# Effect Comparison Of MIS-TLIF Under MED and Quadrant Modes in The Treatment of Lumbar Spinal Stenosis

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**Background Lumbar spinal stenosis is one of the common causes of low back and leg pain. Lumbar intervertebral disc degeneration leads to the decrease of intervertebral height, the limitation of vertebral activity, and the biomechanical changes of the lumbar spine, which in turn makes the lumbar anterior convex angle and sacral inclination angle smaller, and the pelvic inclination angle larger, affecting the stress distribution of the lumbar spine aggravating the intervertebral disc degeneration. If the spinal canal stenosis is not corrected for a long time, can cause the cauda equina nerve, nerve root compression, resulting in neurogenic intermittent claudication. If the spinal canal stenosis is not corrected for a long time, can cause the cauda equina nerve, nerve root compression, resulting in neurogenic intermittent claudication. Surgery can correct lumbar stenosis and reconstruct lumbar stability. But the traditional lumbar fusion trauma is huge, even can aggravate pain, spinal canal stenosis. Therefore, more and more patients are more inclined to MIS-TLIF treatment with less surgical trauma. For single-segment lumbar spinal stenosis, MIS-TLIF has the same effect as open surgery in restoring lumbar interbody height and improving lumbar-pelvis balance. Objective Discussion on the effect difference of minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) in the treatment of lumbar spinal stenosis by Quadrant and MED methods. Methods A total of 96patients with lumbar spinal stenosis who were scheduled to undergo MIS-TLIF surgery in Our Hospital from January 2017 to October 2020 were selected and divided into group A and group B according to the surgical channel selection scheme, with 48 cases in each group. The patients in group A were treater with MED channel, and the patients in group B were treated with Quadrant channel. The degree of surgical trauma, VAS score before and postoperative, JOA score, lumbar-pelvic imaging parameters and surgical complications were compared between the two methods. Results The operation time of the A group was shorter than that of the group B($P < 0.05$). The blood loss, exposure time under X line, drainage flow and down-ground time in A group were lower than those in B group, which had statistical significance ($P<0.05$); A and B groups of patients were compared, the difference was not statistically significant ($P>0.05$); Preoperative, Comparison of VAS scores between A and B groups, the difference was not statistically significant ($P>0.05$). On the first day of postoperative, the VAS score of group A was lower than that of groupB, which had statistical significance ($P < 0.05$). Preoperative, Comparison of JOA scores between A and B groups, the difference was not statistically significant ($P>0.05$); Comparison of JOA scores between 1 month ,3 months and 6 months in Postoperative, the difference was not statistically significant ($P>0.05$). The JOA scores of the two groups at 1 month, 3 months and 6 months postoperative were significantly lower than those Preoperative ($P < 0.05$). Six months postoperative, the lumbar anterior convex angle, segmental anterior convex angle and intervertebral height of the two groups were significantly higher than those Preoperative ($P<0.05$), and the pelvic inclination angle of the two groups was lower than that Preoperative ($P<0.05$).**

**Conclusion MIS-TLIF in the treatment of patients with lumbar spinal stenosis using MED channel or Quadrant channel operation has curative effect, and there is little difference in the recovery of lumbar-pelvis imaging parameters, but the former has the advantages of less surgical trauma and lower postoperative pain.**

**Keywords: Expandable channels；Fixed diameter channel； Minimally invasive transforaminal lumbar interbody fusion； Lumbar spinal stenosis**

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Lumbar spinal stenosis is a common clinical lumbar degenerative disease, which can cause low back pain, lower limb weakness, claudication and other symptoms, and severe cases can be paralyzed.

The traditional lumbar fusion has clear surgical field, sufficient decompression and exact effect, but it needs extensive stripping and traction of soft tissue, and local trauma is large, resulting in postoperative lumbar pain and prolonged recovery time [1].

Minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) not only maintains the advantages of traditional lumbar fusion, but also greatly reduces the surgical trauma. MIS-TLIF is currently the preferred surgical method for the treatment of lumbar spinal stenosis, but there is no consensus on the selection of surgical channels [2].

