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Research Article

Posterior Lumbar Interbody Fusion with Preservation of Posterior Structures for Management of Lumbar Spondylolisthesis

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Abstract

Background: Successful posterior lumbar Interbody fusion requires excessive removal of posterior spinal elements and distraction of neural structures. It also requires a large amount of bone graft.

The authors were developed this technique to assess results of treatment of degenerative Spondylolisthesis by posterior lumbar Interbody fusion with preservation of posterior spinal elements and also to examine the safety and efficacy of the recapping T-saw laminoplasty technique for management of degenerative lumbar Spondylolisthesis using posterior lumbar Interbody fusion by Interbody cages with preservation of posterior elements.

Methods: Twenty-five patients with degenerative Spondylolisthesis underwent recapping T saw laminoplasty in the lumbar spine for posterior lumbar Interbody fusion with Interbody cage. The T-saw was used for division of the posterior elements. After discectomy and insertion of cages, the excised lamina was replaced exactly in situ to their original anatomic position. Patients were followed neurologically and radiologically.

Results: Only one lamina was excised and replaced again. Primary bone healing was obtained in all patients by 4-6 months after surgery. No complications such as postoperative spinal canal stenosis, facet arthrosis, or kyphosis were observed.

Conclusion: This technique of posterior lumbar Interbody fusion through recapping laminoplasty provide wide space for easier insertion of cages and allow anatomic reconstruction of the vertebral arch preserving its important mechanical roles.

Introduction

Lumbar degenerative Spondylolisthesis is an acquired slippage of one lumbar vertebra on the lower one as the result of degenerative instability, in the absence of a defect in the pars interarticularis. Degenerative Spondylolisthesis in adults is often characterized by loss of disc height across the affected segment and sagittal translation, resulting in central, lateral recess, and foraminal stenosis. The indications for surgical management are persistent or recurrent neurogenic claudication, significant reduction in the quality of life [1]. The goal of surgical treatment for Spondylolisthesis includes decompression of neural elements, restoration of the disc space height, and alignment and stabilization of the motion segment [2,3].

A range of surgical techniques has been used for surgical treatment of lumbar degenerative Spondylolisthesis. These include indirect reduction alone, decompression alone, decompression plus lumbar fusion with or without instrumentation, decompression and slip reduction plus instrumented fusion [4].

Laminectomy traditionally has been used to expose the spinal canal during surgery for posterior lumbar Interbody fusion [5,6]. Although removal of the posterior arch affords suitable access to the lesion, it has a great disadvantage in that the protective role of the posterior arch is lost. Iatrogenic instability, sublaxation, and/or kyphosis may occur, especially when the facet joints are removed [7,8].

The technique of Posterior Lumbar Interbody Fusion [PLIF] with restoration of the lamina and facet joint not only provides a wide interspace for the safe and effective PLIF but also restores the posterior constructs, thereby preserving its important mechanical roles. PLIF with cages is gaining popularity for its convenience and improved design for stability [9]. Although some surgeons advocate a pedicle screw fixation system in conjunction with PLIF, the hardware also causes many problems. The technique of recapping T-saw laminoplasty was originally reported by Kawahara, et al. [10] for extirpation of spinal cord tumors. The authors developed technique for PLIF. The purpose of the surgery is not only to provide a wide intervertebral space for safe and effective PLIF, but also to restore the posterior construct, preserving its mechanical functions through physiologic and anatomic reconstruction of the vertebral arch.

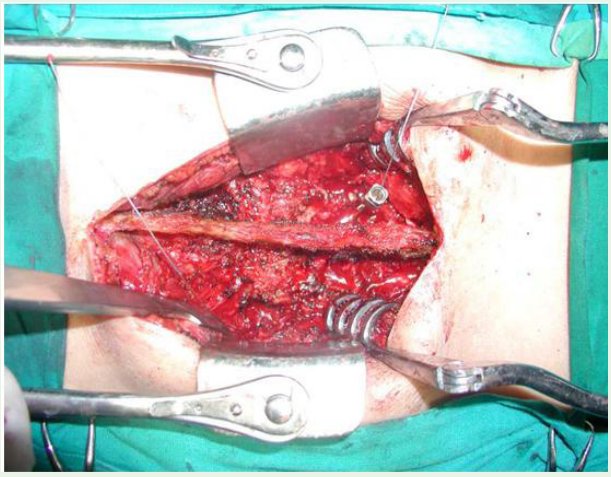

Figure 1: Introduction of T-saw in the interlaminar space.

