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MORPHOMETRIC ANALYSIS OF SPINAL CORDDIMENSIONS OF INDIVIDUALS UNDERGOING MRI SPINE

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ABSTRACT

INTRODUCTION

Knowledge of the normal anatomical measurements and variations of the spinal cord are essential in understanding the occurrence of various spinal disorders1. Studies documenting the normal morphometric data of spinal cord on Indian population are very scarce.

MATERIALS AND METHODS

The current study was a cross sectional observational study. Study subjects included were patients undergoing MRI conditions otherthan spinal cord pathology and healthy volunteers in the study setting. Sample size calculated was **60**. All the eligible subjects were recruited into the study consecutively till the sample size was reached. Individuals of age group between 20 to 40 years undergoing MRI for conditions other than spinal pathology.

RESULTS

A total 60 people were included in the final analysis. The mean of age was 28.03 ± 5.75. Minimum age was 20 years and maximum was 40 years in the study population. Among the study population 41(68.33%) people were aged up to 30 years and19(31.67%) were aged between 31 to 40years. Among the study population 30(50%) were males and remaining 30(50%) werefemales.

CONCLUSION

A single number cannot be used as the basis for evaluating spinal cord size. Each level should be compared with the normal range specific for that level. The large variation in cord size should be taken under consideration inmorphometric analyses of the spinal cord.

INTRODUCTION

Human spine is an interesting mechanical assembly— complex in structure and function. Its purpose is to protect the spinal cord and nerve roots and also to provide flexibility and mobility to the main body, also ensuring access to the indispensable stimuli for the senses of sight, hearing and balance. Low back pain is a very common health problem worldwide and a major cause of disability - affecting performance at

work and general well-being [1]. Low back pain can be acute, sub-acute, or chronic. Though several risk factors have been identified (including occupational posture, depressive moods, obesity, body height and age), the causes of the onset of low back pain remain obscure and diagnosis difficult to make.

In most cases, the origins remain unknown. Low back pain affects people of all ages, from children to the elderly, and is a very frequent reason for medical consultations.1-3 The 2010 Global Burden of Disease Study estimated that low back pain is among the top 10 diseases and injuries that account for the highest number of DALYs worldwide [2].

It is important to know the normal parameters of the cervical spinal cord and spinal canal in the evaluation of degenerative, traumatic and inflammatory conditions. Age, gender, body mass index and spinal cord level are the parameters that should be taken into account in spinal cord and spinal canal measurements [3].

Normal cervical spinal cord and spinal canal measurements determined using the these parameters are required for the detection and differential diagnosis of possible pathologies. There are many studies about evaluating canal diameter, canal-corpus ratio, and interpeduncular distance measurements via conventional radiographs and computed tomography.

However, these imaging techniques are insufficient for soft tissue evaluation. Today, magnetic resonance imaging (MRI) is the most effective and widely used in the evaluation of the cervical spinal canal. With MRI, both soft tissue and bone structures are evaluated, spinal canal and spinal cord dimensions are measured accurately. There are relatively few studies in the literature evaluating cervical spinal canal and cord diameters with MRI [4]. In this study, it was aimed to evaluate basic morphometric data of the human spinal cord, by quantitative measurements in normal population.

MATERIALS AND METHODS

Study subjects included were patients undergoing MRI conditions other than spinal cord pathology and healthy volunteers in the study setting

Sample size calculation was done using Med Calc software version 12. At 99% confidence level and 80% power of study. According to the study conducted by Ko H-Y[1], the correlation co-efficient of sagittal & transverse diameters of cervical spine was 0.57 (minimum at cervical spine). r = 0.57 Sample size calculated was **60**.

Study population: Study subjects included were patients undergoing MRI conditions other than spinal cord pathology and healthy volunteers in the studysetting

Study design: The current study was a cross sectional observational study

Sampling method: All the eligible subjects were recruited into the study consecutively till the sample size was reached.

Study duration: The data collection for the study was done between January 2022to July 2022.

Inclusion criteria for the study group

Individuals of age group between 20 to 40 years undergoing MRI for conditions other than spinal pathology. Volunteers in the same age group.

Exclusion criteria for the study group:

- Spinal cord stenosis. Compressive Cervical Myelopathy, Atrophy. Spinal cord tumors. Patients with spinal injury.
- Individuals with incidentally detected spinal pathology during the MRI scan.Pregnancy.
- After obtaining the informed written consent form all the study subjects wereevaluated by detailed clinical examination of the spinal cord.
- Dimensions of the multiple segments of human spinal cord are measured in AP (anterio-posterior) and transverse diameter of spinal cord at mid vertebrallevel at each vertebral level from C1-D12 by high resolution T2-weighted images acquired by 3 T GE SIGMA MR System.

RESULTS

A total 60 people were included in the final analysis. he mean of age was 28.03 ± 5.75. Minimum age was 20 years and maximum was 40 years in the study population. Among the study population 41(68.33%) people were aged up to 30 years and19(31.67%) were aged between 31 to 40years. Among the study population 30(50%) were males and remaining 30(50%) were females. A single number cannot be used as the basis for evaluating spinal cord size. Each level should be compared with the normal range specific for that level. The large variation in cord size should be taken under consideration inmorphometric analyses of the spinal cord.

The spinal canal diameter was calculated as 12.04±1.16 mm at the C3 level and 12.21±1.33 mm at the C6 level. It was observed that there was no significant difference in cord diameter between these levels ($p>0.05$). Cord diameter mean values at the C3 level are 6.78±0.65 mm, at C6 level 6.20±0.60 mm; cord area mean values 69.87±8.77 mm2 at C3 level, 63.73±8.15 mm2 at C6 level. It was observed that the difference between cord diameter and area at C3 and C6 levels was significant ($p<0.017$).

The mean values for each level by gender are given and the difference between them is evaluated. In all three parameters, the difference between the male and female groups was found to be significant; the canal, cord diameter and cord area were found to be larger in the male population ($p<0.05$). Analysis of the difference between age groups was done with the Bonferroni test.

MR imaging proved to be superior over plain X-ray radiograph, which was used by

earlier research workers, for various morphometric measurements of spinal cord and canal.

DISCUSSION

The studies on spinal canal and cord measurements in the cervical region date back to the early 1900s. In the early periods, studies were conducted with a limited number of samples using cadavers. With the development of imaging techniques, studies that can reach large populations and use different variables can be performed. Vertebral and spinal canal measurements are more prominent in studies performed with conventional radiographs and computed tomography [5].

The studies have shown that the diameter of the spinal canal decreases from the cranial to the caudal in the cervical region, and the spinal cord area increases. This condition has been evaluated as an increasing risk factor in terms of compressive myelopathy and posttraumatic injury at the lower cervical levels. In our study, there was a non-significant decrease in the spinal canal diameter at the C6 level compared to C3. However, cervical spinal cord area and cord diameter also showed a significant decrease [6].

Okada et al and Sherman et al. found that the area and diameter of the cervical spinal canal decreased in C6 compared to C3, similar to our results. Considering the spinal canal diameter alone, the risk of compressive myelopathy can be mentioned. Since the space around the spinal cord decreases relatively at the lower cervical levels, the risk is dominant at these levels [7,8].

However, different results in spinal cord area and diameter measurements raise questions about this issue. Another point that should not be forgotten is that morphometric studies may differ according to age, gender, height, weight and ethnic origin.

Conclusion

In conclusion, cervical spinal canal and spinal cord dimensions in healthy individuals vary according to age, gender and cord level. These results can be used as reference values in future studies on pathologies affecting cervical spinal cord dimensions.

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