Expandable channel (Quadrant) surgery is similar to the direct vision operation of traditional lumbar fusion surgery, but the operation space is relatively narrow, which increases the difficulty of identifying nerves and blood vessels, and the operation space is restricted to some extent, thereby increasing the risk and difficulty of surgery. Excessive extrusion of the multifidus muscle during longitudinal distraction increases surgical trauma[3].

Fixed diameter channel (MED) can provide a fixed diameter channel and good lighting. It can flexibly adjust the direction in the transverse incision. The bilateral decompression of one side incision is more convenient and reduces the re-injury of the incision[4].

This study explored the difference in the efficacy of MIS-TLIF in the treatment of patients with lumbar spinal stenosis under Quadrant and MED methods, as reported below.

## MATERIALS AND METHODS

### Information

A total of 96 patients with lumbar spinal stenosis who were to be treated with MIS-TLIF in XX Hospital from January 2017 to October 2020 were selected and divided into group A and group B according to the selection scheme of surgical channels, with 48 cases in each group.

Inclusion criteria:

(1) Patients had typical sciatic nerve pain, lower limb radioactive pain, intermittent claudication, etc., which were confirmed by CT and MRI as lumbar spinal stenosis. (2) All patients underwent surgery in our hospital by the same group of medical staff. (3) Patients aged 46-75 years. (4) Patients received conservative treatment at least 3 months Preoperative, and the symptoms were not relieved. (5) Preoperative cardiopulmonary function test, normal.

### Exclusion criteria:

(1) Patients with other types of spinal diseases (tuberculosis, tumor, etc.). (2) With pulmonary infection, heart failure. (3) History of acute myocardial infarction. (4) Has a history of cerebrovascular disease in nearly 6 months. (5) Mental illness, Alzheimer 's disease. (6) More than 2 diseased segments of the spine. (7) Combined with other types of complications.

This study fully communicated with patients and their families before the implementation, signed informed consent. It was implemented after the decision of the Medical Ethics Committee of our hospital (DocumentNo.: Ethics (Trial) (2016) No.18).

### Surgical method

Patients in group A received general anesthesia with endotracheal intubation through MED channel, and the prone position was taken.The lesion segments and adjacent pedicle positions were marked on the body surface under C-arm fluoroscopy.Four positioning needles were percutaneously located at the outer edge of the pedicle to be punctured.Four transverse incisions with a length of about 1.5 cm were taken with the positioning needle as the center, and the lumbar fascia was longitudinally cut to explore the gap and articular process between the multifidus muscle and the longest muscle.Needle puncture, insert long guide wire along the needle catheter.

In the lesion segment symptoms, more severe side incision slightly extended, positioning the responsible intervertebral space, insert expansion sleeve, establish working channel.The lower articular process was chiseled through the working channel, and the bony lateral recess was fully reduced. The obtained fragments were made into bone particles for further use.Establish bone graft bed and implant bone particles and cages into intervertebral space.From the spinous base to the contralateral nerve root decompression, expand the central canal, the contralateral nerve root canal, exit the working channel. Pedicle screws were inserted along each pedicle guide wire. After the position was confirmed by C-arm fluoroscopy, the connecting rod was installed. Place drainage tube through decompression incision.

Group B was treated with Quadrant channel, anesthesia method and position with the control group.C-arm machine positioning lesion segment surface projection.3.5 cm longitudinal incision was opened at about 0.5 cm outside the midpoint of the projection area of adjacent pedicles on the same side.The lumbar fascia was cut to explore the space and articular process between the multifidus muscle and the longest muscle.

Place Quadrant working channel, open longitudinally, expose facet joint, part of vertebral plate inside channel.The unilateral partial lamina, inferior articular process and ligamentum flavum were bitten off, and about 2/3 of the superior articular process was chiseled off. The nerve root canal decompression was performed, and the prominent intervertebral disc was removed to deal with the cartilage endplate.Bone particles and cage fusion cages made of autologous bone fragments were inserted into the intervertebral space.C-arm monitor implanted pedicle screw, fixed, decompression incision drainage tube.Drainage was removed 48～72 hours postoperative in both groups. Dehydrant and glucocorticoid were used to relieve nerve root edema. After 3 days began to wear waist circumference out of bed activities, gradually strengthen the waist and back muscle function exercise.

