

ANALYSIS OF PEDICLE DIMENSIONS OF THE THORACOLUMBAR SPINE

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ABSTRACT

The objective of the study was to outline the bilateral pedicle diameters and angulations in transverse plane at the thoracolumbar spine. Computerized tomography scans of 94 patients with dorsolumbar pain but no radiographic signs of bony disease, deformity or spinal operation were investigated between November 2000 and September 2002. There were 26 males and 68 females. The mean age of the patients was 42 years (12-60). The widest pedicle in females was at T12, and in males it was at L2. The largest pedicle angle in the transverse plane was at L2 in both sexes. There was a statistically significant gender related difference between the bilateral pedicle diameters at L1 and L2.

Key words: Pedicle morphology, Computerized tomography, Thoracolumbar spine

ÖZET

TORAKOLOMBER OMURGANIN PEDİKÜL BOYUTLARININ ANALİZİ

Bu çalışmada torakolomber omurganın transvers planda bilateral pedikül çap ve açılanmasının incelenmesi amaçlanmıştır. Kasım 2000 ve Eylül 2002 tarihleri arasında, radyografide kemik hastalığı, deformite veya spinal ameliyat sekeli belirtisi bulunmayan 94 hastanın bilgisayarlı tomografi tetkikleri incelendi. Ortalama yaşı 42 (12-60) olan hastaların 68'i kadın ve 26'sı erkekti. Kadınlarda en geniş pedikül çapı T12 deyken, erkeklerde L2 deydi. Transvers planda en büyük açılanma her iki cinste de L2 de saptandı. L1 ve L2 pedikül çapları cinsler arasında istatistiksel olarak anlamlı fark gösteriyordu..

Anahtar Sözcükler: Pedikül morfolojisi, Bilgisayarlı tomografi, Torakolomber omurga

INTRODUCTION

Instrumentation techniques of the spine, using the pedicle as a source of purchase from the posterior into the vertebral corpus have aroused interest in spinal surgery. Pedicle screw fixation of the spine is considered to be one of the most stable and versatile methods of fixation of the spine (6,7,8). Many systems are being used currently which incorporate plates and screws, rods and screws, and external fixator pins that obtain secure

purchase of the vertebra. (3,9) Although the advantages of these systems are numerous, complications such as failure of fixation and injury to vital structures can be avoided after a through knowledge of the pedicle dimensions (5,6).

This study was undertaken to outline the bilateral pedicle diameter and angulation in transverse plane at the thoracolumbar spine.

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PATIENTS AND METHODS

Computerized tomography (CT) scans of 94 patients with dorsolumbar pain but no radiographic signs of bony disease, deformity or spinal operation were investigated between November 2000 and September 2002. There were 26 males and 68 females. The mean age of the patients was 42 years (12-60). The procedure was approved by the Ethics Committee of the Faculty of Medicine of the University of Mersin.

Following a lateral topogram of the thoracolumbar junction a slice was made at the center of the pedicles of T11, T12, L1, L2 with thickness and increments of 3mm. (Somatom AR Star, Erlangen-Germany). Bilateral pedicle thickness and angulation of the pedicle with the corpus was measured.

Statistical analysis was performed by SPSS 9.0 for Windows. Gender related differences between means were analyzed by Independent samples t-test and comparisons of measurements of sides were accomplished by Paired samples t-test. $P \leq 0.05$ were considered significant.

RESULTS

The mean diameters of the right pedicle at T11 was $5,6 \pm 1,4$ mm in females, $6,5 \pm 1,3$ mm in males, and that of the left was $5,9 \pm 1,3$ mm, and $6,3 \pm 1,8$ mm respectively. At T12 they were $5,9 \pm 1,2$ mm in females, and $6,2 \pm 1,7$ mm in males on the right side, and $6,2 \pm 1,4$ mm in females and $6,3 \pm 1,8$ mm in males on the left side. At L1 the measurements were as $5,4 \pm 1,3$ mm; $6,1 \pm 2$ mm, and $5,7 \pm 1,6$ mm; $6,3 \pm 1,9$ mm respectively. Finally, at L2 they were as $5,6 \pm 1,5$ mm; $6,5 \pm 1,7$ mm, and $5,8 \pm 1,2$ mm; $6,5 \pm 1,6$ mm (Figure 1).

The mean angulations of the right pedicle at T11 was $9,9 \pm 3,4^\circ$ in females, $9,6 \pm 2,3^\circ$ in males and that of the left was $10,3 \pm 3,7^\circ$ and $10 \pm 2,7^\circ$ respectively. At T12 they were $9,4 \pm 2,5^\circ$ in females, and $9,2 \pm 2^\circ$ in males on the right side, and $10,2 \pm 3,0^\circ$ in females and $9,9 \pm 2,2^\circ$ in males on the left side. At L1 the measurements were a

$11,6 \pm 2,8^\circ$; $11,2 \pm 2,5^\circ$, and $12,5 \pm 3,2^\circ$; $12,3 \pm 2,6^\circ$ respectively. Finally, at L2 they were as $12,6 \pm 2,9^\circ$; $12,2 \pm 2,7^\circ$, and $12,9 \pm 3,4^\circ$; $13,4 \pm 2,8^\circ$ (Figure 2).

