A Comparison of the Degree of Lateral Recess and Foraminal Enlargement With Facet Preservation in the Treatment of Lumbar Stenosis With Standard Surgical Tools Versus a Novel Powered Filing Instrument: A Cadaver Study

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ABSTRACT

Background

The SurgiFile (SurgiFile, Inc., Carlsbad, California) is a specialized tool designed for the treatment of lateral recess and foraminal stenosis that allows surgeons to internally expand and decompress the entire length of the neural foramen while preserving the integrity of the overlying facet complex.

Methods

We used two cadaveric specimens in this study. After they removed the lamina and spinous processes of L2, L3, L4, and L5 from the dorsal spine, fellowship-trained spinal surgeons used the standard tools and the SurgiFile to the best of their experience and ability on alternating sides of each level to decompress the lateral recess and neural foramen while still preserving at least 50% of the dorsal facet complex. Using preoperative and postoperative fine-cut CT scans with axial and sagittal reconstructions, we evaluated the degree of decompression and the amount of preserved facet complex using analytical tests and recording the measurements.

Results

The difference between the proximal recess and lateral foramen of the groups was statistically significant in the axial CT images. On sagittal reconstruction CT images, the difference between the two groups was significant ($P < 0.05$, Wilcoxon) only for the lateral foramen. Although a strong trend toward better area change was evident for the proximal recess measurements in the experimental tool sides, this did not achieve statistical significance. Macroscopic and CT scans measurements showed that the amount of facetectomy for adequate decompression with the SurgiFile was less than the amount achieved with the standard tools.

Conclusions

For the treatment of spinal stenosis, this novel powered-file instrument provides surgeons with a new means of decompressing the lateral recess and neural foramina. In this cadaveric study, procedures performed with the SurgiFile tool showed a statistically superior degree of decompression as compared with the standard surgical instruments and techniques.

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INTRODUCTION

The central spinal canal and foramen are defined by both bony structures (vertebral body, facets, pedicles) and soft tissue structures (ligamentum flavum, facet capsules, intervertebral disc annulus). With the aging process, degenerative changes occur in the spine, causing narrowing of the central spinal canal area, the proximal foramen (eg, lateral recess) and the lateral aspect of the spinal foramina. With progressive aging, by the dehydration of nucleus pulposus, the area between individual vertebrae decreases. A decrease in the disc height can often lead to impingement of the vertebral endplates and facet joints, resulting in spondylosis and the formation of reactive osteophytes.[1–3] Consequently, the formation of marginal endplate osteophytes, subsidence and subluxation of the facet processes, secondary loss of foraminal height, and thickening of the ligamentum flavum are the major degenerative changes that lead to narrowing of the central canal and neural foramen (Table 1).

Classically, laminectomy, laminotomy, and foraminotomy have been used in varying combinations to treat spinal stenosis.[1,4–7] The degree of decompression, especially for the proximal recess and neural foramen, are limited by the degree of facet resection. Whereas most decompressions do not lead

Table 1

The Preoperative and Postoperative Foraminal Heights on Axial CT Scans (mm)

	Proximal Recess				Lateral Foramen			
	SurgiFile		Standard		SurgiFile		Standard	
	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
Cadaver 1 L2—3	81	119	75	110	82	132	95	105
Cadaver 1 L3—4	60	132	60	100	75	130	75	100
Cadaver 1 L4—5	93	166	98	130	97	160	107	130
Cadaver 1 L5—S1	95	140	95	124	96	162	100	120
Cadaver 2 L2—3	62	95	70	75	75	100	80	85
Cadaver 2 L3—4	70	105	65	85	70	100	70	80
Cadaver 2 L4—5	50	100	70	95	70	110	75	106
Cadaver 2 L5—S1	80	105	80	100	100	120	100	100
Average	73.875	120.25	76.625	102.38	83.125	126.75	87.75	103.25

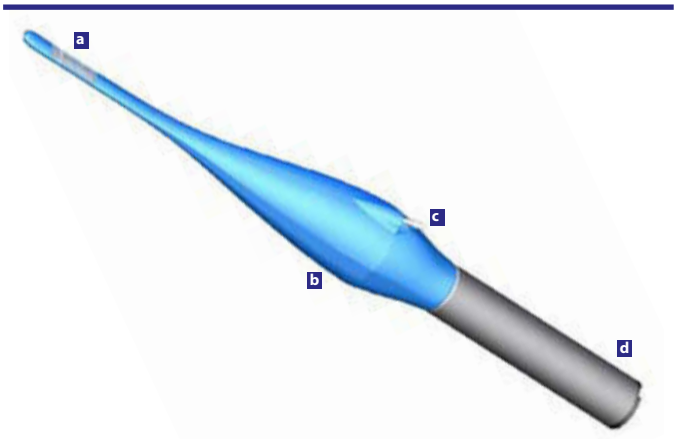
to postoperative spinal instability, over 30% to 50% of these procedures can result in early or delayed spondylolisthesis.[8,9] For such cases, spinal fusion may also be required to support the primary decompressive procedures.[4,9–18] As a result of this balance between the degree of decompression and the amount of induced postoperative spinal instability, incomplete decompression of the exiting nerves remains one of the most common causes of failed back syndrome in the literature.[13,19,20]

We present our initial evaluation of a new surgical tool, the SurgiFile (SurgiFile, Inc., Carlsbad, California), which employs a thin powered-file blade designed to slip into the proximal recess and then internally expand the neural foramen along its entire course by shaving off encroaching osteophytes and impinging facet edges while maximally preserving the overlying facet joint complex. We compared the effectiveness of this tool in achieving neural decompression with that of standard surgical techniques in a cadaveric lumbar experimental study.

Technical Properties of the SurgiFile Tool

The SurgiFile is a novel surgical tool for decompression of the neural foramen while sparing the overlying facet joint complex as much as possible and protecting the underlying neural elements (Figure 1). Its patented toroidal drive functionally converts a standard rotating motor drive's cylindrical spinning motion (ie, Stryker TPS, Anspach eMax, Midas Rex Legend) into a smooth oscillating linear motion that is used to directly drive a specially created file blade. This is accomplished without using cams or gears, thereby delivering a driving force to the cutting blade with minimum torque, heat, and energy loss. Once an adequate surgical exposure of the spinal lamina has been made via small laminotomy or laminectomy, the thin oscillating blade of the device is then used to expand the neural foramen from inside out, a technique that is in direct contrast with the standard approach of outside-in decompression for treatment of spinal stenosis (Figure 2).

Figure 1



The SurgiFile tool is demonstrated with the thin area of the exposed (a) cutting surface, (b) main toroidal drive body, (c) irrigation inlet, and (d) the surgical drill motor.

The surface of the cutting blade contains small raised "cutting-cones" that effectively shave hard cortical bone into small micron-sized particles that are washed away by the flow of saline solution provided by the integrated irrigation pump and delivered through a small portal within the shaft of the blade. With the use of standard suction tips, the surgeon is able to advance the tool progressively through the length of the neural corridor with a minimum of stoppages or exchanges because the particles are too small to clog the suction tips.

Finally, the SurgiFile can be rotated around the dorsal aspects of the foramen, thus allowing the surgeon to decompress not only the osteophytes on the "roof" of the corridor but also those along the "side" walls of the foramen. The SurgiFile maintains the integrity of the stabilizing facet complex during foraminal decompression because it works using an inside-out technique and does not require resection of the overlying joint to gain access to the medial and lateral foraminal areas (Table 2). This