Volume: 25, Issue:3, July 2014 pp: 189-192 ORIGINAL ARTICLE / ORJİNAL MAKALE

MEASUREMENT OF THE HEIGHT OF THE DISC SPACES OF THE LOWER CERVICAL VERTEBRAE AND THEIR CLINICAL USE

ALT SERVİKAL BÖLGENİN DİSK YÜKSEKLİKLERİNİN ÖLÇÜMÜ VE BUNLARIN KLİNİK KULLANIMI

Murat KÖKEN[1],
Selçuk ÖZDOĞAN[2],
Yusuf Emrah GERGİN[3],
Serdar Onur AYDIN[3],
Ebru YÜCE[4],
Mehmet TİRYAKİ[2],
Necati TATARLI[2],
Hikmet Turan SÜSLÜ[2],
Tufan HİÇDÖNMEZ[5]

[1]Orthopedics and Traumatology Specialist, Gazi State Hospital, Samsun
[2]Brain and Nerve Surgery Specialist, Kartal Dr.Lütfi Kırdar Training and Research Hospital, İstanbul,
[3]Brain and Nerve Surgery Asistant Dr., Kartal Dr.Lütfi Kırdar Training and Research Hospital, İstanbul,
[4]Special Akrapol Hospital, Ankara.
[5]Doç. Dr., Brain and Nerve Surgery Specialist, Kartal Dr.Lütfi Kırdar Training and Research Hospital, İstanbul,

Address: Selçuk ÖZDOĞAN, Beyin ve Sinir Cerrahisi Uzmanı, Kartal Dr. Lütfi Kırdar Eğitim ve Araştırma Hastanesi, Cevizli-Kartal / İstanbul.
Phone: 0506 7637173
Fax: 0216 5784965
E-mail: drselcukozdogan@hotmail.com
Received: 2nd May, 2014
Accepted: 15th July, 2014

SUMMARY

Objective: The aim of this study is to determine the normal range of intervertebral disc heights in the lower cervical region.

Materials and Methods: 50 male and 50 female adults who had no cervical trauma or history of pathology were included in the study. Data were collected retrospectively using patient files and the radiology archive. Cervical magnetic resonance imaging midline sagittal sections were taken, and measurement of the disc height was done in millimeters using a computer from a medium space.

Results: The mean age was 40.06 ± 13.59 years for the male patients and 39.47 ± 12.61 years for the female patients. There were no statistically significant differences between the sexes with age. The median value of the C4–5 disc space height was 5.99 ± 0.94 in males and 5.77 ± 0.88 in females. The median value of the C5–6 disc space height was calculated as 6.07 ± 0.79 in males and 5.95 ± 0.92 in females. The median value of the C6–7 disc space height was calculated as 6.37 ± 0.72 in males and 6.22 ± 0.77 in females. No significant differences in the disc space heights were found between the sexes.

Conclusion: The values ranged between 3 mm and 7 mm. Our results are similar to the literature, and support studies that report that the heights of cages and prosthetics used after discectomy should be between these ranges. As a result, it is suggested that the height of the implant used after cervical discectomy should be decided after measurement of the patient's cervical intervertebral disc heights and the foramina stenosis ratio, to decrease the rate of complications such as neurological deficit and implant insufficiency.

Key words: Cervical disc height, anterior cervical discectomy, cervical discopathy

Level of evidence: Retrospective clinical study, Level III

ÖZET

Amaç: Çalışmsnın amacı alt servikal bölge disk aralıklarının normal yükseklik aralıklarında belirlenmesidir.

Materyal-metod: Çalışmada servikal travması veya patolojisi olma- yan 50 erkek ve 50 kadın hasta dâhil edilmiştir. Veriler retrospektif olarak dosyalardan ve radyolojik görüntü arşivinden elde edilmiştir. Servikal manyetik rezonans görüntüleme sagittal orta hat kesitleri alınmış ve disk yüksekliği orta mesafeden milimetrik ölçü kullanılarak bilgisayar ortamında yapılmıştır.

