral column to support the head to the trunk through neck. The first, second, and seventh vertebrae are referred as atypical vertebrae as they differ in many characteristics with the typical cervical vertebrae, namely third, fourth, fifth, and sixth. The bodies of these four vertebrae are small and broader laterally from side to side than anteroposterior aspect.[1] The anterior part is placed on a lower level than the posterior part and its inferior border is projected downward, so as to overlap the upper and forepart of the vertebra below.[2]

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The pedicles are oriented laterally and backward and attach to the vertebral body midway between its superior and inferior borders, so that the superior vertebral notch is as deep as the inferior, and at the same time, it is narrower.[3,4] The laminae are narrow, and thinner above than below; the vertebral foramen is large, and of a triangular form.[5] The spinous process is bifid and short, the two divisions being often of unequal sizes. Since the spinous process is short, certain superficial muscles of back and neck such as the trapezius and splenius capitis get attached to the nuchal ligament rather than directly to the vertebral spine. Nuchal ligament itself attaches to the spinous processes of C2–C7 and to the posterior tubercle of the atlas.[6]

The superior and inferior articular processes of cervical vertebrae may be fused on either or both sides to form articular pillars of bone that projects laterally from the junction of the pedicle and lamina.[7] The articular facets are flat and of an oval form: the superior face backward, upward, and slightly medially and the inferior face forward, downward, and slightly laterally.[8]

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The transverse processes are each pierced by the foramen transversarium, which, in the upper six vertebrae, gives passage to the vertebral artery and vein, as well as a plexus of sympathetic nerves. Each process consists of an anterior and a posterior part.[9] These two parts are joined, outside the foramen, by a bar of bone that exhibits a deep sulcus on its upper surface for the passage of the corresponding spinal nerve.[10]

The anterior portion is the homolog of the rib in the thoracic region and is therefore named the costal process or costal element. It arises from the side of the body, is directed laterally in front of the foramen, and ends in a tubercle, the anterior tubercle.[1,11]

The front tubercle of the sixth cervical vertebra is known as the carotid tubercle or Chassaignac tubercle. This isolates the carotid course from the vertebral supply route, and the carotid corridor can be kneaded against this tubercle to diminish the manifestations of supraventricular tachycardia. The carotid tubercle is likewise utilized as a milestone for anesthesia of the brachial plexus and cervical plexus. The cervical spinal nerves rise up over the cervical vertebrae. For instance, the cervical spinal nerve, C3 goes over the third cervical vertebrae.[2]

MATERIALS AND METHODS

In the present study, a total of 40 dry human typical cervical vertebrae (C3, C4, C5, and C6) of unknown sex and without any gross abnormality will be collected from the Department of Anatomy, Saveetha Dental College, Chennai, India, for evaluation. The height, transverse diameter, anteroposterior diameter of vertebral bodies, height and length of laminae, length and width of pedicles, length of spine, and length and width of superior and inferior articular facets were measured using vernier caliper. The results obtained were analyzed statistically, tabulated, and represented graphically.

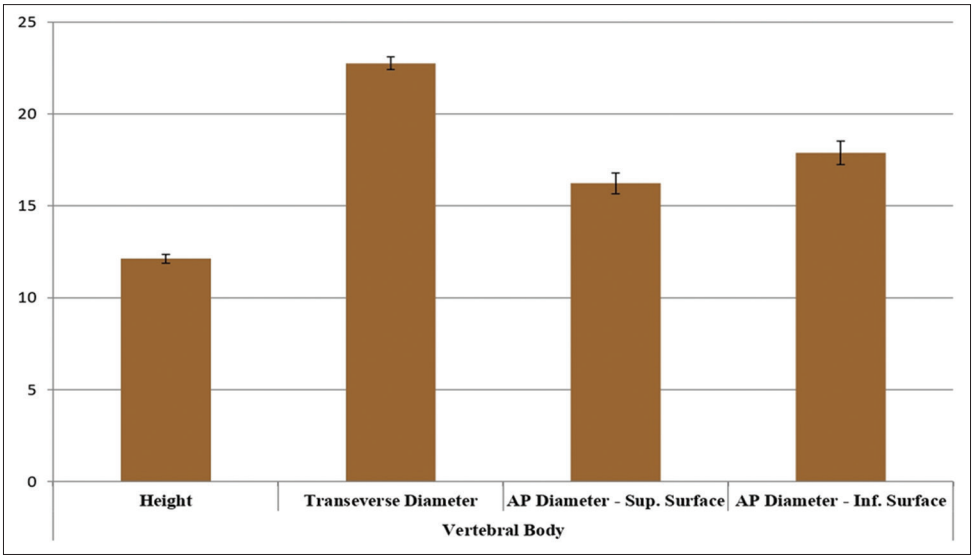

Figure 1: Morphometric analysis of vertebral bodies of typical cervical vertebrae (mm)

