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Transforaminal Endoscopic Decompression of the Lumbar Spine for Stable Degenerative Spondylolisthesis as the Least Invasive Surgical Treatment Using the YESS Surgery Technique

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Abstract

Anthony T. Yeung M.D., has reported his 5-10-year results in a preliminary review of endoscopic transforaminal of isthmic and degenerative spondylolisthesis decompression causing sciatica and back pain at international spine meetings. Fifty-five patients from January 2002-December 2012 served as the database for the clinical presentation in patients who specifically chose to stage Yeung's endoscopic transforaminal decompressive procedure over fusion. The patients were specifically evaluated for endoscopic spine surgery in a shared clinical decision.

This more focused article is subdivided with stratified indications to degenerative spondylolisthesis only, omitting isthmic spondylolisthesis since isthmic spondylolisthesis is traditionally the surgical option of choice for patients who elected to undergo surgical intervention as the standard surgical option versus continuing with non-surgical care. Disc protrusions associated with degenerative spondylolisthesis, disc herniation, patients with concomitant stenosis, who did well with the first study on both degenerative and isthmic spondylolisthesis were analyzed from the first database and stratified for degenerative spondylolisthesis. The patients of the original 10-year follow-up study were 100% satisfied with their decision to try the endoscopic surgery first, even when they subsequently opted for fusion since it would not interfere with a fusion as a secondary staged procedure. There was no attempt to stratify the first patient group who wanted to stage their surgical options, even if fusion became necessary for their pain and activity requirements.

In this 10-year study 33% eventually opted to undergo fusion in order to get more symptom relief. Transforaminal foraminoplasty also provided some unanticipated back pain relief as well. When dorsal endoscopic ablation of the medial branch of the dorsal ramus was later added to the endoscopic procedure to address axial back pain, even better clinical outcomes were obtained by this focused study on degenerative spondylolisthesis, with or without disc protrusion and stenosis.

Keywords: Lumbar spine; Spondylolisthesis; Intradiscal therapy philosophy

Introduction

Background on back pain

Chronic low back pain is a consequence of normal aging from lumbar spondylosis and facet arthrosis. Recent clinical studies from the University of Hong Kong demonstrated that imaging studies detecting disc degeneration in asymptomatic patients would eventually develop of low severe low back pain [1]. Wolfgang Rauschning identified patho-anatomy responsible for pain from the spinal disc and facet Joints in cadaver cryosections. Pfirrmann also described a degenerative cascade that matches the cryosections with MRI images. Chronic low back pain is essentially tied with #2 ischemic heart disease, in the top 5 health condition expenditures according to an analysis published by JAMA in 2013. Diabetes occupied the #1 position.

Fusion

Fusion is generally acknowledged as the surgical treatment of choice for symptomatic isthmic spondylolisthesis, but for degenerative spondylolisthesis, many key opinion spine leaders already advocate decompression first [2,3]. Never-the less, an explosion of minimally invasive fusion procedures emerged. The current hot topic is on attaining lumbo pelvic and sagittal alignment, another phase in the evolution of fusion techniques. Now, some key opinion leaders among spine surgeons are recognizing and acknowledging that not all, or even most patients require instrumented fusion. Endoscopic decompression, whether translaminar or transforaminal, (the least invasive) will eventually lead the way for the staging of procedures that offer the patient more treatment choices.

Literature Review

Degenerative spondylolisthesis following translaminar decompression for spinal stenosis is a known consequence of surgical translaminar decompression. By focusing on the sagittal alignment of the facet joints, this observation has prompted more careful selection of patients who require decompression but may be able to avoid fusion.

Spondylolisthesis, especially isthmic spondylolisthesis, is a spinal condition where 10-15 years ago, fusion was accepted and determined to be the "gold standard" for surgical stabilization [4].

A recent RCT published in the New England Journal of Medicine in patients with lumbar spinal stenosis, with or without degenerative spondylolisthesis, concluded that adding a fusion to decompression surgery did not result in better clinical outcomes at 2 years and 5 years. Instead, it significantly increased direct hospital costs, including the costs of surgery and the in-hospital stay [5]. The article did not study isthmic spondylolisthesis.

