International Journal of Biomedical and Health Sciences
Vol. 6, No. 1, June 30, 2010
Printed in Nigeria

0794-4748/2010 $12.00 + 0.00

http://www.asopah.org

IJBHS 2010027/6203

Anatomical variation of the spinous process in the cervical vertebrae: A case study

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(Received March 10, 2010)

ABSTRACT: A bifid spine is a feature of typical cervical vertebrae such as C3–C6. In contrast to past studies, which have described a bifid spine in the C3–C6 cervical vertebrae, this study is a report on the presence of non bifid spinous process in some of the cervical vertebrae studied. A male cadaver preserved by means of the routine embalming techniques following the completion of dissection was used for bone maceration. The cervical vertebrae were studied for variations. The variation recorded in this study includes the presence of non bifid spinous process of the third, fourth and sixth cervical vertebrae. The presence of unbifided spinous process of the third fourth and sixth cervical vertebra is a rare variation. These findings may be of clinical interest to radiologists, neurologists, orthopaedic surgeons, anthropologists and forensic personnel. We suggest that in dealing with abnormalities involving the cervical vertebrae the possibility of anomalies such as the presence of a non bifid spine should always be considered and the adjustment made accordingly since its presence may be misinterpreted in radiological studies and may be responsible for erroneous counting of cervical spines in a skiagram.

Key words: Cervical vertebra; Cervical spine; Spinous process; Anatomical variation.

Introduction

In humans, and almost all other mammals, there are seven cervical vertebrae, which are labeled C1 to C7. A characteristic feature of the vertebrae C2 to C6 is a projection known as the bifid spinous process only the C7 vertebra has a prominent non bifid spinous process that can be felt at the base of the neck. The transverse processes are each pierced by the foramen transversarium, which, in the upper six vertebrae, gives passage to the vertebral artery and vein and a plexus of sympathetic nerves.

The anatomical variations of the cervical vertebrae as reported in most classical anatomical textbooks mainly include: cervical ribs, non fusion of the halves of the posterior arch of the atlas, presence of articular facets on the superior margin of the anterior arch of the atlas incase of presence of a third occipital condyle. During an osteology demonstration classes for undergraduate medical students, Nayak (2007) noticed the absence of foramen transversarium bilaterally in an atlas vertebra which also presented a transverse process which was about 2 cm in length and resembled the transverse process of thoracic vertebra in shape [1].

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Though the foramen transversarium was absent, he reported that the groove for vertebral artery was present on the posterior arch. Other reported variations of atlas include partial or total fusion of atlas vertebra with the occipital bone, absence of foramen transversarium unilaterally, on the left side and the presence of some accessory bony arches embracing the vertebral artery (Nayak *et al* 2005, Vasudeva and Kumar 1995, Wysock *et al* 2003).

The presence of a non bifid spinous process may be important for radiologists, neurologists and orthopaedists in their day-to-day clinical practice. Such anomalies may also be important for forensic and anthropological studies. Among anatomists the topographical anatomy of a non bifid spinous process of some of the cervical vertebrae with the exception of the seventh cervical vertebra is a subject of debate.

CASE REPORT

A male cadaver preserved by means of the routine embalming techniques following the completion of dissection was used for bone maceration. Following cleaning of the soft tissues the cervical vertebra were immersed for weeks in pure benzene and then bleached by hydrogen peroxide until the vertebra becomes whitish.The bone specimens were studied in detail.

The third, fourth and sixth cervical vertebrae appeared to be normal accept that the spinous processes were not bifid (figure 1, 2 and 3).

