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THE SIGNIFICANCE OF THE CERVICAL SPINAL CANAL SAGITTAL DIAMETER IN ASSOCIATION WITH MYELOPATHY AND SPONDYLOSIS

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Abstract:

Introduction: *The pre-existing sagittal diameter is the distance from the center of the posterior body of each vertebra to the midpoint of the corresponding lamina. The absolute diameter is the distance from the posterior part of the spondylotic spur to the nearest point of the spinolaminar line in a defined intervertebral space. In their studies, they found a pre-existing sagittal diameter of 16.4 mm to 12.4 mm at C5 and an absolute diameter of 14.8 mm to 12.6 mm at an interval of C5-6. To investigate the significance of the sagittal diameters of the cervical spinal canal in relation to spondylosis and myelopathy.*

Place and Duration: *In the Radiology Department of Jinnah Hospital Lahore for one-year duration from April 2018 to April 2019.*

Methods: *Examination of the initial and reduced sagittal diameter of the cervical spine and their association with cervical spondylosis with and without myelopathy. The study consisted of 150 patients who came to the hospital outpatient clinic. A detailed clinical examination was performed in all patients, including clinical history, general and systemic examination. The main groups in this study were physician-referred patients with a provisional diagnosis of cervical spondylosis. A randomized examination was carried out of patients who visited the Radiology Ward without complaints and were assessed radio-graphically. When undertaking a radiological examination, we observed a specific proforma.*

Results: *When multiple discs were involved, the C5-C6 disc along with C4-C5 involvement was more common. When single disc engagement was present, the C5-C6 disc engagement was at its maximum.*

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

Key words: *spondylosis, myelopathy, sagittal diameter.*

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INTRODUCTION:

Wilkinson et al. Recommended two methods for measuring the sagittal diameter as the pre-existing sagittal diameter and absolute diameter[1-2]. The pre-existing sagittal diameter is the distance from the center of the posterior body of each vertebra to the center of the corresponding lamina. The absolute diameter is the distance from the posterior part of the spondylotic spur to the nearest point of the spinolaminar line in a defined intervertebral space[3-4]. In their studies, they found an existing sagittal diameter of 16.4 mm to 12.4 mm at C5 and an absolute diameter of 14.8 mm to 12.6 mm at an interval of C5-6. The study found that the canal was narrower in patients with cervical spondylosis than in healthy subjects[5-6]. The brain suggested that a complete examination using plain film makes myelography unnecessary, except for preoperative surgery. Brooker and Barter reported that people with all the radiographic features of cervical spondylosis may be symptom free. On the other hand, visible cervical myelopathy may occur in the presence of slight radiographs of the cervix. Hink and Sachdev reported that the sagittal diameter of the cervical spinal canal is the best guide for detecting canal stenosis. Satouru K et al. Confirmed the diagnosis of developmental canal stenosis if the antero-posterior diameter was less than 15 mm at point C5 (FFD = 1.5 m). Jain UK et al. Found that the minimum sagittal diameter at the level of C3 and the maximum at the level of C2 in healthy subjects.

MATERIALS AND METHODS:

This analysis was held in the Radiology Department of Jinnah Hospital Lahore for one-year duration from April 2018 to April 2019. This study assesses the initial and reduced sagittal diameters of the cervical spine and their correlation with cervical spondylosis with and without myelopathy. The material for analysis consisted of 150 patients who came to the hospital outpatient clinic. A detailed clinical examination was performed in all patients, including clinical history, general and systemic examination. The main group in this study were patients referred by a physician with a provisional diagnosis of cervical spondylosis. A randomized examination was carried out of patients who came to the radiology department without complaints and were assessed radiographically. When undertaking a radiological examination, we observed a specific proforma. The study was divided into two groups:

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

2. Assess the reduced sagittal diameter at each level. The patients were divided into three groups behind:

a. Group I: Asymptomatic (random) cases

b. Group II: Cases with cervical spondylosis but without myelopathy

c. Group III: Cases of cervical spondylosis and myelopathy

During radiography of patients referred by a doctor to the head of asymptomatic or cervical spondylosis, the following methods were examined: Standard lateral X-rays were taken in the neutral position of the cervical spine with a focal film up to a distance of 180 cm. This lateral view was taken with the patient's neck in a neutral position and the jaw slightly raised so that the angles of the lower jaw were free of the cervical vertebrae. To get a good visualization of C7, the patient sits down and lowers his arms as much as possible. Shoulder traction with heavy weights in both hands helps lower the shoulders. To get a true lateral projection, the patient's neck must be perpendicular to his shoulders as well as to the medial rays. This places the cervical spine a considerable distance from the film. The distortion and magnification are very significant under these circumstances unless a long target distance of the film is used. So what is the 6 feet (180 cm) distance of the focus film? The actual side view in the neutral position was assumed by the following radiographic factors. A true side view in a neutral position allows the examination of specific elements and parameters.