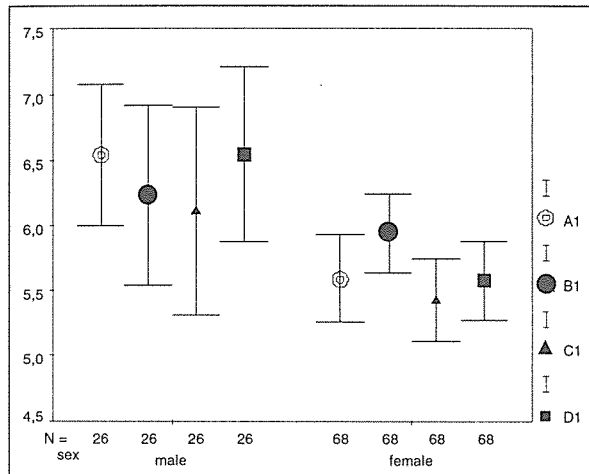


Figure 1. Graph showing the outcome of the measurement of pedicle diameters of females and males.

A1=T11 pedicle diameter; B1=T12 pedicle diameter, C1= L1 pedicle diameter, D1= L2 pedicle diameter.

There was a gender related difference in favour of males between the bilateral pedicle diameters at L1 and L2. There was not any gender related difference between the angulations at all levels. The difference between the pedicle diameters and angles of right and left sides was not significant.

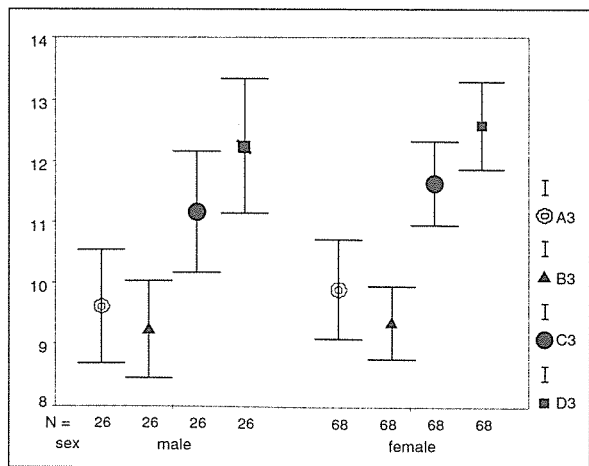


Figure 2. Graph showing the outcome of the measurement of pedicle angles of females and males.

A3=T11 pedicle angulation; B3=T12 pedicle angulation, C3= L1 pedicle angulation, D3= L2 pedicle angulation

DISCUSSION

Spine pedicle fixation is being widely employed in internal fixation of the spine (3,5). A detailed knowledge of pedicle dimensions is essential when using pedicle screws. A wide variability has been reported between demographic groups (1). The oval shaped pedicle is narrowest in the transverse plane (5,9). It is in this plane that the maximum possible pedicle screw diameter is determined. Screws larger than the pedicle can cause pedicle breakage, thread cut out, root irritation and implant failure (2,7,8,9).

In his study of 30 skeletons, Berry et al. emphasized that CT scanning could be a useful tool for evaluating spinal geometry in vivo. They found that the mean diameter of the right pedicles were: T12 7.7 mm \pm 2.1, L1 7.0 \pm 1.9 mm, L2 7.4 \pm 1.6 mm; and that of left were: T12 7.6 \pm 1.5 mm, L1 6.9 \pm 1.7 mm, L2 7.5 \pm 1.5 mm. The right transverse inclination angles were: T12 -5 \pm 8°, L1 6 \pm 8°, L2 11 \pm 3°; and the left transverse inclination angles were: T12 -1 \pm 10°, L1 9 \pm 7°, L2 12 \pm 3° (1).

Hou et al. studied 40 specimens and noted the following: The cumulative mean diameters were 8.1 mm at T11, 8.3 mm at T12, 7.0 mm at L1, and 7.4 mm at L2. Progressing distally produced more inclination away from the midline (3). Although they displayed the outcome of in vitro specimens, the results of the analysis of the pedicles of different populations were not in accordance with our in vivo results.

In their series, Kaygusuz et al. studied CT scans of 111 Turkish patients and noted the mean pedicle diameter in females and males respectively: L1 4.78 mm, L2 5.44 mm, L1 5.76 mm, L2 6.3 mm (4). In our study the diameters at these levels were similar. However, Us et al. found that the mean diameter of pedicles of Turkish females were: T11 6.58 mm, T12 7.00 mm, L1 7.08 mm, L2 7.65 mm; and that of males were: T11 6.92 mm, T12

7.44 mm, L1 7.40 mm, L2 7.96 mm (7).

A limitation of our study was that the sagittal diameters of the pedicles and their angulations in this plane were not assessed due to the reluctance in overexposing the patients to radiation.

Although the number of cases in our series was small, more studies involving greater number of patients should be initiated to emphasize the different dimensions of the pedicles of the thoracolumbar spine.

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