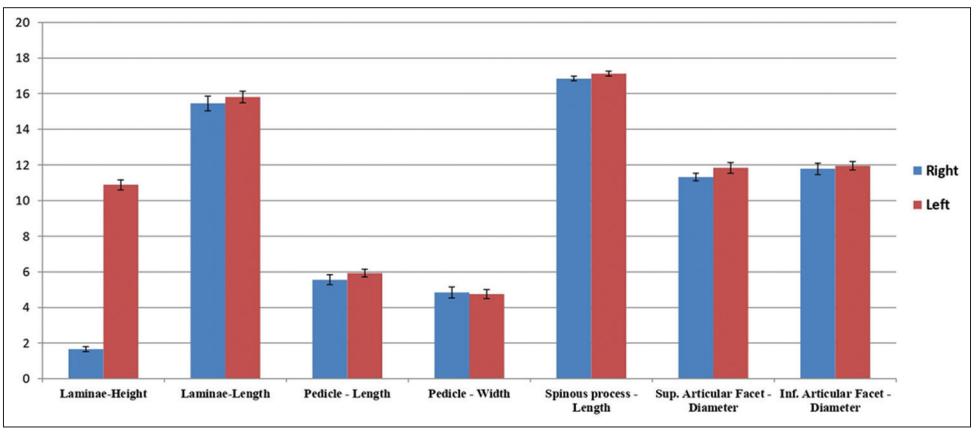

Figure 2: Morphometric analysis of various processes of typical cervical vertebrae (mm)

RESULTS

The study was carried out to compare the morphometrical and morphological analysis of the typical cervical column between adult individuals and between gender and to analyze the correlation between the cervical column morphology, the cranial base angle, the craniocervical inclination with craniofacial morphology, and stature of angles of individuals. The shape, size, and prominence, height, anteroposterior diameter, and transverse diameter of C3, C4, C5, and C6 vertebral bodies are almost the same except the height of left and right lamina. The various data obtained by morphometrical analysis of typical cervical vertebrae are represented in Figures 1 and 2.

DISCUSSION

Several degenerative diseases of cervical region arise from conditions such as spondylosis, stenosis of intervertebral discs, and formation of osteophytes. The changes are seen on radiographs which are used in a grading system from 0 to 4 ranging from no changes, to early with minimal development of osteophytes,[3] mild with definite osteophytes, moderate with additional disc space stenosis or narrowing,[4] to the stage of many large osteophytes, severe narrowing of the disc space, and more severe vertebral end plate sclerosis.[5]

Accidental injuries to the cervical vertebrae are usual at the level of the second cervical vertebrae (C2), but the neurological-related injuries are not much common. C4 and C5 are the areas that see the highest amount of cervical spine trauma.[7] If it does occur, however, it may cause death or profound disability, including paralysis of the arms, legs, and diaphragm, which leads to respiratory failure. In clearing the cervical spine, Canadian studies have developed the Canadian C-Spine Rule (CCR) for physicians to decide who should receive radiological imaging.[8]

The severity of damage and related problems to the cervical spine depends on where the spine was injured. The bony spine protects a tube-like spinal column with its nerves that help control muscles to various sections of the body.[9] The seven cervical vertebrae, at the top portion of the spine, have eight nerve pairs. A child's spinal column is more elastic than the spinal column of an older people. Injuries to the cervical spine can produce varying results depending on the location of the injury and its severity.[10]

Damage to any of the upper cervical nerves and additionally the spinal string may cause loss of motion of a few or the majority of the breathing muscles and conceivably the arms and legs. Damage to the lower cervical nerves and additionally the spinal cord may result in loss of motion of the upper and lower furthest points (arms and legs) and can cause intestine and bladder impairment. The most elevated occurrence of spinal damage happens in teenagers and youth grown-ups 16–24 years of age. When patients achieve 15–16 years of age and have for the most part achieved skeletal development, spine wounds take after those of grown-ups. The most widely recognized cervical spine damage in youths is at the C5 and C6 vertebral level.[11]

CONCLUSION

Our results showed that there was no significant variation in the cervical vertebrae dimensions of the shape, size, and prominence, height, anteroposterior diameter, and transverse diameter of C3, C4, C5, and C6 vertebral bodies which are almost the same except the height of left and right lamina. The variations in morphological and morphometrical analysis of typical cervical vertebrae may have clinical correlation. A thorough osteological knowledge on the morphology and morphometry of typical cervical vertebra provide required assistance to the orthopaedic surgeons in improvising their surgical procedure which in turn reduce the surgical and even the post-operative complications.

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