**Observation indicators**

The degree of surgical trauma (operation time, blood loss, X-ray exposure time, postoperative drainage, postoperative ambulation time, hospitalization time), preoperative and postoperative pain score (VAS), Japanese Orthopaedic Association (JOA) score, lumbar-pelvic imaging parameters (lumbar lordosis angle, segmental lordosis angle, intervertebral height, pelvic incidence angle, pelvic tilt angle, sacral tilt angle) and surgical complications were compared between the two methods.

Pain degree score (VAS)[5], full score 10 points, the lowest 0 points, the more serious the patient ' s subjective pain, the higher the score.The Japanese Orthopaedic Association evaluated the treatment score (JOA) score [6]. The scale mainly includes multiple indicators such as upper limb motor function, lower limb motor function, sensory function and bladder function. The total score of JOA score is the highest of 29 points. The higher the score is, the better the recovery of motor function is.

The lumbar lateral X-ray films were taken before and 6 months postoperative. The lumbar-pelvic imaging parameters (lumbar lordosis angle, segmental lordosis angle, intervertebral height, pelvic incidence angle, pelvic tilt angle and sacral tilt angle) were measured by PACS (HangzhouShixuanCompany) system software. All measurements were completed by the same person, and the average value was taken three times. Lumbar lordosis angle: angle between L1 superior endplate and S1 superior endplate. Segmental lordosis: angle between inferior endplate of upper vertebral body and superior endplate of lower vertebral body. Intervertebral height: average height of the most anterior, median and final margin of fusion intervertebral space. Pelvic incident angle: The perpendicular line of the endplate is made by the midpoint of the endplate on S1, and the angle between the perpendicular line and the connection line between the midpoint of the endplate on S1 and the center of the femoral head. Pelvic inclination angle: the angle between the connection line of the midpoint of the superior terminal plate and the center of the femoral head and the horizontal perpendicular line of S1. Sacral inclination: angle between the upper endplate of S1 and the horizontal line.

**Statistical processing**

In this study, the measurement indexes such as lumbar-pelvis imaging parameters were tested by normal distribution, which were in accordance with the approximate normal distribution or normal distribution, and expressed as ($\bar{x}$±s). The T test in SPSS software was used. $\chi^2$ test analysis of adverse reactions. Test level $\alpha$=0.05.

## RESULTS

**Comparison of general data between the two groups of patients**

There was no significant difference in baseline data such as age, height, weight and gender composition between group A and group B (P>0.05). Table 1.

**Comparison of surgical trauma indexes between the two groups**

The operation time of group A was shorter than that of group B (P<0.05).The blood loss, X-ray exposure time, postoperative drainage volume and postoperative ambulation time in group A were lower than those in group B, and the difference was statistically significant (P<0.05).There was no significant difference in hospitalization time between group A and group B (P>0.05). Table 2.

**Comparison of VAS scores between the two groups before and postoperative**

Preoperative, there was no significant difference in VAS score between group A and group B (P>0.05). On the first day postoperative, the VAS score of group A was lower than that of group B, and the difference was statistically significant (P<0.05).There was no significant difference in VAS scores at 3 d and 5 d postoperative between group A and group B (P>0.05). Table 3.

**Comparison of JOA scores between the two groups before and postoperative**

Preoperative, there was no significant difference in JOA score between group A and group B (P>0.05). There was no significant difference in JOA score between the two groups at 1 month, 3 months and 6 months postoperative (P>0.05). The JOA scores of the two groups at 1 month, 3 months and 6 months postoperative were significantly lower than those Preoperative (P<0.05). Table 4.

**Comparison of lumbar-pelvis imaging parameters between the two groups before and postoperative**

There was no significant difference in lumbar-pelvis imaging parameters between group A and group B before and 6 months postoperative (P>0.05). Six months postoperative, the lumbar anterior convex angle, segmental anterior convex angle and intervertebral height of the two groups were significantly higher than those Preoperative (P<0.05), and the pelvic inclination angle of the two groups was lower than that Preoperative (P<0.05). Table 5.