Sonuçlar: Erkeklerde yaş ortancası 40.06 ± 13.59, kadınlarda ise 39.47 ± 12.61 olarak hesaplanmıştır. Yaş grupları arasında erkek ve kadınlarda istatistiksel anlamlı bir fark yoktur. C4-5 mesafesi disk yüksekliği ortanca değeri erkeklerde 5.99 ± 0.94, kadınlarda 5.77 ± 0.88 olarak elde edilmiştir. C5-6 mesafesi disk yüksekliği ortanca değeri erkeklerde 6.07 ± 0.79, kadınlarda 5.95 ± 0.92 hesaplanmıştır. C6-7 mesafesi disk yüksekliği ortanca değeri erkeklerde 6.37 ± 0.72, kadınlarda 6.22 ± 0.77 hesaplanmıştır. Mesafelerin yüksekliklerinde cinsiyetler arası anlamlı fark bulunamamıştır.

Çıkarım: Bulunan değerler 3 mm ile 7 mm arasında değişiklik göstermektedir. Elde edilen bu veriler, literatürdeki çalışmalarla benzerdir ve diskektomi sonrası disk aralığına konulması gereken kafes veya protezlerin yüksekliklerinin bu değerler arasında olması gerektiğini ileri süren çalışmaları destekler görünmektedir. Sonuç olarak; servikal diskektomi gibi girişimlerden sonra disk aralığına konulacak materyalin yüksekliğine, hastanın kendi disk yükseklikleri ve foramenin daralma oranına bakılarak karar verilmesinin olası nöral defisit ve implant yetesizliği gibi komplikasyon oranı azaltılacağı fikirleri sürülmüştür.

Anahtar Kelimeler: Servikal disk yüksekliği, anterior servikal dis- kektomi, servikal diskopati

Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

INTRODUCTION:

Degenerative processes that increase with aging are the most common cause of pathology in the cervical region, as well as increased cervical discopathy, spinal stenosis, and instabilities. Cervical discectomy is the most frequently performed surgery of the cervical region[3]. The anterior approach that began to be used in the early 19th century was further developed and popularized by Robinson-Smith, Cloward, and Hodgson-Stock[7,9,14]. In the 1970s, anterior fusion techniques using plates and screws were developed, and the anterior approach began to be used routinely for degenerative cervical disc disease, spondylosis, fractures and neoplasms[4,10].

To give fusion after anterior cervical discectomy, autografts, PEEK cages and prostheses have begun to be placed in the disc space. The use of these materials at the correct height helps fusion, and also leads to a reduction of symptoms through decompressing the neural canal[2]. It is necessary to have a full knowledge of the disc height to place material of the correct height. There are not many studies on this subject.

In this study, we analyzed the heights of the C4–5, C5–6 and C6–7 disc spaces, which are the levels at which cervical disc operations are done most commonly, in adult patients.

MATERIALS AND METHODS:

50 male and 50 female patients without cervical trauma or pathologies were included in the study. Data were obtained retrospectively from patient files and the radiological image archive. Cervical magnetic resonance imaging (MRI) midline sagittal sections were taken and the disc height was measured by computer in millimeters from a medium space (Figure-1).