With the escalating cost of health care, contributing to ever increasing cost of health care, payment by insurance payers is under duress. Each stakeholder, must consider the rationale and cost of health care delivery with a consideration toward necessity and affordability [6]. This includes patients who underwent traditional translaminar decompression who later develop back pain from lumbar spondylosis and facet arthrosis as part of the post-operative or aging process. In some patients, degeneration also resulted a grade 1-2 spondylolisthesis not present pre-operatively.

The rationale that spondylolisthesis is a sign of instability, serves as a rationale for fusion. Flexion/extension x-rays demonstrating instability is further used to document instability. Fusion utilizing instrumentation to enhance fusion is the current state of the art technique. Various dynamic stabilization schemes and techniques were also developed using pedicle based and interspinous-based stabilization [7,8].

With over 27 years' experience treating patients who sought endoscopic decompression for their painful spinal condition, a personal database of Yeung's patients who sought endoscopic decompression and who refused fusion, even if traditionally indicated, but opting for endoscopic decompression first, were reviewed. Yeung subsequently published a series of articles in open access journals supporting endoscopic spinal decompression dating back to 2015 [9].

Yeung's article, "Moving Away from Fusion", was published on Dec 2, 2015 in the Journal of Spine. Yeung reviewed 58 patients with degenerative and isthmic spondylolisthesis from 2003 to 2013 from his personal database. Neither statistical analysis was performed nor powered for this study but results from the review were used to create a stratification strategy going forward [10]. Encouraged by the feedback from Yeung's returning patients and an electronic survey with Survey Monkey software, and with loyal patients who maintained contact or who updated their clinical status, most only had recurrent minor symptoms that was not severe enough to require further surgical intervention, but only needed follow-up reassurance or advice. These patients were specifically instructed to notify Yeung if their spinal condition worsened after discharge. The patient's satisfaction of the index surgery universally expressed in follow-up visits stimulated Yeung's interest in following his patients' clinical experience. There were 58 patients in the initial 10-year follow-up period. The patients included high performance athletes, spine and orthopedic surgeons who maintained contact after they sought the less invasive endoscopic decompression procedure over fusion, as the "gold standard" for spondylolisthesis at the time. Some of the patients were featured on Yeung's practice website as patient case reports or with voluntary patient testimonials. Some of their surgeries were featured on playlists of spondylolisthesis on Yeung's website and You Tube.

From Yeung's review of the 58 unstratified patients with a 5-10 year follow up, the life time analysis found that approximately 33% avoided additional surgery after 5-10 years, and 100% were satisfied with their decision to delay fusion as their first surgical option (Figure 1).

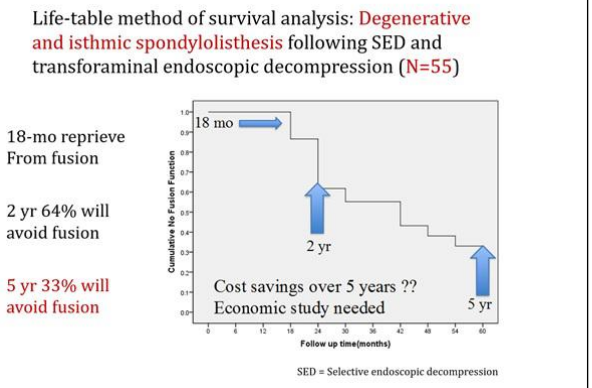


Figure 1: Life-table method of survival analysis: Degenerative and Isthmic Spondylolisthesis following selective endoscopic discectomy (SED^{TM}) and transforaminal endoscopic decompression.

Results and Discussion

As Yeung closely followed these patients, he continued stratification of patient selection from his evolving endoscopic surgery technique, aided by new instrumentation and decompressive techniques that surgically facilitated decompression utilizing Yeung's trademarked "inside out" intradiscal therapy philosophy and transforaminal decompression methods. Yeung further identified those patients most likely to benefit from endoscopic transforaminal decompression, even with degenerative spondylolisthesis or isthmic spondylolisthesis by first performing transforaminal diagnostic and therapeutic injections to identify the pain segment and used a criteria of 50% -70% improvement as a sign that transforaminal decompression would provide longer pain relief with selective endoscopic decompression if the patient was very satisfied with the injection results, especially if they had weeks or months of lasting relief. Patients with isthmic spondylolisthesis were more reluctantly offered foraminal decompression when their main complaint was not sciatica but had predominant back pain. Diagnostic and therapeutic injections using the same trajectory as surgical decompression helped define patients who could expect at least reasonable intermediate term pain relief results when the patients chose endoscopic decompression first, as a "staged procedure". Later, hybrid procedures adding dorsal endoscopic rhizotomy to the transforaminal endoscopic discectomy procedure resulted in better resolution of back pain associated with spondylolisthesis.

