International Journal of Surgery 50 (2018) 72–78

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.elsevier.com/locate/ijsu

Original Research

Outcomes of multisegmental transforaminal enlarged decompression plus posterior pedicle screw fixation for multilevel lumbar spinal canal stenosis associated with lumbar instability

Chao Sun[a], Wei Ji Tian[b], Hui Xin Liu[a,*], Ping Guo Guan[a]

[a] Department of Spine Surgery, The Affiliated Jiangning Hospital of Nanjing Medical University, Nanjing 211100, China
[b] Department of Orthopedics, Shanghai General Hospital of Nanjing Medical University, Songjiang 201600, Shanghai, China

ARTICLE INFO

Keywords:
Lumbar spinal canal stenosis
Transforaminal enlarged decompression
Laminectomy
Pedicle screw fixation

ABSTRACT

Purpose: The aim of this study was to evaluate the clinical and radiologic results of multisegmental transforaminal enlarged decompression (TED) plus posterior pedicle screw fixation in the treatment of multilevel lumbar spinal canal stenosis (LSCS) with lumbar instability (MLSCSI).

Methods: 113 patients with MLSCSI underwent surgery were recruited in this study. All patients were suffering from symptoms typical of degenerative LSCS and treated with either TED plus fusion (TEDF group) or conventional laminectomy plus fusion (CLF group). Clinical and radiologic parameters were evaluated. The clinical data, including Visual Analog Scale (VAS) for back and leg pain, Oswestry Disability Index (ODI), operative time, intraoperative blood loss, postoperative drainage, hospital stay, and the rate of postoperative complications, were assessed. With respect to radiologic parameters, mean disc height (MDH) and lumbar lordotic angle (LLA) were measured using plain radiographs. Patient satisfaction was evaluated according to the North American Spine Society (NASS) Outcome Questionnaire.

Results: No serious complications occurred during the follow-up. The operative time was significantly shorter for TEDF group than for CLF group, and similar results were found with regard to the blood loss and postoperative drainage ($p < .05$). The improvements in ODI, leg and back VAS scores were observed in both groups after surgery and follow-up ($P < .05$). In the last follow-up, ODI and back VAS scores in TEDF group were significantly higher than those in CLF group ($P < .05$). Regarding radiologic variants, MDH and LLA were improved after operation for 3 months ($P > .05$) and were all well maintained in the final follow-up in both groups. Patients in TEDF group were more satisfied than patients in the CLF group (85.2% vs 76.9%, $p = .092$).

Conclusions: Satisfactory clinical and radiological outcomes can be achieved with the use of multisegmental TED plus lumbar fusion for the treatment of MLSCSI. This technique can reduce surgically induced instability and obviously improve the symptoms and signs of the patients, suggesting a safe and effective therapeutic procedure for MLSCSI.

1. Introduction

Lumbar spinal canal stenosis (LSCS), resulting in significant pain and disability, is one of the most common indication for spinal surgery in the increasingly elderly population [1]. Commonly, surgery for LSCS is considered when conservative treatment has failed. However, the optimal surgical procedure is still debated. There has been a surge in the number of lumbar spine decompression operations explored for LSCS over the past decade [2]. Conventionally, it is worth mentioning that laminectomy is the most popular surgery with the advantage of obtaining adequate decompression by extensively removing the posterior structures including the lamina, spinous processes, ligamentum flavum, interspinous ligaments, and facet joints. However, some reports suggest the high rate of the reoperation after the conventional laminectomy (CL) because of postoperative instability and muscle weakness and atrophy resulting from the extensive resection of the posterior stabilizing structures. To prevent this, several procedures involving microdecompression have been studied to overcome this problem [1,3,4].

Most recently, there has been an increase in microsurgical procedures, aiming at minimizing invasiveness and reducing surgically induced instability. Typically, it is reported that transforaminal

* Corresponding author.
E-mail address: Professorlxh2010@163.com (H.X. Liu).

https://doi.org/10.1016/j.ijsu.2017.12.031
Received 13 June 2017; Received in revised form 23 October 2017; Accepted 26 December 2017
Available online 09 January 2018
1743-9191/

decompression (TD) has been accepted as one of the predominant microsurgical approaches [4,5]. In order to maintain the effect of decompression and reduce the damage to the structure of the lumbar spine, we improved the TD technique, which called transforaminal enlarged decompression (TED) in the following paper. This technique was similar to the decompression approach described by Michael et al., the decompression effect of which has been shown to be approximately equal to that obtained from CL [5]. For cases of multilevel LSCS with lumbar instability (MLSCSI), there are more theoretical concerns regarding surgically induced instability owing to multisegmental decompression. Therefore, posterior fixation may be necessary in addition to microsurgical decompression, aiming to help indirectly reduce pressure in the spinal canal and at the same time stabilise the spine. Despite the increasing use of these minimally invasive decompression and implant techniques, to our knowledge, there have been no studies on specially assessing this two combined techniques for the treatment of MLSCSI. The aim of this study was to explore the clinical and radiological outcomes of multisegmental TED plus posterior pedicle screw fixation in the treatment of MLSCSI and to clarify the advantages and disadvantages of this procedure.

