The Importance of the Sagittal Diameters of the Cervical Spinal Canal in Relation to Spondylosis and Myelopathy.

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ABSTRACT

Background: The pre existing sagittal diameter is the distance from the middle of the posterior part of the vertebral body of each vertebra to the midpoint of corresponding lamina. The absolute diameter is the distance from the posterior aspect of spondylotic spur to the closest point in spinolaminar line at the particular inters space. They found in their study that pre existing sagittal diameter of 16.4 mm to 12.4 mm at C5 and the absolute diameter of 14.8 mm to 12.6 mm at C5-6 interspace. To study the importance of the sagittal diameters of the cervical spinal canal in relation to spondylosis and myelopathy. **Methods:** This study consisting of evaluation of initial and decreased sagittal diameters of cervical spines and its correlation with cervical spondylosis with and without myelopathy. The material of this analysis consisted of 150 patients who attended the outpatient department of the hospital. A detailed clinical examination was done in all the patients who included clinical history, general and systemic examination. Major groups under this study were the patients referred by a clinician with a provisional diagnosis of cervical spondylosis. A random survey of patients visited the Department of Radiology without any complaints were done, they were evaluated radiologically. While undertaking the radiological examination, we observed a specific proforma. **Results:** When multiple discs were involved, C5 – C6 disc involvement along with C4 – C5 was more common. When single disc involvement was there, then C5 – C6 disc involvement was maximum. **Conclusion:** The initial size of the canal may be an etiological factor in the development of cervical myelopathy.

Keywords: spondylosis, myelopathy, sagittal diameter.

INTRODUCTION

Wilkinson et al[1] advocated two methods for measurement of the sagittal canal diameter as the pre existing sagittal diameter and the absolute diameter. The pre existing sagittal diameter is the distance from the middle of the posterior part of the vertebral body of each vertebra to the midpoint of corresponding lamina. The absolute diameter is the distance from the posterior aspect of spondylotic spur to the closest point in spinolaminar line at the particular inters space. They found in their study that pre existing sagittal diameter of 16.4 mm to 12.4 mm at C5 and the absolute diameter of 14.8mm to 12.6 mm at C5-6 interspace. The study showed that the canal was narrower in patients with cervical spondylosis myelopathy than normal persons.

Brain[2] suggested that a complete investigation with plain film make myelography unnecessary, except before surgery.

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Brooker and Barter[3] reported that subjects with all radiological features of cervical spondylosis may be symptom free. On the other hand, manifest cervical myelopathy may occur in the presence of modest cervical radiological changes.

Hink and Sachdev[4] reported that the sagittal diameter of the cervical spinal canal is the best guide for detecting canal stenosis.

Satouru K, et al[5] confirmed that the diagnosis of developmental canal stenosis if the Antero - posterior diameter was less than 15 mm at C5 (FFD = 1.5 m).

Jain UK et al[6] found that the minimum sagittal diameter at the level of C3 and maximum at C2 level in normal persons.

MATERIALS AND METHODS

This study consists of evaluation of initial and decreased sagittal diameters of cervical spines and its correlation with cervical spondylosis with and without myelopathy. The material of this analysis consisted of 150 patients who attended the outpatient department of the hospital.

A detailed clinical examination was done in all the patients who included clinical history, general and systemic examination. A major group under this study was the patients referred by a clinician with a provisional diagnosis of cervical spondylosis. A random survey of patients visited the Department of Radiology without any complaints were done, they were evaluated radiologically. While undertaking the radiological examination, we observed a specific proforma.

