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MEASUREMENT OF LUMBAR INTERVERTEBRAL DISC HEIGHTS BY COMPUTED TOMOGRAPHY: MORPHOMETRIC STUDY

LOMBER DİSK ARALIKLARIN YÜKSEKLİKLERİNİN BİLGİSAYARLI TOMOGRAFİ İLE ÖLÇÜMÜ: MORFOMETRİK ÇALIŞMA

ABSTRACT:

Purpose: We aimed to obtain data from computed tomography of healthy human lumbar intervertebral disc heights.

Materials and Method: We inspected 50 female and 50 male between the ages of 18 and 60 who have admitted to emergency room for minor traumas. Data collected from files of the patients who did not have any history of operations or disease for the lumbar spine rethrospectively.

Results: This study included a total of 100 patients, of whom 50 were female (50 %) and 50 were male (50 %). Mean age was 44.84 ± 9.9 years for males, and 45.1 ± 10.7 for females. There was no statistically significant difference between males and females of age ($p=0.950$). Intervertebral disc heights between L1 and L2 vertebrae were 9.46 ± 0.86 mm in males, and 9.81 ± 0.95 mm in females. The L1-L2 intervertebral disc heights were significantly higher in females ($p=0.006$). The L2-L3 intervertebral disc heights were 9.68 ± 0.9 mm, and 9.42 ± 0.68 mm in males and females, respectively, which were statistically similar ($p=0.072$). L3-L4, L4-L5, and L5-S1 intervertebral disc heights were significantly higher in males, when compared to females.

Conclusions: This study has been conducted to evaluate lumbar disc heights with morphometric measurements by using computed tomography to support anatomic knowledge for safe surgery performed to intervertebral disc space.

Key words: Lumbar intervertebral disc height, lumbar vertebra morphology, computed tomography measurement

Level of evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Çalışmanın amacı sağlıklı insan lomber vertebral disk aralıklarının bilgisayarlı tomografi ile ölçümünü yapmaktır.

Materyal ve metod: Acil servise minör travmalar nedeni ile başvuran ve hikayelerinde lomber bölgeden hastalık veya operasyon bulunmayan 18 ve 60 yaş arası 50 bayan ve 50 erkek hasta retrospektif olarak incelendi.

Sonuçlar: Çalışmada 50 bayan (% 50) ve 50 erkek (% 50) toplam 100 hasta incelendi. Ortalama yaş erkeklerde 44.84 ± 9.9 ve bayanlarda 45.1 ± 10.7 olarak hesaplandı. Cinsiyetler arasında yaş bakımından istatistiksel anlamlı fark yoktu ($p=0.950$). Erkeklerde L1-2 mesafesi disk aralığı yüksekliği ortalama 9.46 ± 0.86 mm, bayanlarda 9.81 ± 0.95 mm olarak bulundu ve bayanlarda bu aralık istatistiksel anlamlı olarak daha büyük hesaplandı ($p=0.006$). L2-3 disk aralığı erkeklerde ortalama 9.68 ± 0.9 mm, bayanlarda 9.42 ± 0.68 mm olarak hesaplanmış ve istatistiksel fark bulunamamıştır. L3-4, L4-5 ve L5-S1 disk mesafeleri erkeklerde bayanlarla karşılaştırıldığında daha yüksek olarak bulunmuştur.

Çıkarım: Bu çalışmada lomber disk aralıkları yükseklikleri morfometrik olarak bilgisayarlı tomografi ile hesaplanmaya çalışılmış ve disk aralıklarına yapılan ameliyatların daha güvenli yapılabilmesi için anatomik bilgi desteği sağlanmaya çalışılmıştır.

Anahtar kelimeler: Lomber vertebral disk aralık yükseklikleri, lomber vertebra morfolojisi, bilgisayarlı tomografi ile ölçüm

Kanıt Düzeyi: Geriye dönük klinik çalışma, Düzey III

INTRODUCTION:

Lumbar degenerative disc disease is the most common cause of low back pain. The exact mechanism of the degenerative process is defined as multifactorial, irreversible and associated with a mechanical dysfunction¹. Progressive disc degeneration will result in a loss of the intervertebral disc space height which depends on the degree of disc degeneration, and it has been shown to have a significant influence on the biomechanics and kinematics of a lumbar motion segment⁵.

The use of new technology in the treatment of degenerative disc diseases is updating rapidly. It has been developing in combination with various techniques for spinal stabilization like minimally invasive and instrumental approaches for the treatment of adult degenerative disc disease, stenosis, and deformity of the lumbar spine. Posterior approach to the lumbar disc spaces for posterolateral fusion scan has been technically challenging, frequently requiring the use of an approach surgery for adequate exposure. For successful surgery and suitable instrumental design, well anatomical knowledge of the lumbar vertebra is also needed.