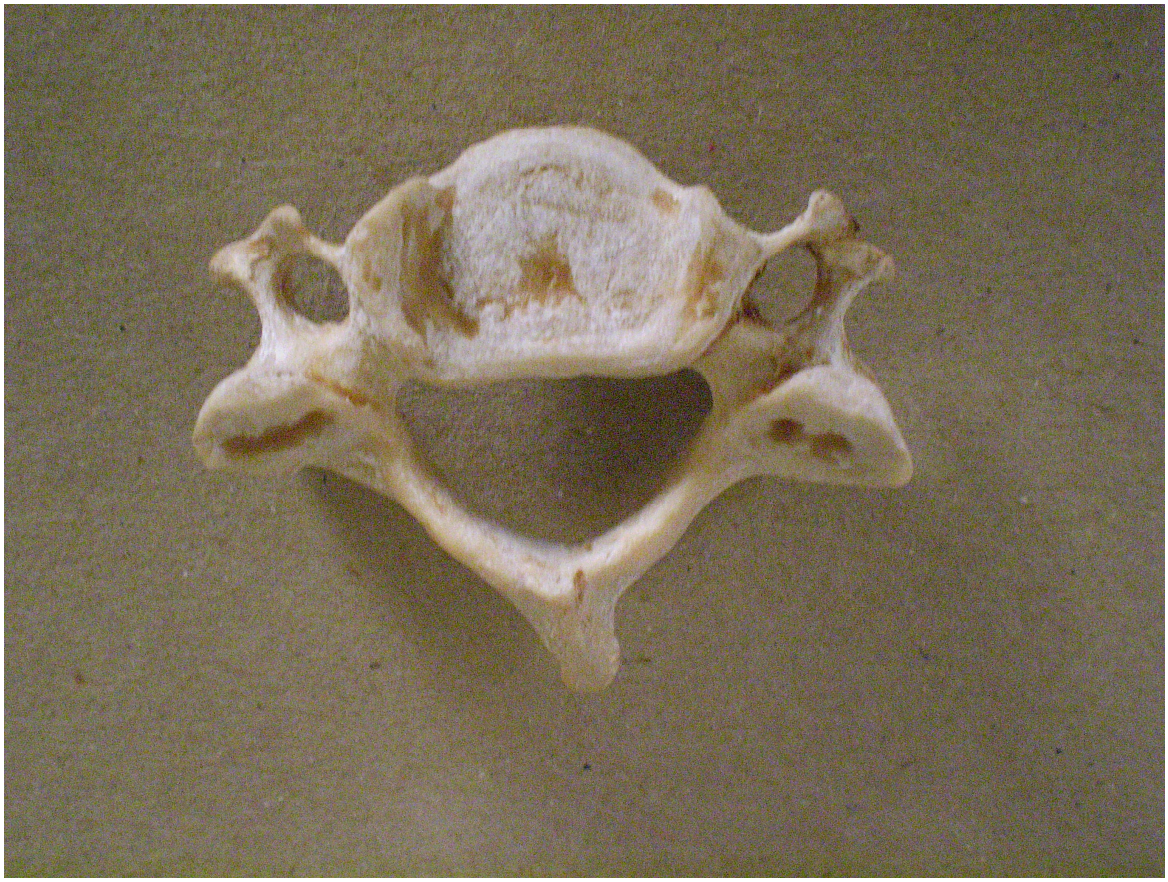

Fig. 1: The third cervical vertebra showing a non bifid spine.

Fig. 2: The fourth cervical vertebra showing a non bifid spine.

Fig. 3: The sixth cervical vertebra showing an accessory transverse foramen on the left side, a wider transverse foramen on the right side and a non bifid spine.

Discussion

A spine is referred to as a bifid spine if it is split into two at the tip (Srijit *et al* 2005). A bifid spine is a feature of the third to sixth cervical vertebrae (Williams *et al* 1989). However, the present study reports a morphological variant in the form of non bifidity of the spinous process.

The variation recorded in this study includes the presence of unbifided spinous process of the third, fourth and sixth cervical vertebrae. From anatomical point of view, the presence of non bifid spinous process present in the reported case defies the classical description of a typical or atypical cervical vertebra.

The bifid spinous process has been described as developing as a result of two ossification centres (Williams *et al* 1998) therefore the presence of these non bifid spines might be a case of presence of one primary center of ossification. The non bifidity of these spinous processes if not a congenital abnomality could also be explained on the fact that the tip of the spinous process which is cartilaginous ossifies at the age of fourteen years (Williams *et al* 1989), so the continuous traction by the muscles attached to them and the fact that most Africans are used to carrying heavy loads on their heads may have caused the hyperossification and disappearance of the bifidity of the spinous process.

It is a known fact that the presence of bifid spinous processes is associated with racial origin, Duray *et al* (1999) studied the frequency of bifidity of cervical spinous processes at different vertebral levels in a sample of 359 Americans of African (black) and European (white) descent of known sexes. They reported that at C2, most individuals (91%) had bifid spinous processes, but significant differences between race/sex subgroups were found at C3–C6, whereby the whites showed a higher frequency of bifidity than blacks and males a higher frequency of bifidity than females. The differences between races were greater than differences within races. They revealed that C3 and C4 are the most useful level for identifying race. Based on these levels, 76.05% of a validation sub sample was correctly classified by race (80.25% for whites, 72.09% for blacks).

Past research studies have reported the incidence of bifid spinous processes as being higher in foetuses than in adults in European and Native Africans (Shore 1931).

The identity of an individual may therefore be traced by the presence of such anomaly and thus this feature may be important for forensic and anthropological studies. The spinous process provides attachment to the ligamentum nuchae and other extensor muscles (Williams *et al* 1989). When the presence of a non bifid spine is considered, then there could be an alteration in the functional anatomy of these extensor muscles. There is also the possibility of the curvature of the vertebral column being altered in the presence of such an anomaly. Admittedly, because the history of the individual was not available in the present case, it is not possible to comment upon the clinical profile resulting from the anomaly.

As anatomists, we suggest that in dealing with abnormalities involving the cervical vertebra the possibility of anomalies such as the presence of a non bifid spine should always be considered and the adjustment made accordingly since its presence may be misinterpreted in radiological studies and may be responsible for erroneous counting of cervical spines in a skiagram. This, then, may be considered our modest contribution towards creating awareness of this interesting anomaly, which may be important for radiologists, orthopaedic surgeons and neurologists.

ACKNOWLEDGEMENT: We sincerely thank Mr. Isaac Kemevor-Asimah (Chief Technologist), Mallam Sani Lawan Galadima, Mallam Auwalu Haladu, Mallam Sirajo A. Dorayi, Mallam Shazali Garba and Mallam Murtala Muhammad (Senior Technologist) of the Gross Anatomy Unit for helping out in the bone preparation.

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