Minimally invasive transforaminal lumbar interbody fusion case series

Clinical data from 50 patients with lumbar degenerative disease who underwent MIS-TLIF between January 2019 and September 2020 were retrospectively analyzed. The group included 29 males and 21 females aged from 33 to 72 years old, with an average age of (65.3±7.13) years. Twenty-two patients underwent unilateral decompression, and 28 underwent bilateral decompression. The side(ipsilateral or contralateral) and site(low back, hip, or leg) of the pain were recorded before surgery, 3 days after surgery, and 3 months after surgery. The pain degree was evaluated using the visual analogue scale(VAS) at each time point. The patients were further grouped based on whether contralateral pain occurred postoperatively (8 cases in the contralateral pain group and 42 in the no contralateral pain group), and the causes and preventive measures of pain were analyzed.

All surgeries were successful, and the patients were followed up for at least 3 months. Preoperative pain on the symptomatic side improved significantly, with the VAS score decreasing from (7.00±1.79) points preoperatively to (3.38±1.32) points at 3 days postoperatively and (3.98±1.17) points at 3 months postoperatively. Postoperative asymptomatic side pain (contralateral pain) occurred in 8 patients within 3 days after surgery, accounting for 16% (8/50) of the group. The sites of contralateral pain included the lumbar area (1 case), hip(6 cases), and leg (1 case). The contralateral pain was significantly relieved 3 months after surgery.

More cases of contralateral limb pain occur after unilateral decompression MIS-TLIF, and the reason may include contralateral foramen stenosis, compression of medial branches, and other factors. To reduce this complication, the following procedures are recommended: restoring intervertebral height, inserting a transverse cage, and withdrawing screws minimally [1)].

2022

Patients undergoing MIS-TLIF were collected through a retrospective review of a prospectively maintained single-surgeon database. PROMs administered pre/post-operatively included Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS-PF), Visual Analog Scale (VAS) back/leg pain, Oswestry Disability Index (ODI), and 12-Item Short Form (SF-12) Physical/Mental Component Score (PCS/MCS). Patients were grouped based on preoperative VAS leg scores: VAS leg≤7 or VAS leg>7. Inferential statistics were utilized to compare PROMs, MCID achievement rates, and postoperative satisfaction between groups.

Results: 562 patients were eligible (168 VAS leg≤7; 394 VAS leg>7). Significant differences between cohorts in postoperative mean PROMs were noted for: PROMIS-PF 6-weeks/2-years, SF-12 PCS 6-weeks/2-year, SF-12 MCS 6-week/12-weeks/6-months/1-year, VAS back 6-weeks/12-weeks/6-months, VAS leg 6-weeks/12-weeks/6-months/2-years and ODI at all postoperative time points ($p<0.045$, all). VAS leg>7 cohorts demonstrated a greater proportion achieving MCID for VAS leg at all postoperative timepoints and ODI at 12 weeks ($p<0.010$, all). Postoperative satisfaction was greater in VAS back≤7 cohort for: VAS leg 6-weeks/12-weeks/6-months/2-years, VAS back 12-weeks/2-years, and ODI 6-weeks/12-weeks/6-months/2-years ($p<0.046$, all).

Conclusion: Patients with severe preoperative leg pain demonstrated worse postoperative PROM scores and patient satisfaction for disability and back/leg pain. MCID achievement rates across

cohorts were similar. Patients with severe leg pain may have expectations for surgical benefits incongruent with their postoperative outcomes, and physicians may seek to manage the preoperative expectations of their patients to reflect likely outcomes following MIS-TLIF [2)]

2021

The objective of a study of Khalifeh et al. from The Johns Hopkins Hospital, Baltimore, MD Washington University School of Medicine, St. Louis, Henry Ford Health System, Detroit, was to evaluate radiologic changes in central spinal canal dimensions following minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) with placement of a static or an expandable interbody device.

MIS-TLIF is used to treat lumbar degenerative diseases and low-grade spondylolisthesis. MIS-TLIF enables direct and indirect decompression of lumbar spinal stenosis, with patients experiencing relief from radiculopathy and neurogenic claudication. However, the effects of MIS-TLIF on the central spinal canal are not well-characterized.

They identified patients who underwent MIS-TLIF for degenerative lumbar spondylolisthesis and concurrent moderate to severe spinal stenosis. They selected patients who had both preoperative and postoperative magnetic resonance imaging (MRI) and upright lateral radiographs of the lumbar spine. Measurements on axial T2-weighted MRI scans include anteroposterior and transverse dimensions of the dural sac and osseous spinal canal. Measurements on radiographs include disk height, neural foraminal height, segmental lordosis, and spondylolisthesis. They made pairwise comparisons between each of the central canal dimensions and lumbar sagittal segmental radiologic outcome measures relative to their corresponding preoperative values. Correlation coefficients were used to quantify the association between changes in lumbar sagittal segmental parameters relative to changes in radiologic outcomes of central canal dimensions. Statistical analysis was performed for “all patients” and further stratified by interbody device subgroups (static and expandable).