Patients who did not reject fusion who may benefit or potentially get more prolonged relief with fusion, were referred to the traditionally fellowship trained spine surgeons in Yeung's group, headed by Christopher Yeung, M.D. of Desert Institute of Spine Care. If a referring spine surgeon referred the patient, the patient was referred back to the referring spine surgeon. All patients were satisfied with their original decision to avoid fusion. Most were able to put up with mild back pain following endoscopic foraminal decompression for their sciatica.

A 2-year follow-up database of 32 patients with degenerative spondylolisthesis stratified by adding a hybrid endoscopic hybrid rhizolysis procedure in conjunction with transforaminal endoscopic discectomy from 2012-2015 at Yeung's institute showed statistically significant good/excellent outcomes in regard to the ODI and VAS score, and modified Mac Nab criteria. Compared with the data from 2002-2012, only 4/32 (12.5%) patients chose to have fusion after the 2 years follow-up period. These patients were younger patients who did not wish to curtail their physical activities, even with improvement in pain scores. Fusion following transforaminal endoscopic decompression for the patients with degenerative spondylolisthesis was therefore significantly further reduced (Table 1).

Variables	Preoperative	Postoperative	P value
ODI score	27.1±9	17.6±10	<0.001
VAS score	5.0±2.8	2.2±1.6	<0.001
Patients who opted for fusion as a staged procedure		4/32 (12.5%)	

Table 1: A 2-year follow-up outcomes following transforaminal endoscopic decompression for degenerative spondylolisthesis.

Case examples images on degenerative spondylolisthesis

Case example #1: This is shown in Figures 2-5.

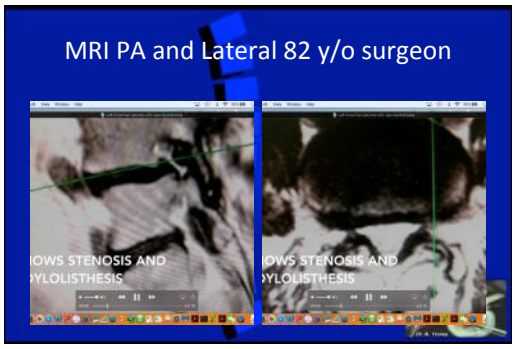


Figure 2: (Case 1 example) This 82/y/o orthopedic surgeon was referred by his spine surgeon for symptoms of residual back pain associated with intermittent claudication following a traditional translaminar decompression. He had a grade 1 spondylolisthesis and was satisfied to put up with anticipated residual back pain. The surgeon, however, had a small estraforaminal disc protrusion in addition to spondylolisthesis causing back pain. He wanted a MIS endoscopic decompression and to avoid the possibility of fusion. He was offered a hybrid procedure of selective endoscopic discectomy and dorsal endoscopic rhizotomy when he had a good result with a preoperative diagnostic and therapeutic transforaminal steroid injection. Results of endoscopic transforaminal decompression and dorsal rhizotomy were excellent. The following images were extracted from the video documentation of his surgery.

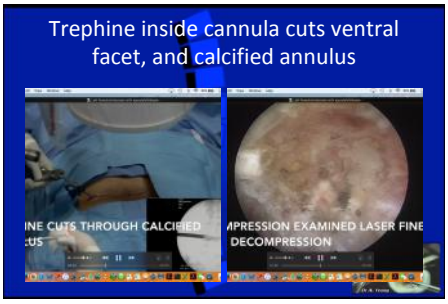


Figure 3: The needle encountered resistance from a calcified annulus and foraminal stenosis, necessitating the use of a trephine to enter the disc space, cutting the ventral facet and the calcified annulus.



Figure 4: Bone from the ventral facet and calcified annulus exposed the dorsal annulus and disc for further mechanical and laser decompression until the epidural space was reached.