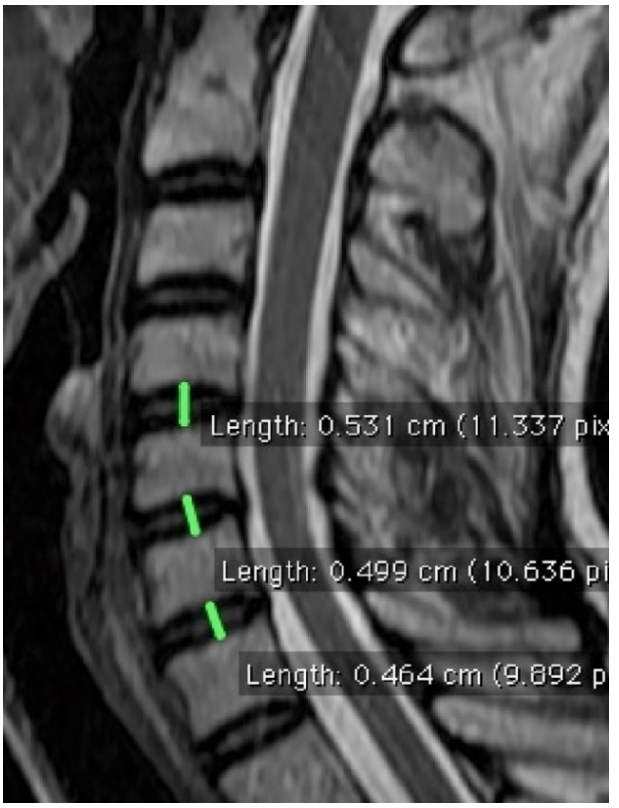

Figure-1. Measurement of C4–5, C5–6 and C6–7 disc distances with cervical MRI

Statistical data were presented with median values and standard deviations. The Mann-Whitney U test was used for comparison of the groups. For statistical analysis, the PASW Statistics v18 program was used. P-values lower than 0.05 were taken to indicate statistical significance.

RESULTS:

The median age was calculated as 40.06 ± 13.59 years in males and 39.47 ± 12.61 years in females. There were no statistically significant differences between the age groups for men and women (p=0.271) (Table-1).

The median C4–5 disc space height was measured as 5.99 ± 0.94 in males and 5.77 ± 0.88 in females. There was no significant difference between the sexes (p=0.653) (Table-1).

The median C5–6 disc space height was calculated as 6.07 ± 0.79 in males and 5.95 ± 0.92 in females. There was no significant difference between the sexes (p=0.397) (Table-1).

The median C6–7 disc space height was calculated as 6.37 ± 0.72 in males and 6.22 ± 0.77 in females. There was no significant difference between the sexes (p=0.782) (Table-1).

Table-1. Statistical data distribution table of C4–5, C5–6, and C6–7 disc heights (mm)

	Male		Female		
	Median	Standard Deviation	Median	Standard Deviation	P
AGE	40.06	13.59	39.47	12.61	0.271
C4-5	5.99	0.94	5.77	0.80	0.653
C5-6	6.07	0.79	5.95	0.92	0.397
C6-7	6.37	0.72	6.22	0.77	0.782

DISCUSSION:

As new technologies emerge, the variety of fusion materials and removable dentures being used in cervical disc surgery also increases. To use these materials properly, it is necessary to have a full knowledge of the anatomical and morphometric characteristics of the cervical spine and disc spaces. There are not many studies on this subject but the number of morphometric measurements is gradually increasing, due to the increasing number of materials[6,17].

Yukawa et al. reported a C4–5 median value of 6.2 mm in males and 5.6 mm in females, a C5–6 median value of 6.1 mm in males and 5.4 mm in females, and a C6–7 median value of 6.6 mm in males and 6.3 mm in females, in their studies of direct cervical lateral radiographs of 1,230 adults[18]. Although the measurement techniques they used are different, these results are parallel to the results of our study.

Abuzayed et al. reported the median values as 3.9 mm for C4–5, 3.9 mm for C5–6, and 4.5 mm for C6–7, using computed tomography measurements of 48 adult patients[1]. On measurement of seven cadavers using MRI by Sohn et al., the median values were reported as 4.6 mm for C4–5, 3.92 mm for C5–6, and 3.97 mm for C6–7 [15].

It is possible to find different results in the literature due to differences in the measurement techniques and the mean patient age[1,6,8,13,17,18]. However, the measured values usually vary between 3 mm and 7 mm. In the light of such information, the material thickness being used after cervical discectomy can be determined. In the literature, it is often emphasized that PEEK cages and prosthetics in a height range of 4 mm to 7 mm should be preferred. However, it has been suggested that the disc spacing is already in decline with cervical degenerative discopathy, and therefore it is required to relieve the narrowing foramina by using materials 2 mm larger than measurements taken preoperatively[2,11]. It has been reported that raising the foramen by up to 3 mm liberalizes and relieves the neural tissue.

Complications that may occur in cervical fusion or prosthesis implantation include material breakage, forward withdrawal from the disc distance, the development of vertebral fractures, a narrow channel, and extreme nervous tension[5,12,16]. The material should be thinner than the disc space to prevent it moving forwards. However, if it is too thin, the foramen will shrink and cause pain. Bigger materials can cause fractures in the vertebral end portions, as well as lead to neuropathic symptoms through stretching the foramen.