- Sagittal diameters of the cervical spinal canal
- Alignment of the upper cervical spine with the foramen magnum
- Atlantoaxial joint space
- Correct positioning of the anterior and posterior vertebral bodies
- Alignment of the posterior edges of the articular processes
- Intervertebral spaces
- Paravertebral soft tissues
- Articular facet joints

The radiological evaluation of the loss of normal cervical lordosis, osteophytosis, and lowering of the intervertebral discs (level, number, severity) associated with congenital defects is performed. The initial sagittal diameter, i.e. the antero-posterior diameter of the spinal canal, was measured at each level between the posterior border of the vertebral body at its midpoint and the anterior border of the corresponding lamina. This method was described by Wolf et al. (1956) and modified by Payne and Sapillane (1957). The reduced diameter was measured in the anterior, posterior direction of the cervical spine between the posterior inferior border of the vertebral body and the lamina just below. This method was taken from the method described by Cailliet (1982). Lateral views of the cervical spine were taken for all patients with a focussing distance of 6 feet so distortion and magnification are negligible.

RESULTS:

This study on 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 (randomized)
- Group II: 52 cases with cervical spondylosis without neurological symptoms
- Group III: 48 cases with cervical spondylosis and myelopathy.

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

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

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

When multiple drives were involved, the involvement of the C5 - C6 drive along with C4 - C5 was more common. When single disk engagement was present, the C5-C6 disk engagement was at its maximum.

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

DISCUSSION:

Initial and reduced sagittal diameters were measured at each level from C1 to C7 in all groups described. In the present study, the mean initial sagittal diameter was maximum at C1 (21.51 mm) and minimal at C4 (16.84 mm) for healthy subjects[7-8]. The sagittal mean diameter was minimal at the C4 level in all studies, except for the study by Agrawal et al., In which the sagittal mean diameter was minimal at the C3 level (16.56 mm). This study describes the mean range of variation in sagittal diameters based on studies by others and from this study[9-10]. However, this study cannot be compared to the Boijsen study as it was taken with a short FFD (59 inches) and therefore a magnification of 1 mm was consistently present in all measurements. The measurements in this study correspond to the studies performed by Burrows EH as they performed a random sampling. These results confirmed a gradual decrease in the sagittal diameter of the spinal canal from the large foramen to the level of the 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 men and women as observed by Burrows EH Since the two midline bone points in this measurement are in the vertebra, they are at a constant distance apart that is not affected by the posture of the head or neck patient, they must not be altered by osteophytic hypertrophy at the periphery of the vertebral bodies normally seen as part of the aging process or profuse in cervical spondylosis[11-12]. This has been well acknowledged by the Burrows EH. Thus, the age

factor has nothing to do with the initial sagittal diameter of the cervical spinal canal as it is congenital. In the present study, the mean initial sagittal diameter of the cervical canal from levels C3 to C7 was smaller in patients from group III. This was similar to the studies of Murone I and Agrawal. The mean initial sagittal diameter from C3 to C7 in Group I was 17.33 mm. In group cases of cervical spondylosis with myelopathy, the mean initial sagittal diameter from C3 to C7 was 14.94 mm. Thus, the mean initial sagittal diameter of the cervical spinal canal from level C3 to C7 in the case of cervical myelopathy was 2.39 mm lower than in the control group. A difference of 2-3 mm was reported by Murone I and Agrawal. This shows that the initial size of the spinal canal is the determining factor in the development of cervical myelopathy. Cases of group II cervical spondylosis without neurological symptoms had a mean baseline sagittal diameter of C3 to C7 of 16.66 mm. So, in general, for the population of this region, if the mean initial sagittal diameter exceeds 16.66 mm, the chances of developing cervical myelopathy are far off. But if the mean initial sagittal diameter is less than 14.94 mm, the patient is more likely to develop cervical myelopathy if he develops spondylosis changes in the cervical spine. Hink and Sachdev reported that the sagittal diameter of the cervical spinal canal was the best guide for measuring the initial size of the canal. However, this method is only applicable to initial channel size measurement. Reduced sagittal diameters of the cervical spinal canal were measured in healthy subjects and in cases of cervical spondylosis with or without myelopathy[13-14]. The reduced sagittal diameter was smaller compared to the initial sagittal diameter at all levels, in all cases, both with and without myelopathy. This has been well observed and confirmed by Agrawal et al[15]. In his study. The difference between the initial sagittal diameter and the reduced sagittal diameter, which is a measure of the acquired reduction in the sagittal diameter of the cervical spinal canal caused by osteophytes, was the same for Groups II (0.86 mm) and III (0.87 mm). This means that osteophytes alone will not cause myelopathy if the initial sagittal diameter of the spinal canal is normal. This is the reason why two patients with the same degree of spondylotic degeneration may have completely different clinical images on a plain X-ray, which depend on 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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