INTRODUCTION

Lumber spinal stenosis is a common disorder characterized by stenosis of the spinal canal, resulting in neural compression(1). Persistent pain and neurogenic claudication are the main clinical manifestations (2). Surgery is indicated when conservative treatment has failed or progressive symptoms limits daily activity with lowering quality of life(3). Surgical options include laminectomy, flavectomy, laminotomy, laminoplasty, and spinal fusion. However, most of the surgical options are destabilizing procedures, and there is risk of morbidity in this aged population(6). Recently minimal invasive spine surgery techniques have allowed foraminotomy through the transforaminal endoscopic approach(7). On the other hand, interspinous devices may decrease lumbar spinal stenosis by distraction of the buckled ligamentum flavum. All these techniques have advantages and disadvantages.

The aim of this article is to describe a novel technique to expand the stenotic spinal canal through cutting and distracting the pedicle using a special custom made distraction screw. This pedicle osteotomy technique is called “canal expanding pediculoplasty”.

Description of Technique:

Seven male cadavers were used for this study. The operative procedure was performed in prone position. After determination of the bony landmarks (spinous processes and iliac crests). The position of the targeted pedicle was determined under biplanar fluoroscopy, and a Jamshidi needle was directed into the 2 o'clock location of the appropriate pedicle. After confirmation of the position of the Jamshidi needle, it was replaced with a 2 mm K wire.

Incremental serial tissue dilators were placed sequentially. The inner dilator was removed, leaving the last placed

Spinal Canal Expanding Pediculoplasty

Alper Gokce, M.D., Fatih Ozyer, M.D., Burak Yalcin, M.D., Sait Naderi, M.D.

1 Department of Orthopaedics and Traumatology, Namik Kemal University, School of Medicine, Tekirdağ, Turkey
2 Department of Orthopaedics and Traumatology, Istanbul University, Cerrahpasa Medical Faculty, Istanbul, Turkey
3 Department of Orthopaedics and Traumatology, Nusaybin State Hospital, Nusaybin, Turkey
4 Department of Neurosurgery, Umraniye Teaching and Research Hospital, Istanbul, Turkey

ABSTRACT

Lumber spinal stenosis is a clinical condition secondary to narrowing of the spinal canal, resulting in neural compression. Elongation in pedicle length may lead expansion of the spinal canal and decompress the nerve roots. In this article a minimal invasive technique was described for expanding of a narrowed spinal canal with distraction pedicle osteotomy. A special pedicle screw was designed to distract the osteotomized pedicle and to recreate stability in broken osseous frame of the medullary canal. This technique was tested on 14 lumbar spinal levels of 7 male cadavers unilaterally. Initial preexpansion measurements were as follows: A 2.1 mm (1-3 mm); B 2.1 (1-3 mm); C 13.4 mm (11-17 mm) and D 98 mm² (71-104 mm²). After expansion of the osteotomized pedicle the values were measured as A 5.6 mm (4-9 mm); B 2.1 (1-3 mm); C 15.9 mm (14-22 mm) and D 129 mm² (107-194 mm²). Canal expansion was improved as follows: A: 167%, B: 0% no change, C:19%, D: 31%. It is concluded that the pediculoplasty technique provides canal expansion in a minimal invasive way.

KEY WORDS: Decompression, Minimal invasive spinal surgery, Spinal stenosis.
dilator as the working port. A cannulated modified Kambin sleeve (6.4 mm diameter; Smith and Nephew) was passed over the tissue dilator with a guide pin until it abutted to the cortical margins of the pedicle without reaching into the vertebral body.

Using fluoroscopic guidance, the transitional zone of the pedicle was identified for the osteotomy site. This proximal part of the pedicle is an important localisation at the vertebral body-pedicle junction. The C arm of the image intensifier was rotated 90° to obtain a lateral view of the guide pin and the length of the pedicle was measured. An oscillating saw has prepared for osteotomy with bending at the end 90 degrees. It was inserted in the dilated pedicle till the measured depth with a thin blade of 5 mm width. The saw rotated around itself 360 degrees and pedicle cortex was cut from inside to outside (Figure 2).