2. Materials and methods

2.1. Subjects

Under the approval of the Ethical Committee of Nanjing Medical University, a sum of 113 patients with MLSCSI undergoing posterior surgery were enrolled from January 2009 to January 2015. The inclusion criteria for subjects were as follows: (1) patents with stenosis of 2 and more than 2 levels with typical clinical symptoms (neurogenic claudication, radicular pain, low back pain or both) and coexisting lumbar instability; (2) computed tomography (CT) or magnetic resonance imaging (MRI) scan confirmation of compressive canal stenosis; (3) conservative therapy for at least 6 months without any effect; (4) follow-up of more than 2 years. Our exclusion criteria were as follows: patents with one level stenosis; follow-up of less than 2 years; coexisting degenerative scoliosis with a Cobb angle greater than15° and spondylolisthesis; and having a history of previous lumbar spine surgery.

We then identified those patients who underwent either TED plus fusion (TEDF) surgery or CL plus fusion (CLF) surgery. Finally, a total of 61 patients with TEDF surgery and 52 patients with CLF surgery were recruited in this study.

2.2. Clinical outcomes and assessments

Each patient in this study was assessed clinically by asking the detailed clinical history and performing a thorough examination. Bodily pain, such as leg and back pain, was estimated by Visual Analog Scale (VAS) and functional disability was evaluated using Oswestry Disability Index (ODI, range from 0 to 100, with higher scores indicating more disability related to back and leg pain). Preoperative, postoperative, and final follow-up clinical signs and symptoms were evaluated. The data, including preoperative comorbidities, operation time, bleeding loss, hospital day and intraoperative and postoperative complications were recorded. Patient satisfaction with the procedure was measured using the North American Spine Society (NASS) Outcome Questionnaire with possible scores of 1–4 (Table 1); scores of 1 were considered to indicate “satisfied/good,” scores of 2 were considered to indicate “fair”, and scores of 3 or 4 were considered to indicate “dissatisfied/poor.”

2.3. Radiographic evaluations

All the patients performed the preoperative anterioposterior and lateral radiographs, flexion and extension lateral radiographs, CT and MRI scans of the lumbar spine. Radiologic parameters were analyzed from the plain lateral radiographs including lumbar lordotic angle (LLA) and mean disc height (MDH) [4]. As was shown in Fig. 1, the LLA was measured as the angle subtended by the superior endplate line of L1 and superior endplate line of S1. The average value of anterior height, central height, and posterior height was taken as the height of intervertebral space of this segment. MDH was defined as the means of the height of intervertebral space at every stenosis level, being regarded as representative values. The measurement was made twice by two orthopedists majoring in spinal disorders. Data for preoperative, postoperative and follow-up radiological measures were collected. The signs of implant failure including the presence of screw breakage, screw pullout, implant loosening, and rod breakage were assessed during follow-up from radiographs.

Flexion and extension lateral radiographs in the standing position were taken to assess the stability of the spine. Lumbar instability was defined based on evidence of dynamic anterior-posterior translation of 4 mm or more and/or angulation greater than or equal to 10°on the flexion-extension films [6]. CT was done for all patients preoperatively to provide more precise information about the nature of neural compression, aiming to distinguish soft tissue neural compression from bony compression. MRI was utilized to demonstrate the narrow type and certify if disc herniation and hypertrophy of ligamentum flavum and facet joint were contained or not.

Table 1
Patient satisfaction index.

Score	Options
1	Surgery met my expectations
2	I did not improve as much as I had hoped but I would undergo the same operation for the same results
3	Surgery helped but I would not undergo the same operation for the same outcome
4	I am the same or worse as compared to before surgery

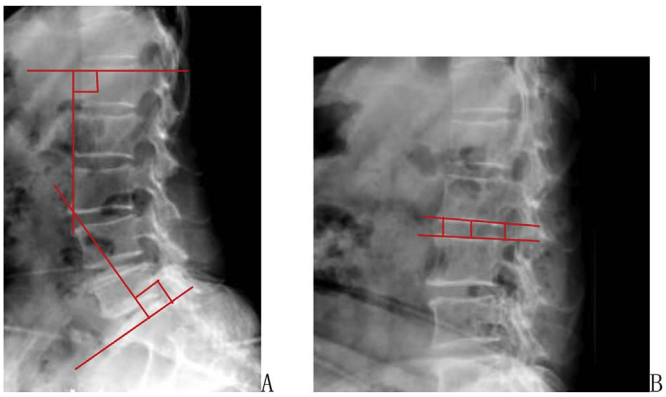

Fig. 1. A) Cobb's angle for LLA: the angle subtended by the superior endplate line of L1 and superior endplate line of S1. B) The average value of anterior height, central height, and posterior height was taken as the height of intervertebral space.

2.4. Statistical analysis

Student *t*-test was performed for statistical analysis of the surgical outcomes between two groups. The software Statistical Package for the Social Sciences (SPSS, version 17.0) was used for all analyses. Any value of p less than 0.05 was considered statistically significant.

2.5. Surgical procedures

Under general anesthesia, posterior midline incision was made and the site was targeted and determined by intraoperative C-arm. Patients were all in the prone position and pillows were put under the shoulders,