**Comparison of surgical complication rate between two groups**

The complication rate of group A was 6.25%, and that of group B was 16.67%. There was no significant difference between the two groups (P>0.05). Table 6.

## DISCUSSION

Quadrant minimally invasive channel system is a spinal posterior minimally invasive surgery system developed on the basis of intervertebral disc mirror system. It can be operated directly with the help of channel lighting system to complete spinal canal decompression, nerve root release, intervertebral fusion and fixation [7-14]. Quadrant pathway enters through the establishment of an expandable channel, which can be opened vertically and horizontally without extensive stripping of muscles and soft tissues. It has little damage to paravertebral soft tissues, and can retain most of the posterior structures, which is conducive to the protection of the stability of the posterior structure [12]. However, excessive extrusion of multifidus muscle when longitudinal opening, resulting in muscle fiber tear, severe cases can appear ischemic necrosis, postoperative fibrosis, pain[13].

MED channel can provide a fixed diameter channel, with good lighting conditions, and equipped with advanced camera system, which can magnify the microscopic tissue more than 6 times, and play a role similar to microscopic surgery. It is conducive to the operator to accurately identify the nerve root, dural sac, peripheral blood vessels, ligaments and other structures, prevent false injuries, and greatly reduce the surgical trauma [14]. MED channel in the transverse incision can be more flexible tilt, swing, help adjust the direction, to facilitate decompression operation, reduce incision injury [15,16]。

This study found that the operation time of MED channel was shorter than Quadrant channel. The amount of bleeding, X-ray exposure time, postoperative drainage and postoperative ambulation time were lower than those of Quadrant channel.There was no significant difference in the length of hospital stay between the two groups, suggesting that the use of MED channel in MIS-TLIF treatment of patients with lumbar spinal stenosis reduce surgical trauma, shorten the operation time, and accelerate postoperative recovery.This is because MIS-TLIF provides a good surgical vision through an expandable channel with a smaller incision and destroys the blood vessels and nerve structures around the paraspinal muscles.MED channel is gradually expanded in concentric circular mode, without excessive traction and tearing of soft tissue, which can reduce the degree of soft tissue injury.The the Quadrant channel is longitudinally opened, the multifidus muscle is damaged. At the same time, the upper and lower leaves can cause soft tissue embedding after opening. When the surgical field is cleared, tissue damage is caused, thereby delaying postoperative recovery.

In this study, VAS was used to evaluate the degree of postoperative pain, and JOA score was used to evaluate limb dysfunction. It was found that MED channel was more conducive to reducing postoperative pain and improving dysfunction in patients with lumbar spinal stenosis treated with MIS-TLIF.This is because Quadrant channel open can cause skin and soft tissue overstretch, increase postoperative short-term low back pain, affect the early ambulation, is not conducive to limb function exercise and recovery.The study also found that the lumbar lordosis angle, segmental lordosis angle and intervertebral height of the two groups at 6 months postoperative were significantly higher than those Preoperative, and the pelvic tilt angle was lower than that Preoperative, but there was no significant difference in lumbar-pelvic imaging parameters between the two groups. It is suggested that MIS-TLIF has good effect in the treatment of lumbar spinal stenosis by MED channel or Quadrant channel, and there is little difference in the recovery of lumbar-pelvic imaging parameters.

In summary, MIS-TLIF in the treatment of patients with lumbar spinal stenosis using MED channel or Quadrant channel surgery has good results, and there is little difference in the recovery of lumbar-pelvis imaging parameters. However, the former has the advantages of smaller surgical trauma and lower postoperative pain.

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**Table 1.**
**General data comparison of preliminary patients**