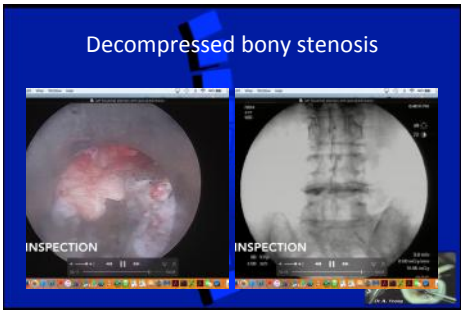


Figure 5: The epidural space in the anterior canal identified pulsating epidural fat following resection of the dorsal annulus. This view documents adequate endoscopic decompression of foraminal stenosis and PA and lateral intra-operative images. PA and lateral C-arm images confirm the decompression of the foraminal lateral recess. The patient reported complete resolution of his sciatica, intermittent claudication, as well as back pain at first week and 2-year follow-up. Branches of the dorsal ramus innervating the facet joint can be transected and ablated in the foramen before the nerves exit the foramen to innervate the facet joint.

Case example # 2: This is shown in Figures 6-8.

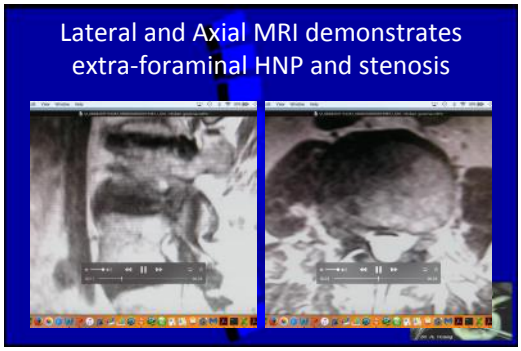


Figure 6: (Case 2) This 76 y/o male with 50% chronic back pain, and 50% R thigh pain, has MRI evidence of a small extraforaminal HNP associated with grade 1 degenerative spondylolisthesis on imaging studies. He did not have intermittent claudication of concomitant stenosis. Because of significant back pain and right sciatica complaints, he was advised to consider translaminar decompression and fusion after consultation with a spine surgeon. The rationale for a probable fusion was due to the location of the HNP that may require removal of the facet joint to reach the extraforaminal HNP creating the need for fusion. The patient opted for a transforaminal endoscopic decompression that resolved both back pain and sciatica at 2-year follow-up.



Figure 7: a) Endoscopic view of extraforaminal HNP (initial endoscopic view); b) Second fragment in the axilla to be extracted.

The lessons learned by foraminal endoscopic decompression and endoscopic rhizolysis in the past 27 years

1. A horizontal sagittal alignment of the facet at the level of the index surgery was helpful in predicting further slippage following endoscopic decompression.
2. Endoscopic transforaminal decompression did not create additional spondylolisthesis if the sagittal alignment was more horizontal than vertical.
3. Patients with a favorable response to transforaminal epidural blocks predicted a favorable response to transforaminal endoscopic decompression.
4. Patients who had retired from their day job responded better than younger active patient who were still working, none regretted to have their surgery staged.
5. If back pain represented as their dominant pain complaint, a hybrid procedure that included dorsal endoscopic rhizotomy relieved back pain as well, but it may be staged since foraminoplasty may also relieve back pain by resecting or ablating the branches of the dorsal ramus in the foramen.



Figure 8: a) Decompressed exiting nerve visualized endoscopically; b) Degenerative disc (stained blue) with extruded extraforaminal fragments 1 and 2.

Health care reforms

Health Care Reform in the United States is focused on providing universal health care for all citizens, but it must be affordable.

Our ability to respond to the individual pain needs of our patients will help facilitate cost containment. This will encourage innovation by preserving physician autonomy with incentive to develop new treatment through clinical and basic science research. This will allow physicians' autonomy to treat patients for their individual needs with minimal interference from payers and regulators.

Conclusion

The treatment algorithm in spine continues to evolve and change due to a better understanding of the patho-anatomy, correlated with the pathophysiology of pain. Yeung writes about his own response to endoscopic transforaminal decompression evolving technique in publications including a series of articles in that supports transforaminal endoscopic decompression as a first line surgical procedure for selected patients with degenerative spondylolisthesis.

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