Fifty-one patients (age 60.4 y, 68.6% female) who underwent MIS-TLIF at 55 levels (65.5% at L4-L5) were included in the analysis. Expandable interbody devices were used in 45/55 (81.8%) levels. Mean duration from surgery to postoperative MRI scan was 16.5 months (SD 11.9). MIS-TLIF was associated with significant improvements in dural sac dimensions (anteroposterior +0.31 cm, transverse +0.38 cm) and osseous spinal canal dimensions (anteroposterior +0.16 cm, transverse +0.32 cm). Sagittal lumbar segmental parameters of disk height (+0.56 cm), neural foraminal height (+0.35 cm), segmental lordosis (+4.26 degrees), and spondylolisthesis (-7.5%) were also improved following MIS-TLIF. We did not find meaningful associations between the changes in central canal dimensions relative to the corresponding changes in any of the sagittal lumbar segmental parameters. Stratified analysis by interbody device type (static and expandable) revealed similar within-group changes as in the overall cohort and minimal between-group differences.

MIS-TLIF is associated with radiologic decompression of lumbar foraminal stenosis and central spinal canal stenosis. The mechanism for neural foraminal and central canal decompression is likely driven by a combination of direct and indirect corrective techniques [3)].

2019

Senker et al., analyzed 187 patients who underwent minimally invasive surgery (MIS) in the form of

one- to four-level fusion procedures. In 146 patients, additional widening of the spinal canal was performed. The subjects were grouped into four age categories of approximately equal size (33-56, 56-66, 66-74 and 74-85). The effect of age on the incidence of peri- and postoperative complications was investigated and compared between the age groups.

Older age was not associated with the occurrence of perioperative complications, which include wound healing disorders, hematomas, wound traction-blisters and Cerebrospinal fluid fistula. Fourteen patients (7.49%) encountered distinct surgical technique related complications, making surgical revision necessary in eight patients (4.28%). Furthermore, increasing age didn't elevate the risk of postoperative adverse events, i.e. pulmonary embolism, ischemic heart attack or pneumonia, among others. However, older patients were found to stay in hospital longer than younger patients, especially when more than one level was fused.

Minimally invasive surgery techniques are safe in elderly patients. The small-scale surgical approach guarantees a low incidence of infections and wound healing disorders. However, a longer hospital stay must be expected in older patients [4].

Eighty-three consecutive MITLIF patients; 71 underwent 1-level fusion and 12 had multilevel fusions. Average operative time for single level was 181 min; multilevel was 323 min. Average estimated blood loss was 140 mL. Time before ambulation was <1 d, average length of stay was 1.6 d. There were a total of 4 complications in this series (4.8%). There was zero incidence of durotomy or Cerebrospinal fluid fistula.

This modified MITLIF technique of maintaining the medial facet prior to discectomy and interbody graft placement can offer the minimally invasive spine surgeons increased assurance while placing the graft and potentially enhance the overall safety and efficacy of this approach. Surgeons utilizing this approach will have little difficulty utilizing this slight modification [5].

2015

A retrospective study of 41 patients who underwent MIS TLIF for single segment, grade 1 or 2 IS (n=18) and DS (n=23). The same surgical techniques and procedure were applied to both groups. Perioperative outcomes (operation time, blood loss, hospital stay, complications), clinical outcomes (VAS, ODI), radiologic parameters (disc height, degree of spondylolisthesis, slip angle, lumbar lordosis, segmental lordosis, sacro-pelvic parameters: pelvic incidence, sacral slope, pelvic tile) and fusion rates using CT scanning were compared between groups at 1 year postoperatively.

There were no significantly different perioperative results between groups. Mean VAS and ODI scores significantly improved postoperatively in both groups, but were not significantly different between groups at each follow-up point. Radiologic parameters were not significantly different between groups except disc height and degree of spondylolisthesis. The disc heights were increased postoperatively (IS: 6.79 to 9.22 mm; DS: 8.18 to 8.97 mm) in both groups and there were significant differences preoperatively. In addition, disc height restoration was greater for IS than DS (2.43 mm vs. 0.79 mm, p=0.01). However, postoperative disc heights were not significantly different between groups. The degree of spondylolisthesis was significantly different between groups both pre- (16.77 vs. 11.33%, p<0.01) and postoperatively (9.79 vs. 3.78%, p<0.01). However, slip reduction was no different between groups (6.97 vs. 7.56%, p=0.74). Fusion rates were not significantly different between groups [6].

2014

Wong et al. reviewed the surgical technique, outcomes, and complications in a series of 144 consecutive 1- and 2-level MI-TLIFs in comparison with an institutional control group of 54 open traditional TLIF procedures with a mean of 46 months' follow-up. The evidence base suggests that MI-TLIF can be performed safely with excellent long-term outcomes [7].