In the present study, we aimed to obtain data from computed tomography of healthy human lumbar intervertebral disc heights. In this context, intervertebral disc heights were evaluated for each lumbar segment for safe surgical intervention by the posterior fixation approach for total disc replacement, prosthesis, fusion cages, lumbar discectomy and stenosis.

MATERIALS AND METHOD:

We inspected 50 female and 50 male between the ages of 18 and 60 who have admitted to emergency room for minor traumas. Data collected from files of the patients who did not have any history of operations or disease for the lumbar spine retrospectively.

Measurement of lumbar intervertebral disc heights were made from computed tomography midline sagittal images. Anterior, center and posterior lumbar intervertebral disc heights were measured and mean values calculated for each level.

Descriptive data were presented by using mean and standard deviation. Mann-Whitney U test was used for comparisons between the independent groups of the study, and statistical significance was evaluated according to a two-sided Type-I error level of 5 %. Statistical Package for the Social Sciences (SPSS) 21 software (IBM Corp. in Armonk, NY) was used for all statistical analyses of this research.

RESULTS:

This study included a total of 100 patients, of whom 50 were female (50 %) and 50 were male (50 %). Mean age was 44.84 ± 9.9 years for males, and 45.1 ± 10.7 for females. There was no statistically significant difference between males and females of age ($p=0.950$).

Intervertebral disc heights between L1 and L2 vertebrae were 9.46 ± 0.86 mm in males, and 9.81 ± 0.95 mm in females. The L1-L2 intervertebral disc heights were significantly higher in females ($p=0.006$).

The L2-L3 intervertebral disc heights were 9.68 ± 0.9 mm, and 9.42 ± 0.68 mm in males and females, respectively, which were statistically similar ($p=0.072$).

However, L3-L4, L4-L5, and L5-S1 intervertebral disc heights were significantly higher in males, when compared to females. These values and comparisons between groups are presented in Table-1, which reveals a statistical significance of $p<0.001$ in all comparisons.

Table-1. Mean and p values of age, sex and intervertebral disc heights.

	Male	Female	P
	Mean±SD	Mean±SD	
AGE	44.84±9.9	45.1±10.65	0.950
L1 - L2	9.46±0.86	9.81±0.95	0.006
L2 - L3	9.68±0.9	9.42±0.68	0.072
L3 - L4	10.04±0.76	8.53±0.76	<0.001
L4 - L5	10.38±0.72	9.69±0.79	<0.001
L5 - S1	11±1	9.84±0.68	<0.001

DISCUSSION:

Radiological examinations of the morphologic characteristics of lumbar intervertebral discs, such as height and volume, have been used extensively for biomechanical studies and clinical investigations of the human spine^{6,11}. Lumbar vertebra anatomy is characterized by wide individual variations as reported in the literature^{12,13,16}. Height and volume of the intervertebral disc influences the load-carrying capacity of the spinal column. Besides, morphologic abnormalities such as intervertebral disc space narrowing and thinning have been associated with acute or chronic disabilities of the lumbar spine².

Lumbar degenerative disc disease is one of the major causes of chronic low-back pain with lumbar segmental instability. Surgery must be suggested when conservative treatments fails. In addition to diagnostic tests or interventional studies, morphometric studies have the potential to help surgical planning and facilitate the design of intervertebral prosthesis and fusion materials^{3,17}. Artificial total disc replacement as an alternative to spinal fusion has been increasingly applied for the treatment of degenerative disc disease^{9,14}. It is suggested that the patient's normal intervertebral segment motion might be restored and maintained while the adjacent level was prevented from non-physiologic loading and thus the pain was relieved^{4,15,18}.

There are various researches and measurement techniques for intervertebral disc morphology. For example Neubert et al suggested a computerized method for the measurement of intervertebral disc heights using Laplace equation and volume using sagittal areas from 2D MR scans of the lumbar spine¹⁰. They compared results with the measurements obtained by manual digitization, and observed strong reliability for both manual and semi-automated methods. Kim et al reported that disc height index and sagittal range of motion showed a significant correlation with the incidence of recurrent lumbar disc herniation, suggesting that preoperative biomechanical conditions of the spine can be an important pathogenic factor in the site of lumbar disc surgery⁸. This study has been conducted to evaluate lumbar disc heights with morphometric measurements by using computed tomography to support anatomic knowledge for safe surgery performed to intervertebral disc space.

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