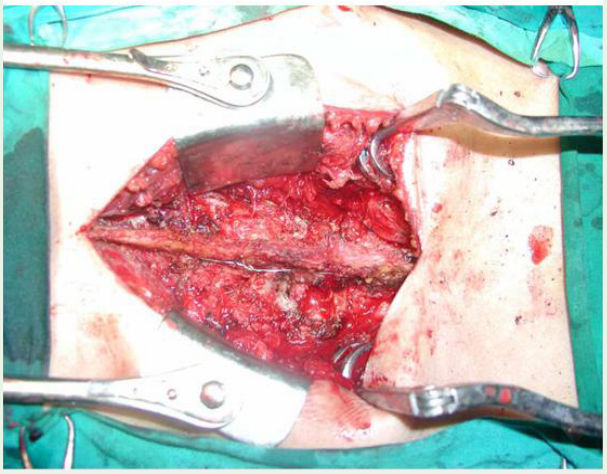

Figure 3: Restoration of the posterior elements to normal.

Materials and Methods

This study consisted of 25 patients with degenerative Spondylolisthesis met the criteria for inclusion in the study: a clinical diagnosis of degenerative Spondylolisthesis with symptoms that had been unresponsive to an adequate trial of non-operative treatment. There were 18 women and 7 men. The ages of the patients ranged from 41 to 68 years [mean, 51.7 years]. The level of operation was between the fourth and fifth lumbar vertebrae in 16 patients and between the third and fourth lumbar vertebrae in 9 patients. Before the operation, plain radiographs of the lumbo-sacralis spine (including anteroposterior and lateral views) were made for all patients and repeated at follow-up visits. All the patients were asked to rate their pain in the back and lower limbs on a scale ranging from 0 point [no pain] to 5 points (severe pain). The scores for pain in the back and lower limbs were rated separately. This scoring procedure was repeated at the most recent follow-up examination.

The results were rated as excellent, good, fair, or poor. The results were excellent when the patient resumed unrestricted activity and had complete relief of pain in the back or lower limbs, or both. A good result meant that there was occasional discomfort in the back or lower limbs necessitating no-narcotic medication, major improvement compared with the preoperative condition and resumption of unrestricted activity. A fair results was defined as intermittent discomfort in the back or lower limbs or both; improvement compared with preoperative condition; restriction of activity; and occasional need for non-narcotic medication. Patients who had poor results had major discomfort in the back or lower limbs; or both necessitating non-narcotic and occasional narcotic medication; no improvement compared with the preoperative condition and major restriction of activity.

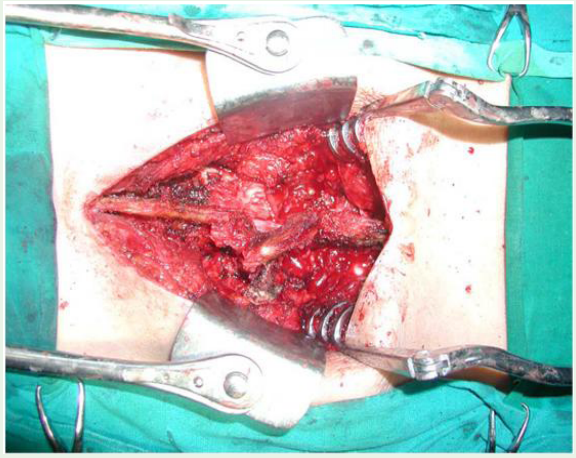

Figure 2: The surgical field after cutting of the laminae.

Surgical Technique

Through midline posterior exposure, the paraspinal muscles are dissected, leaving the supra- and interspinous ligaments intact. Subperiosteal exposure of the posterior elements is performed to the bases of the transverse processes. Undue injury to the facet capsules should be avoided. The soft tissue attached to the lateral aspect of the pars interarticularis is dissected and removed and the ligamentum flavum is excised. The T-saw within its guide is introduced through the interlaminar space in the nerve root canal in a cephalocaudal direction (Figure 1). The tip of the T-saw guide should hug the medial cortex of the lamina and pedicle so as not to injure the spinal cord or the nerve root. The tip of the T-saw guide can be found ventral to the inferior extent of the pars interarticularis at the exit zone of the neural foramen. The T-saw guide is withdrawn as tension is maintained on the T-saw with a T-saw holder at each end. Using a reciprocating motion, the saw produces a fine cut of the pars interarticularis. The same procedure is repeated on the other side. The lamina then may be rotated out of surgical field with the supra- and interspinous ligaments act as a pedicle (Figure 2). Posterior lumbar Interbody fusion was performed through the widely exposed intervertebral space by inserting a pair of Interbody cages. Because the bone lost by the T-saw is negligible, the excised laminae can be restored to their exact original anatomic position (Figure 3). They are secured with sutures to the surrounding soft tissue or by stainless steel. Suction drain is used for 2 days after surgery and the patient is allowed to ambulate 3 days after surgery wearing a lumbar orthosis. The patient wears the orthosis for 2-4 months as bone healing proceeds.

