Journal of Clinical Orthopaedics and Trauma 8 (2017) 185–190

Contents lists available at ScienceDirect

Journal of Clinical Orthopaedics and Trauma

journal homepage: www.elsevier.com/locate/jcot

Full length article

Roentgenographic and computerized tomography based morphometric analysis of cervical spinal canal diameters to establish normative measurements in an Indian population

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ARTICLE INFO

Article history:
Received 15 August 2016
Received in revised form 30 October 2016
Accepted 11 January 2017
Available online 20 January 2017

Keywords:
Cervical spinal canal
Cervical canal stenosis
Cervical spondylotic myelopathy

ABSTRACT

Compressive cervical myelopathy secondary to degenerative changes in the cervical spine is a common cause of neurologic morbidity in the elderly. Identification of canal stenosis and addressing it surgically in addition to the obvious compressive lesions is essential to obtain satisfactory results. We attempt to define the saggital and transverse diameters in a normal adult population presenting at our centre with head injuries. We found that the values were lower than those reported in comparable studies for a western population, and also that the dimensions in women are significantly lower than in men.

1. Introduction

Cervical compressive myelopathy secondary to degenerative (spondylotic) changes is a common cause of neurologic morbidity in elderly patients. The symptoms can also arise earlier, in a younger population, if there is any congenital narrowing of the canal, as the canal can be compromised with relatively minor spondylotic changes which appear earlier in the natural history.[1] However, the presence of spondylotic changes being an universal age-related occurrence, it may be unclear as to whether the myelopathic changes should be attributed to the reduction in bony canal dimensions and the cord compression resulting from it or not. Also it is necessary to know whether there is a component of canal stenosis over and above the obvious compressive lesions such as a disc or osteophyte. We have attempted to define the normal diameters of the bony canal (sagittal and transverse) using radiographs and computerized tomography scans in skeletally mature adults, as normative data for the same are not available in the literature for an Indian population.

2. Material and methods

We have used cervical spine radiographs and computerized tomography (CT) scans of 100 consecutive patients older than 18 years of age with head injury and without cervical spine injury admitted to our Centre. Patients with pre-existing cervical spine malformations, surgery or rheumatoid arthritis were excluded. The lateral cervical spine radiograph is part of the primary survey in ATLS® protocol for all poly trauma patients.[2] The cervical spine is included as part of Head CT-scan protocols in case of a head injury at our institute. As such, patients were not exposed to any additional radiation for the purpose of this study.

Permission for use of the scans was obtained from the patients or relatives, based on the status of consciousness of the patient. The height of the patients was taken from medical records.

The radiographs were taken with a spherical marker to control for magnification, with the beam centered on C4 as defined by the upper border of the thyroid cartilage, from a source 6 feet (72 in.; 180 cm) away. The X-rays and CT scans were analyzed using OsiriX ver 5.6 (Pixmeo, Geneva, Switzerland). The Antero-posterior diameter was measured at each level on the radiograph from the midpoint of the posterior cortex of each vertebra to the nearest point on the spino-laminar line (Fig. 1). The antero-posterior and transverse diameter in the CT scans was measured on an axial cut taken parallel to the superior end-plate through the mid-point of the posterior cortex as defined on a sagittal section. The antero-posterior diameter was measured from a point on the posterior cortex to a point on the posterior elements defined by the line bisecting the interpedicular line. The lateral diameter was measured as the largest perpendicular to this line within the confines of the canal (Fig. 2). As the points of reference detailed above are variable and subject to observer bias, two authors (KAP and GB) measured each parameter independently. Further, each author took two readings (not one after the other). So, we had four

