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ScienceDirect
SAS Journal 4 (2010) 47–53
SAS Journal
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Clinical and radiographic outcomes after minimally invasive transforaminal lumbar interbody fusion

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Abstract

Objective: To evaluate outcomes after minimally invasive transforaminal lumbar interbody fusion (MI-TLIF).
Background: MI-TLIF is a relatively novel technique for treating symptomatic spondylolisthesis and degenerative disc disease of the lumbar spine. It has become a popular option for lumbar arthrodesis largely because of its potential to minimize iatrogenic trauma to the soft tissue, paraspinous muscles as well as to neural elements.
Methods: Literature search using PubMed database.
Results: Eight retrospective clinical studies and 1 prospective clinical study were identified. No randomized studies were found. The indications for surgery were low-back pain and/or radicular symptoms secondary to spondylolisthesis and/or degenerative disc disease. Analysis of radiographic outcomes demonstrated a fusion rate greater than 90% in the vast majority of patients. Patients also experienced a significant improvement in functional outcome parameters at a mean follow-up of 20 months. Comparison of functional outcomes of MI-TLIF patients to a similar matched cohort of patients who underwent conventional open TLIF did not demonstrate any statistically significant difference between both cohorts.
Conclusion: For carefully selected patients, MI-TLIF has a very favorable long term outcome that is comparable to conventional open TLIF, with the added benefit of decreased adjacent tissue injury.

Keywords: Minimally invasive spine; Transforaminal lumbar interbody fusion; Outcomes; TLIF

Transforaminal lumbar interbody fusion (TLIF) is relatively novel technique for lumbar interbody fusion. The prototypical posterior lumbar interbody fusion (PLIF) was originally described by Cloward.[1] A limitation of the PLIF procedure was its medialized approach, which required bilateral exposure as well significant retraction of the nerves. PLIF would, therefore, be prohibitive in the upper lumbar segments because of the risks to the conus from increased retraction.[2] It is against this background that TLIF was subsequently introduced by Harms and Rolinger,[3] and has now been widely adopted as a more lateralized unilateral approach relative to PLIF.[3–7]

The potential peri- and postoperative morbidities associated with conventional lumbar fusion surgery served as an impetus for the development of minimally invasive fusion techniques of the lumbar spine. The extensive dissection and trauma to soft tissue and paraspinous muscles that occurs with conventional lumbar fusion were deemed to be significant confounders to patient outcome.[8–14] Minimally invasive approaches were, therefore, designed to prevent iatrogenic trauma by employing muscle-splitting techniques using specially designed dilators. As a consequence, benefits such as decreased intraoperative blood loss and shorter hospital durations have been reported.[15–17]

Minimally invasive transforaminal lumbar interbody fusion (MI-TLIF) is a relatively novel paramedian muscle-splitting technique for arthrodesis via a unilateral approach in patients with mechanical back secondary to degenerative disc disease (DDD) and spondylolisthesis. The potential benefits are decreased iatrogenic soft tissue and muscle damage. It is hypothesized that such benefits would translate to better clinical outcomes. As MI-TLIF is becoming a very popular method of arthrodesis, stratified long term clinical and radiographic outcome data are necessary. The purpose of this literature review is to determine long term functional and radiographic outcomes in patients who underwent MI-TLIF.

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1935-9810
doi:10.1016/j.esas.2010.03.002

Table 1
Demographics of patients in clinical series undergoing minimally invasive transforaminal lumbar interbody fusion

Reference	Number of patients in study	Mean age in years (range)	Male/Female	Mean number of follow-up months	Study type
Peng et al, 2009[18]	29	54 (26-74)	5/24	24	Prospective
Schizas et al, 2009[26]	18	45.5 (NA)	NA	22	Retrospective
Dhall et al, 2008[25]	21	53 (NA)	NA	24	Retrospective
Park et al, 2008[19]	40	56 (38-71)	19/21	35	Retrospective
Scheufler et al, 2007[20]	53	57 (NA)	24/29	16	Retrospective
Beringer et al, 2006[24]	8	49 (35-63)	NA	9	Retrospective
Deutsch et al, 2006[21]	20	49 (33-55)	12/8	6	Retrospective
Jang et al, 2005[22]	23	60 (48-68)	8/15	19	Retrospective
Schwender et al, 2005[15]	49	NA (23-80)	19/30	23	Retrospective

Abbreviation: NA, not available.