The bone taper was placed and threaded to the osteotomy side and a bending maneuver was repeated gently in the craniocaudal direction until the pedicle was broken. Ventral and lateral bending was not recommended to avoid damage to nerve roots and the dural sac (Figure 3). Detachment of the osteotomy site were made by this “new designed pedicle screw” which will be left as an implant for stabilisation of opened osseous frame of the spinal canal.
Pedicle screw

A “new pedicle screw” was designed for distraction (Figure 4) of the osteotomized pedicle that was composed of two parts with different diameters. The screw is 40 mm in length complete. The terminal half of the screw is 3.5 mm in diameter and taper cut designed at the distal tip. The other half is also 20 mm in length, but has 6.5 mm diameter width. The distances between the threads of the screw were same in both parts. By driving the screw, the step at the transition of the screw between the two parts distracts the osteotomy site while pushing the vertebral body from the pedicle (Figure 5).

METHODS

Two lumbar spinal levels (L4 and L5) of each selected cadaver were operated on in this study. Whole lumbar regions (L1-S) of the cadavers were dissected and resected for transport to CT examinations. Pedicle screws were slackened for measurement of spinal canal at pre-expansion. The screws were then tightened and expanded and the spinal canal was visualized with computerized tomography.

The distances (A and B) were measured at the inner neural foramina of the spinal canal. The sagittal diameter (C) of the spinal canal was measured between the posterior corner of the vertebral body and the anterior border of the spinous process and the area of the canal were measured as well (Area) with an ellipse. The data were listed and mean values are calculated.

RESULTS

Initial pre-expansion measurements were as follows: A 2.1 mm (1-3 mm); B 2.1 (1-3 mm); C 13.4 mm (11-17 mm) and D 98 mm² (71-104 mm²). After expansion of the osteotomized pedicle the values were measured A 5.6 mm (4-9 mm); B 2.1 (1-3 mm); C 15.9 mm (14-22 mm) and D 129 mm² (107-194 mm²). Canal expansion was improved as follows: A:167%, B: 0% no change, C:19%, D: 31%.

DISCUSSION

Spinal stenosis is a common progressive disorder in elderly population resulting in neurological symptoms. The osteophytes, hypertrophied ligaments and facet joints start to take more space in the spinal canal.

Treatment alternatives vary between conservative treatment, physical therapy and surgical therapy. When symptoms fail to improve or progress despite conservative treatment, surgery may be indicated to decompress the nerve roots by opening the spinal canal by performing laminectomy, facetectomy and removing the degenerate material(8). In case of spinal instability, a supplemental bony fusion can be performed(9-11).

Regaining volume expansion of the spinal canal can be achieved using a variety of laminoplasty techniques, a surgical option similar to those used in the cervical spine. However, the use of laminoplasty in the lumbar spine has not become popular.

Approximately 85% of affected individuals are over 60 years of age, with a risk of high co-morbidities complicating the postoperative process(2). The likelihood of systemic complication in patients with high co-morbidities has led to the use of minimal invasive approaches. An interspinous distractive device is among the percutaneous techniques.
that can expand the spinal canal a limited amount (14). Despite the reported good clinical results of these implants, the validity and generalization of these studies are controversial. Studies included carefully selected patient cohorts and only patients for whom pain relief at baseline was achieved in flexion but exacerbated in extension. The patients’ evaluation was based on efficacy outcomes with subjective self-reported scales. The follow-up periods were no longer than 2 years. Not all participants in the studies completed many of the device implantation procedures, and intercentre analysis was also not performed.

The technique described here is a novel, minimal invasive technique. Our results showed that it provided 19%, mean expansion in the spinal canal diameter and 31% expansion in the canal sectional area. Canal expansion may be achieved using unilateral or bilateral pediculoplasty. The technique also allows multilevel application and combination with rigid or flexible spinal rods.

CONCLUSION

We conclude that the pediculoplasty technique provides canal expansion in a minimal invasive way. Further surgical studies supplemented with the radiological measurements should be performed in animal studies, before application of this technique on humans.

REFERENCES


Address for correspondence:
Alper Gokce
Namik Kemal Caddesi No:14 59030 Tekirdag
Tel: 0 (282) 264 35 13 (14/13/16)
Fax: 0 (282) 260 21 95
e-mail: a.gokce@yahoo.com