A STUDY ABOUT LUMBAR VERTEBRAL PEDICLE DIAMETER MEASUREMENT FROM DIRECT RADIOGRAMS

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Transpedicular fixation of the spine, is a secure way of obtaining effective vertebral stabilization in the management of different spinal disorders. In this study we investigate whether the pedicle size measurement from conventional radiograms is possible for a healthy preoperative instrumentation planning. Transverse lumbar vertebral pedicle diameter was measured in 38 pedicles of 10 healthy individuals and 79 pedicles of 40 disarticulated cadaveric vertebrae for a total of 117 pedicles. In measurements, direct radiograms and for comparison, radiograms obtained with a computerized digital substraction angiography system was used. In both of these investigations, magnification was corrected. In the cadaveric vertebrae, also the actual pedicle sizes were measured. We found that the diameters of pedicles measured on direct radiographs or DSA radiographs may differ significantly from the actual measurements of vertebrae even when there is no detectable magnification.

Key Words: *Vertebral morphology, pedicle diameter, lumbar vertebra.*

INTRODUCTION

Transpedicular fixation of the spine is very popular nowadays. The screws passing through the strongest part of the vertebra, that is the pedicle, provides secure fixation. Since 1989 we have been using transpedicular screws in many different spinal disorders including vertebral fractures, scoliosis, spondylolysthesis and pseudoarthrosis repair, in our clinic. It is known that for an effective stabilization, the screw with the largest possible diameter must be implanted (7). For different purposes and different age groups, screws with different diameters are required. Knowing the size of the pedicle is therefore important for preoperative instrumentation planning. In this study we investigate whether the pedicle size measurement from conventional radiograms is possible. The vertebral pedicle is not cylinderical but resembles an hourglass, with the exception of the fifth lumbar vertebra (5, 6, 8). So along the length of the pedicle, both the sagittal and transverse diameters change independently (1, 2, 3, 4). In a recent study, it has been shown that, the oval, which describes the pedicle on AP radiograms, is the narrowest part of the pedicle (6). In this oval, the transverse diameter is narrower than the sagittal one so the maximum allowable screw diameter is determined in this plane (8). Therefore we choose to investigate this critical diameter, i.e. the transverse diameter, in our study.

MATERIALS AND METHODS

We performed this study in two parts. In the first part, we have measured transverse lumbar vertebral pedicle diameters of 10 healthy adult individuals. In the second part, we have investigated pedicles of 40 disarticulated cadaveric lumbar vertebrae those having no detectable anomaly. Since in some direct radiograms the pedicle image was not very accurate for a healthy measurement, we excluded some of the pedicles from the study. We investigated 38 pedicles of 10 healthy individuals and 79 pedicles of 40 disarticulated vertebrae. In measurements, direct radiograms and for comprison, more precise radiograms obtained with a computerized Digital Substraction Angiography (DSA) system (PHILIPS ARC-U 14, GERMANY) was used. magnification on both of these radiographs was corrected by a standard measurement tool for DSA, a metal ball of 47.60 mm. diameter. In cadaveric vertebrae, we also measured actual pedicle transverse diameters. The narrowest dimension in the transverse plane was choosen as the transverse diameter of the pedicle.

RESULTS

After completion of the measurements, we compared the data. In the first group; i.e. 38 pedicies of 10 healthy individuals; we obtained two sets of transverse diameters: magnification corrected data from direct radiograms and data from DSA system. In the second group; i.e. 79 pedicles of 40 disarticulated vertebrae; in addition to data similar to above, we have also obtained actual pedicle sizes with direct measurement, The results we have also obtained actual pedicle sizes with direct measurement. The results we have obtained from these data are as follows:

1) Although the magnification was corrected, the

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actual pedicle sizes in group II differred from the sizes obtained by conventional radiograms and DSA radiograms. In this group, we found that, actual pedicle size is bigger than the sizes obtained with X-ray and DSA radiograms for and average of 2.1 mm. (2.01 mm bigger when compared with direct radiograms and 2.2 mm bigger when compared with DSA radiograms).

2) Also there is some mild difference (Approximately 0.2 mm) between the measurements obtained by direct radiograms and DSA radiograms both in group I and group II.

DISCUSSION

In this study we try to find out whether the pedicle size measurement from conventional radiograms is possible for a healthy preoperative instrumentation planning. We have measured the transverse diameter of the oval that represents the pedicle in PA radiograms. Since this is the narrowest part, it is important in choosing the maximum allowable screw diameter.

But we saw that, even there is no detectable magnification, the pedicle sizes measured from direct radiograms or DSA radiograms do not correlate with the actual pedicle diameters of the disarticulated and fixed vertebrae. In living individuals, the problem is more complicated since with axial rotation the pedicle image changes; therefore the diameters of the same vertebral pedicle could change in the same patient with posture. Also the lateral borders of the pedicles may not be clearly visible on PA radiograms. Our findings are parallel with Olsewski who have compared various measurements on radiographs and CT scans with actual sizes for a morphometric study and found measurements from both CT and direct radiographs does not reflect the actual pedicle diameter (8).

We conclude that pedicle size measurement from direct radiograms is not safe even there is no magnification.

REFERENCES

1. Berry J.L., Moran J.M., Berg W.S., Steffee A.D. A Morphometric Study of Human Lumbar and Selected Thoracic Vertebrae. Spine Vol.12, No.4 pp:362-367, 1987.
2. Hou S., Hu R., Shi Y. Pedicle Morphology of the Lower Thoracic and Lumbar Spine in a Chinese Population. Spine Vol.18, No.13 pp:1850-1855, 1993.
3. Krag M.H., Weaver D.L., Beynnon B.D., Haugh L.D. Morphometry of the Thoracic and Lubar Spine Related to Transpedicular Screw Placement for Surgical Spinal Fixation Spine Vol.13, No.1 pp:27-32, 1988.
4. Moran J.M., Berg W.S., Berry J.L., Geiger J.M., Steffee A.D. Transpedicular Screw Fixation. J. of Orthopaedic Research 7(1):107-114, 1989.
5. Olsewski J.M., Simmons E.H., Kallen F.C., Mendel F.C., Morphometry of the Lumbar Spine: Anatomical Persphectives Related to Transpedicular Fixation. J.Bone and Joint Surg., Vol. 72-A, No.4, APRIL, 1990.
6. Phillips J.H., Kling T.F., Cohen M.D. The Radiographic Anatomy of the Thoracic Pedicle Spine Vol.19, No.4 pp 446-449, 1994.
7. Weinstein J.N., Spratt K.F., Spengiler D., Brick C., Reid S. Spinal Pedicle Fixation: Reliability and Validity of Roentgenogram-Based Assessment and Surgical Factors on Successful Screw Placement. Spine Vol. 13, No.9 pp:1012-1018, 1988.
8. Zindrick M.R., Wiltse L.L., Doornik A., idell E.H., Knight G.W., Patwardhan A.G., Thomas J.C., Rothman S.L., Fields B.T., analysis of the Morphometric Characteristics of the Thoracic and Lubar Pedicles. Spine Vol. 12, No.2 pp:160-166, 1987.