Figure 4: Forty-two years female patient with degenerative Spondylolisthesis L4-5 level.

Results

Twenty-five patients had undergone recapping T-saw laminoplasty for PLIF in degenerative Spondylolisthesis (Figure 4). There were 18 women and 7 men, with mean age 41.6 years [range, 36-64 years]. The postoperative follow-up period ranged from 28 to 47 months [mean, 35 months]. The operation was performed in 16 patients in L4-5 level and in 9 patients in L3-4 level (Figure 5). One lamina was excised and replaced in all patients. Sufficient visual field was obtained in all operations. The T-saw did not cause any dural tear. No patients experienced any decrease in neurologic function. There were no wound infections or miscellaneous complications noted.

Figure 5: The same patient after insertion of the interbody cages.

Bony union between the recapped lamina and the host bone was achieved in all levels within three months after surgery. Postoperative spinal canal stenosis (due to excessive bone formation) was not observed in any patient. No bone resorption, collapse, or sclerosis in the relapsed lamina was observed radiologically in any patient. The latest follow-up examination showed no complications caused by mechanical instability such as increased slippage of the vertebra, retropulsion of the Interbody cage.

Over-All Results

There were fourteen excellent, ten good, one fair, and no poor result. Low back pain was reduced to 23 percent of the preoperative incidence, and radicular pain to 9 percent. Increasing working capacity was noted in 43 percent of patients and unchanged in 57 percent.

Discussion

Intercorporal lumbar spondylodesis was introduced as a method for treatment Spondylolisthesis in 1952. Because the grafted material was under compression following Intercorporal fusion, this method seemed to be sounder than the posterior fusion [11]. With increasing awareness of the importance of anterior spinal column and development of various kinds of Interbody cages, Posterior Lumbar Interbody Fusion [PLIF] using Interbody cages are rapidly gaining popularity. Ther has been some criticism for PLIF due to technical difficulty of the procedures, risk of neural damage, excessive removal of the facet-lamina structures with increasing spinal instability with post laminectomy kyphosis [12-15]. PLIF with segmental instrumentation has been advocated to improve the problems of the isolated PLIF [16] but complications of the instrumentation add to the complexity of the procedure [17,18]. Many reports have described the biomechanical importance of the posterior spinal elements [19,20]. So, preservation or reconstruction of these elements is important to preserve as much as the normal spinal biomechanics as possible.

The authors PLIF technique provides a wide space to achieve successful Interbody fusion by inserting large Interbody cages with minimal nerve retraction. It also reconstructs the posterior structures preserving its significant mechanical roles without internal fixation. The T-saw is a device for cutting the bone, originally developed for cutting the pedicles in total en block excision of spinal cord tumor [10,21,22]. It has many advantages over the conventional Gigli saw, it is thin, flexible, can be introduced safely in small space, and its surface is smooth so it cuts without injuring the dura or the nerve roots [23]. Also, the cut of the T-saw is so thin that the bone loss is negligible, which make it easy for the replaced lamina to stay in its primary position and to remain very stable with ideal situation for bony fusion without excessive bone formation. This method provides a wide interspace to insert large enough cages and remove the disc material with minimal nerve root retraction. The postoperative kyphosis was avoided by inserting large cages to fit into the ventral part of intervertebral space after distraction of the space with a vertebral spreader. The cages were stabilized by the distraction-compression principal, by their threaded external surface, and by further compression by weight bearing.

Conclusion

The recapping laminoplasty combined with Interbody fusion technique effectively restores the 3 columns of the spine, the

anterior column through Interbody bony fusion, the middle column through effective removal of the retro pulsed disc fragment, and the posterior column through anatomic reconstruction of the posterior arches and preservation of their biomechanical function. Recapping laminoplasty combined with Interbody fusion technique offers better canal clearance similar to the anterior decompression technique but technically less demanding, carries low risks, and ensures good stabilization. The technique of PLIF with restoration of posterior spinal elements through recapping T-saw laminoplasty provides wide interspace for safe and effective PLIF with preservation of the important mechanical roles of the posterior structure.

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