Jhala A, Singh D, Mistry M. Minimally invasive transforaminal lumbar interbody fusion: Results of 23 consecutive cases. Indian J Orthop. 2014;48(6):562-567. doi:10.4103/0019-5413.144217

2013

Twenty consecutive patients undergoing MIS-TLIF at L5-S1 were prospectively randomized into 2 groups. Except for the type of guide wire used, the senior author (JZ) utilized the same operative technique in all 20 patients, including bicortical Sl screw fixation. In Group l, standard guide wires were used in 10 patients. In Group 2, Y-Wire was utilized. Total fluoroscopy time and radiation dosage were recorded on a GE 9900 C-arm machine, along with operating room time and complications. Significant reduction in fluoroscopy time and radiation dosage utilizing an innovative guide wire in the placement of percutaneous MIS pedicle screws

Results Total fluoroscopy time per case for Group 1 averaged 232.1 seconds vs. 152.2 seconds for Group 2 ($P = 0.017$). Radiation dosage for Group 1 averaged 17.22 rads vs. 9.29 rads in Group 2 ($P < 0.001$). There was no significant difference in operating room time ($P = 0.18$). There was inadvertent advancement of one S1 guide wire in Group 1. Postoperative CT scan of the abdomen with contrast was negative.

Utilizing Y-Wire for percutaneous pedicle screw placement significantly decreased fluoroscopy time by 34% and radiation dosage to the patient and surgeon by 46%. Tapping the distal Sl cortex allows bicortical screw purchase, but there is no mechanical stop preventing inadvertent guide wire advancement. The unique design of the Y-Wire guide wire may prevent inadvertent guide wire advancement through the vertebral body, reducing the risk of injury to vital structures ventral to the spine, while reducing the patient and surgeon exposure to harmful radiation [8]

2007

Percutaneous transforaminal lumbar interbody fusion pTLIF was performed in 43 patients with single-level and 10 patients with bi- or multilevel lumbar discopathy or degenerative pseudolisthesis resulting in axial back pain and claudication, pseudoradicular, or radicular symptoms. Decompression, discectomy, and interbody cage insertion were performed through 18-mm tubular retractors followed by percutaneous pedicle screw-rod fixation. Clinical outcome was assessed by early postoperative pain scores (visual analog score) and standardized functional outcome questionnaires (American Academy of Orthopedic Surgeons lumbar spine and Roland-Morris low back pain score). Fusion rates were assessed by thin-slice computed tomographic scan at 16 months. Clinical outcome, time in the

operating room, intraoperative blood loss, and postoperative access-site pain were compared with an institutional reference series of 67 oTLIF procedures. RESULTS: Excellent and good clinical results were obtained in 46 (87%) out of 53 patients at 16 months. The time spent in the operating room was equivalent and the blood loss reduced compared with oTLIF ($P < 0.01$). There was no morbidity related to instrumentation. Postoperative pain was significantly lower after pTLIF after the second postoperative day ($P < 0.01$). The overall clinical outcome was not different from oTLIF at 8 and 16 months. CONCLUSION: pTLIF allows for safe and efficient minimally invasive treatment of single and multilevel degenerative lumbar instability with good clinical results. Further prospective studies investigating long-term functional results are required to assess the definitive merits of percutaneous instrumentation of the lumbar spine [9].

2005

Forty-nine patients underwent minimally invasive transforaminal lumbar interbody fusion (TLIF) from October 2001 to August 2002 (minimum 18-month follow-up). The diagnosis was degenerative disc disease with herniated nucleus pulposus (HNP) in 26, spondylolisthesis in 22, and a Chance-type seatbelt fracture in 1. The majority of cases (n = 45) were at L4-L5 or L5-S1. A paramedian, muscle-sparing approach was performed through a tubular retractor docked unilaterally on the facet joint. A total facetectomy was then conducted, exposing the disc space. Discectomy and endplate preparation were completed through the tube using customized surgical instruments. Structural support was achieved with allograft bone or interbody cages. Bone grafting was done with local autologous or allograft bone, augmented with recombinant human bone morphogenetic protein-2 in some cases. Bilateral percutaneous pedicle screw-rod placement was accomplished with the Sextant system. There were no conversions to open surgery. Operative time averaged 240 minutes. Estimated blood loss averaged 140 mL. Mean length of hospital stay was 1.9 days. All patients presenting with preoperative radiculopathy (n = 45) had resolution of symptoms postoperatively. Complications included two instances of screw malposition requiring screw repositioning and two cases of new radiculopathy postoperatively (one from graft dislodgement, the other from contralateral neuroforaminal stenosis). Narcotic use was discontinued 2-4 weeks postoperatively. Improvements in average Visual Analogue Pain Scale and Oswestry Disability Index (preoperative to last follow-up) scores were 7.2-2.1 and 46-14, respectively. At last follow-up, all patients had solid fusions by radiographic criteria. Results of this study indicate that minimally invasive TLIF is feasible and offers several potential advantages over traditional open techniques [10].

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