Methods

A comprehensive literature search was performed using PubMed for all journal articles published until August of 2009. Keywords employed in the search included "transforaminal lumbar interbody fusion," "minimally invasive," and "lumbar fusion," and were searched individually or in combination. Based on the initial list of publications, we reviewed the bibliography of each article to identify further pertinent studies. The appropriate articles for our study were subsequently selected based on several criteria. Only studies that specifically addressed minimally invasive transforaminal lumbar interbody fusion were selected. Furthermore, articles without patient outcome data and at least 3 months of postoperative follow-up were excluded, as were case reports.

A total of 133 citations including case reports, clinical case series, and technical notes were found using the keyphrase "transforaminal lumbar interbody fusion." There were no randomized studies found. Of these articles, 38 were associated with the descriptor "minimally invasive." Pertinent long term patient outcome data were only reported in 9 articles. Given that our primary objective was to evaluate long term outcomes in patients undergoing MI-TLIF, we, therefore, incorporated only those 9 articles in our study.

Results

Patient characteristics

The 9 clinical series encompassed a total of 261 patients who were treated by MI-TLIF. The demographic data are illustrated in Table 1. The mean age at the time of operation was provided in all but 1 of the studies.[15] Based on 8 of the 9 studies, the mean age was 53. Gender frequency information, which was reported in 6[15,18–22] of the series, demonstrated a female predominance with 117 females relative to 87 males. The minimum follow-up was 6 months, with a combined mean of approximately 20 months. There were 8 retrospective studies and 1 prospective study.

Patient selection

Selection criteria for patients undergoing MI-TLIF were quite similar to those undergoing open conventional TLIF with a few exceptions. Traditionally, open conventional TLIF has been used to treat mechanical axial lumbar pain as well as associated radiculopathy secondary to DDD and spondylolisthesis. MI-TLIF was utilized in similar indications except for patients with very high-grade spondylolisthesis, where open conventional TLIF is preferred because of the technical challenges.[23] MI-TLIF was also favored in recurrent disease herniations, as well as selected lumbar revision operations, as the surgical trajectory is lateral to the previous operative scar tissue plane. In terms of imaging, patients were evaluated with a combination of diagnostic modalities such as static and dynamic lumbar plain films, lumbar MRI, and/or CT myelogram.

Patient selection criteria, as well as preoperative assessment, were provided for each of the clinical series. Exclusion criteria were provided for some of the studies.[18,22] Beringer and Mobasser[24] evaluated 8 patients who had a combination of axial lumbar pain and radiculopathy from DDD and recurrent disc herniations. There were no spondylolisthesis patients in this series. With respect to DDD, the patients had to fail 9 months of conservative treatment in conjunction with demonstration of concordant pain on provocative discography in order to be considered surgical candidates. Deutsch and Musacchio[21] applied a similar selection criterion in their series of 20 patients with respect to diagnosis and failure of conservative management; however, discography was never employed as a basis for patient selection. Peng et al[18] selected 29 patients with axial lumbar pain and radiculopathy, secondary to DDD and spondylolisthesis, who had failed conservative management for a minimum of 6 weeks. In addition, they excluded patients who had significantly collapsed disc space, no movement on dynamic lumbar plain films, or those with a significant amount of scarring at the neural foramen. Scheufler et al[20] evaluated 53 patients of whom 19 had DDD and 34 had Grade 1 degenerative spondylolisthesis. MI-TLIF was only offered to patients with symptomatic advanced DDD and