The study was divided into two groups

1. Evaluate initial sagittal diameter of the spinal canal that is antero posterior diameter of the spinal canal at each level

2. Evaluate decreased sagittal diameter at each level. Patients were divided into three groups
    a. Group I: Asymptomatic cases (random)
    b. Group II: Cases with cervical spondylosis but without myelopathy
    c. Group III: Cases with both cervical spondylosis and myelopathy

During radiography of patients referred by clinician under the head of cervical spondylosis or those who were asymptomatic were examined in following manner:

Standard lateral radiographs in the neutral position of the cervical spine were taken with a focus film of 180 cm distance in patients. This lateral view was taken with the patient's neck in neutral position and jaw was slightly raised, so that the angles of the mandible were clear of cervical vertebral bodies. In order to obtain a good visualization of C7, the patient sits up and drops his shoulders as much as possible. Traction on the arms by means of heavy weights in both hands helps in lowering shoulders. In order to obtain a true lateral projection, the patient's neck must be perpendicular to his shoulders, and also to the central rays. This places the cervical spine a considerable distance from the film.

Distortion and magnification are very considerable under these circumstances, unless a long film target distance is employed. So what focus film distance of 6 feet (180 cm) is kept.

A true lateral view in neutral position has been taken by following radio-graphical factors.

Lateral view	KV	MAS	GRID	FFD
Neutral	64-70	32-40	Non-Bulky	180 cm

True lateral view in neutral position allows studying specifically following elements and parameters.

- Sagittal diameters of the cervical spinal canal
- The alignment of upper portion of cervical spine with foramen magnum
- Atlanto axial joint space
- Normal alignment of anterior and posterior border of vertebral bodies
- Alignment of posterior margins of articular processes
- Inter-vertebral disc spaces
- Articular facet joints
- Para-vertebral soft tissues

Radiological evaluation of loss of normal cervical lordosis, osteophytosis, decreased inter-vertebral discs (level, number, severity) associated congenital anomalies is done.

The initial sagittal diameter that is the antero-posterior diameter of the spinal canal was measured at each level between the posterior border of a vertebral body of its midpoint and anterior border of corresponding lamina. This method was described by Wolf et al (1956) and modified by Payne and Sapillane (1957).

The decreased diameter was measured in the anterior, posterior direction of the cervical spine between the posterior inferior limit of the vertebral body and lamina just below. This method was adopted from the method described by Cailliet (1982).

Lateral views of the cervical spine were done in all patients with focus film distance of 6 feet so that distortion and magnification are negligible.

RESULTS

The present study of the importance of the sagittal diameters of the cervical spinal canal in relation to cervical spondylosis and myelopathy includes 150 cases. They were divided into 3 groups.

- Group I: 50 asymptomatic cases (random)
- Group II: 52 cases with cervical spondylosis without neurological symptoms
- Group III: 48 cases with cervical spondylosis and myelopathy

In the present study, the initial and the decreased sagittal diameters were measured at each level from C1 to C7 on plain radiograph and compared with other available studies.

Table 1: Comparison of average initial and decreased sagittal diameters of cervical spinal canal of group II and group III cases with group I cases.

Vertebral level	Initial sagittal diameter (mm)		Decreased sagittal diameter (mm)	
	Difference of group I & II	Difference of group I & III	Difference of group I & II	Difference of group I & III
C1	0.19	2.24	1.26	2.2
C2	0.11	2.83	0.54	3.51
C3	0.81	3.24	1.53	3.65
C4	0.69	3.33	1.43	3.95
C5	0.60	3.23	1.52	3.92
C6	0.78	2.05	0.95	2.44
C7	0.47	2.35	0.63	2.35
Total	3.64	19.27	7.86	22.02
Average	0.52	2.75	1.12	3.14

Table 2: Other radiological findings in asymptomatic (group I) and symptomatic (group II & III) cases.

Radiological findings	Group I (50 cases)		Group II & III (100 cases)	
	Number	Percentage	Number	Percentage
Alteration of cervical curve	11	22	68	68
Disc narrowing	9	18	56	56
Anterior osteophytosis	9	18	60	60
Posterior osteophytosis	15	30	72	72
Sclerosis of Luschka's joint	13	26	62	62
Subluxation	0	0	9	9
Long T.P. of C7	3	6	30	30
Cervical rib	0	0	6	6
Block vertebrae	0	0	8	8

Table 3: Single or multiple disc involvement in cervical spondylosis (symptomatic group) and group I (Asymptomatic group).