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http://dx.doi.org/10.1016/j.jcot.2017.01.003
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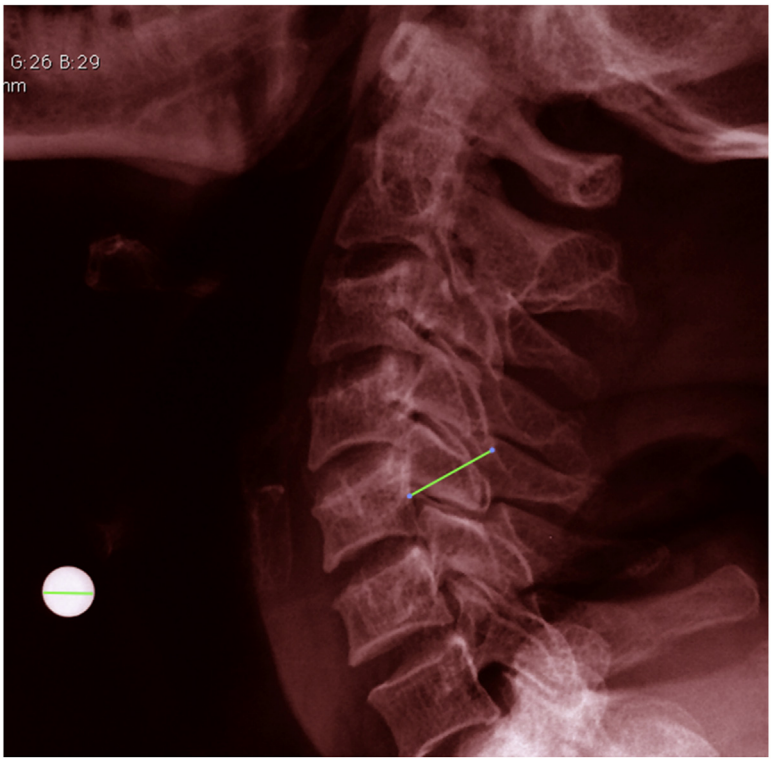

Fig. 1. Sagittal Cervical canal diameter on Lateral radiograph. The magnification control is seen at left lower corner.

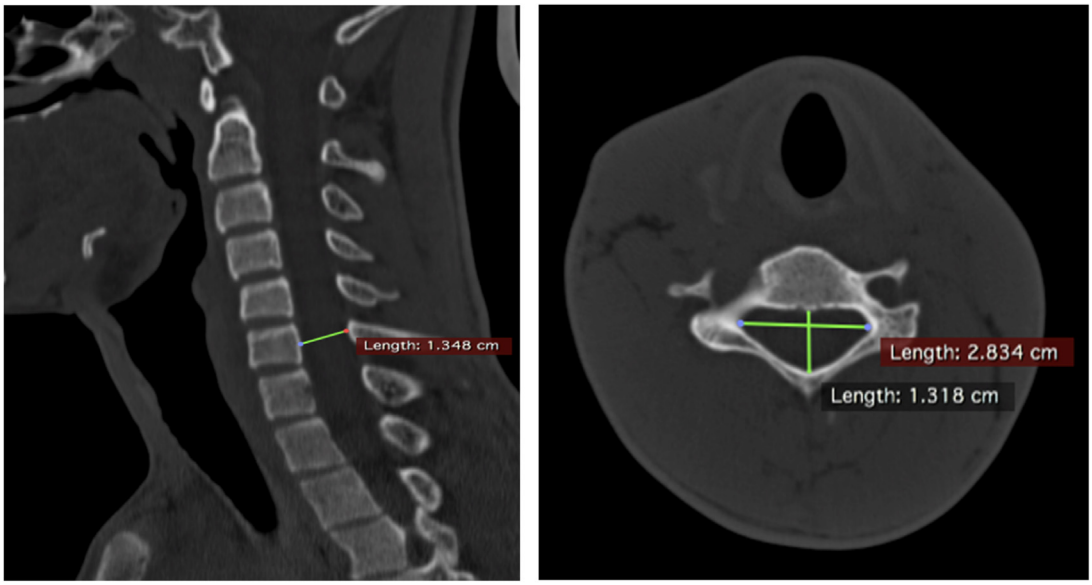

Fig. 2. Measuring sagittal and transverse diameters on CT scan. The point and direction of the axial section is first defined on the sagittal section (a), the diameters are then measured on the axial section as shown (b).

values for each parameter, the mean of which was admitted for analysis, thereby minimizing observer bias.

The values collected were then analyzed using GraphPad Instat ver 3.4, and trends were evaluated.

3. Results

We collected data from 100 consecutive cases that satisfied our inclusion criteria. 65 men and 35 women were included. We found there to be no correlation between height and cervical spine diameters among the patients studied (using Pearson's correlation coefficient, $r = 0.0152$, $p = 0.523$). A statistically significant correlation was seen between the antero-posterior diameters measured on lateral radiographs and CT scans (Using Pearson's correlation coefficient, intermediate to strong correlation was found with a p value less that 0.005, as summarized in Table 1). Thus, well made lateral radiographs can be used alone if CT scan is not available. However, in a spondylotic cervical spine accuracy can be poor due to poor visualization of canal osteophytes and a CT scan is still recommended.