In conclusion, according to the results of our study and similar studies, the lower cervical spine disc height values vary in the range of 3 mm to 7 mm. These measurements should be made with the help of preoperative radiological examinations. The height of the material to be introduced into the disc space should be determined by looking at the patient's own disc height and foramen narrowing rate, to reduce the complication rate.

REFERENCES

1. Abuzayed B, Tutunculer B, Kucukyuruk B, Tuzgen S. Anatomic basis of anterior and posterior instrumentation of the spine: morphometric study. *Surg Radiol Anat* 2010; 32: 75-85.
2. Albert TJ, Smith MD, Bressler E, Johnson LJ. An in vivo analysis of the dimensional changes of the neuroforamen after anterior cervical diskectomy and fusion: A radiologic investigation. *J Spinal Dis* 1997; 10(3): 229-233.
3. Angevine PD, Arons RR, McCormick PC. National and regional rates and variation of cervical discectomy with and without anterior fusion, 1990-1999. *Spine* 2003; 28(9): 931-939.
4. Bailey RW, Bagdley CE. Stabilization of the cervical spine by anerior fusion. *J Bone Joint Surg Am* 1960; 42(4): 565-624
5. Bertalanffy H, Eggert HR. COmplications of anterior cervical discectomy without fusion in 450 consecutive patients. *Acta Neurochirurgica* 1989; 99(1-2): 41-50.
6. Boyle JJW, Singer KP, Milne NM. Morphological survey of the cervicothoracic junctional region. *Spine* 1996; 21(5): 544-548.
7. Cloward RB. The anterior approach for removal of ruptured cervical discs. *J Neurosurg* 1958; 15: 602-617.
8. Frobin W, Leivseth G, Biggemann M, Brinckmann P. Vertebral height, disc height, posteroanterior displacement and dens–atlas gap in the cervical spine: precision measurement protocol and normal data. *Clin Biomech* 2002; 17: 423–431.
9. Hodgson AR, Stock FE. Anterior spinal fusion: A preliminary communication on the radical treatment of Pott's disease and Pott's paraplegia. *Br J Surg* 1956; 54: 266-275.
10. Johnston FG, Crockard HA. One-stage internal fixation and anterior fusion in complex cervical spinal disorders. *J Neurosurgery* 1995; 82(2): 234-238.
11. Lu J, Ebraheim NA, Huntoon M, Haman SP. Cervical intervertebral disc space narrowing and size of intervertebral foramina. *Clin Orthop Rel Res* 2000; 370: 259-264.
12. Olsewski JM, Garvey TA, Schendel MJ. Biomechanical analysis of facet and graft loading in a smith-robinson type cervical spinal model. *Spine* 1994; 19(22): 2540-2544.
13. Pait TG, Killefer JA, Arnautovic KI. Surgical anatomy of the anterior cervical spine: The disc space, vertebral artery, and associated bony structures. *Neurosurgery* 1996; 39(4): 769-776.
14. Robinson RA, Smith GW. Anterolateral cervical disc removal and interbody infusion for cervical disc syndrome. *Bull John Hopkins Hosp* 1955; 96: 223-224.
15. Sohn HM, You JW, Lee JY. The relationsheep between disc degeneration and morphologic changes in the intervertebral foramen of the cervical spine: A cadeveric MRI and CT study. *J Korean Med Sci* 2004; 19: 101-106.
16. Truumees E, Demetropoulos CK, Yang KH, Herkowitz HN. Effects of disc height and distractive forces on graft compression in an anterior cervical discectomy model. *Spine* 2002; 27(22): 2441-2445.
17. Tubbs RS, Rompala OJ, Verma K, Mortazavi MM, Benninger B, Loukas M, Chambers MR. Analysis of the uncinate processes of the cervical spine: an anatomical study. *J Neurosurg Spine* 2012; 16: 402–407.
18. Yukowa Y, Kato F, Suda K, Yamagata M, Ueta T. Age-related changes in osseous anatomy, alignment, and range of motion of the cervical spine. Part I: Radiographic data from over 1,200 asymptomatic subjects. *Eur Spine J* 2012; 21: 1492–1498.