Group	Total number of patients	Single disc involvement	Multiple disc involvement
Symptomatic	56	40	16
Asymptomatic	9	8	1

When multiple discs were involved, C5 – C6 disc involvement along with C4 – C5 was more common. When single disc involvement was there, then C5 – C6 disc involvement was maximum.

DISCUSSION

Initial and decreased sagittal diameters were measured at each level from C1 to C7 in all described groups. In the present study, the average initial sagittal diameter was maximum at C1 (21.51 mm) and minimum at C4 (16.84 mm) for normal subjects. The average sagittal diameter was minimum at C4 level in all the studies except in study done by Agrawal et al[1] in which the average sagittal diameter was minimum at C3 (16.56 mm) level.

The present study describes the average range of variation in sagittal diameters from the studies done by others and the present study. However the present study cannot be compared with Boijsen's study[8] as it was done with a short FFD (59 inches) hence there was a magnification of 1 mm consistently present in all measurements.

Measurements from the present study correspond to the studies done by Burrows EH[9] as they had done a random sampling.

These findings confirmed that the gradual diminution in sagittal diameter of the spinal canal from the foramen magnum to the level of fourth cervical vertebra, beyond this level the measurements remain constant up to the thoracic spine.

There was a difference of 1 mm in the initial sagittal diameters of the cervical spine in male and female patients observed by Burrows EH[9]

Since the two midline bony points in this measurement are in the vertebra, they are of a constant distance apart, uninfluenced by the posture of the patient's head or neck, they cannot be altered by osteophytic overgrowth at the margins of vertebral bodies, occurring normally as part of ageing process or exuberantly in cervical spondylosis. This was well confirmed by Burrows EH.[9] So age factor has nothing to do with the initial sagittal diameter of the cervical spinal canal, as it is a congenital variant.

In the present study, the average initial sagittal diameter of the cervical canal from C3 to C7 levels had been lower in group III patients. This was similar to study by Murone I[10] and Agrawal.[7]

The average initial sagittal diameter from C3 to C7 from group I was 17.33 mm. For group cases of cervical spondylosis with myelopathy average initial sagittal diameter from C3 to C7 was 14.94 mm. So that, the average initial sagittal diameter of the cervical spinal canal from C3 to C7 levels in cervical myelopathy was smaller by 2.39 mm than in the control group. A difference of 2-3 mm was reported by Murone I[10] and Agrawal.[7]

This shows that the initial size of the spinal canal is a determining factor in the development of cervical myelopathy. Group II cases of cervical spondylosis without neurological symptoms showed on an average initial sagittal diameter from C3 to C7 was 16.66 mm.

So generally speaking, for the population of this region, if the average initial sagittal diameter is more than 16.66 mm, the chances of development of cervical myelopathy are far remote. But if the average initial sagittal diameter is less than 14.94 mm, the patient is more likely to develop cervical myelopathy, if he develops the changes of spondylosis in the cervical spine.

Hink and Sachdev[4] reported that the sagittal diameter of the cervical spinal canal was the best guide for measurement of the initial size of the canal. However, this method is applicable only for measurement of the initial size of the canal. The decreased sagittal diameters of the cervical spinal canal were measured in normal persons and in cases of cervical spondylosis with and without myelopathy. The decreased sagittal diameter was less, as compared to the initial sagittal diameter at all levels, in all cases, both with or without

myelopathy. This was well observed and confirmed by Agrawal et al[7] in his study.

The difference of initial sagittal diameter and decreased sagittal diameter, which provides a measure of acquired reduction of sagittal diameter of the cervical spinal canal produced by osteophytes, was seen to be same for both group II (0.86 mm) and group III (0.87 mm).

This indicates that osteophytes itself will not produce myelopathy if the initial sagittal diameter of the spinal canal is normal. This is the reason why two patients exhibit identical degrees of spondylotic degeneration in plain X ray film may present entirely with different clinical pictures, which depends upon the initial sagittal (antero posterior) diameter of the cervical spinal canal which varies from patient to patient.

CONCLUSION

The initial size of the canal may be an etiological factor in the development of cervical myelopathy.

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