| Index | A 组（n=48） | B 组（n=48） | t/$\chi^2$ 值 | P 值 |
|---|---|---|---|---|
| Age（years） | 65.6±7.3 | 64.8±7.0 | 0.548 | 0.585 |
| Height（cm） | 166.4±6.0 | 165.4±5.1 | 0.880 | 0.381 |
| Body weight（kg） | 121.8±8.0 | 123.0±7.2 | -0.772 | 0.442 |
| Course of disease (months) | 19.8±5.2 | 19.2±6.0 | 0.524 | 0.602 |
| Sex（%） | | | 1.046 | 0.306 |
| Male | 28(62.22) | 23(51.11) | | |
| Female | 20(44.44) | 25(55.56) | | |
| Hypertension（%） | | | 1.191 | 0.275 |
| Yes | 18(40.00) | 13(28.89) | | |
| No | 30(66.67) | 35(77.78) | | |
| Diabetes（%） | | | 1.787 | 0.181 |
| Yes | 11(24.44) | 6(13.33) | | |
| No | 37(82.22) | 42(93.33) | | |
| Diseased segment | | | 1.352 | 0.245 |
| L4～L5 | 33(73.33) | 38(84.44) | | |
| L5～S1 | 15(33.33) | 10(22.22) | | |

Table 2.
Comparison of surgical trauma indexes between the two groups ($\bar{x}\pm s$)

| Group | n | Operation time (min) | Bleeding volume (mL) | X-ray exposure time (min) | Postoperative drainage (mL) | Postoperative time (d) | Hospital stays (d) |
|---|---|---|---|---|---|---|---|
| A group | 48 | 165.3±16.2 | 149.3±24.0 | 49.5±6.4 | 54.3±11.0 | 2.6±0.9 | 10.8±1.8 |
| B group | 48 | 149.1±13.8 | 176.1±28.6 | 55.3±8.5 | 67.8±15.3 | 3.2±1.1 | 11.2±2.1 |
| t | | 5.274 | -4.973 | -3.777 | -4.963 | -2.925 | -1.002 |
| P | | 0.000 | 0.000 | 0.000 | 0.000 | 0.004 | 0.319 |

Table 3.
Comparison of VAS scores between the two groups of patients before and postoperative ($\bar{x}\pm s$,Scores)

| Group | n | Preoperative | 1d postoperative | 3d postoperative | 5d postoperative |
|---|---|---|---|---|---|
| A group | 48 | 5.71±1.30 | 3.80±0.84* | 2.77±0.87* | 1.54±0.68* |
| B group | 48 | 5.94±1.41 | 4.20±0.96* | 3.03±1.02* | 1.63±0.73* |
| t | | -0.831 | -2.173 | -1.344 | -0.625 |
| P | | 0.408 | 0.032 | 0.182 | 0.533 |

Note: Comparison with this group*P<0.05

Table 4.
Comparison of JOA scores between two groups of patients before and postoperative ($\bar{x}\pm s$,Scores)

| Group | n | Preoperative | 1 month postoperative | 3 months postoperative | 6 months postoperative |
|---|---|---|---|---|---|
| A group | 48 | 21.54±2.81 | 11.73±2.07* | 6.84±1.55* | 5.20±1.16* |
| B group | 48 | 20.72±3.04 | 12.40±2.31* | 7.38±1.73* | 5.68±1.24* |
| t | | 1.372 | -1.497 | -1.611 | -1.959 |
| P | | 0.173 | 0.138 | 0.111 | 0.053 |

Note: Comparison with this group*P<0.05

Table 5.
Comparison of imaging parameters of lumbar spine and pelvis before and postoperative between the two groups ($\bar{x}\pm s$)

| Group | n | Lumbar lordosis (°) | | Segmental lordosis (°) | | Intervertebral height (mm) | |
|---|---|---|---|---|---|---|---|
| | | Preoperative | 6 months postoperative | Preoperative | 6 months postoperative | Preoperative | 6 months postoperative |
| A group | 48 | 39.51±2.66 | 46.18±2.80* | 7.94±0.84 | 9.08±0.88* | 9.68±1.14 | 12.58±1.85* |
| B group | 48 | 38.66±3.15 | 45.46±3.40* | 8.13±0.88 | 9.41±0.94* | 9.23±1.41 | 11.98±1.90* |
| t | | 1.428 | 1.133 | -1.082 | -1.776 | 1.719 | 1.568 |
| P | | 0.157 | 0.260 | 0.282 | 0.079 | 0.089 | 0.120 |
| | | | | | | | |
| Group | n | Pelvis angle of incidence (°) | | Pelvic tilt angle (°) | | Sacral tilt angle (°) | |
| | | Preoperative | 6 months postoperative | Preoperative | 6 months postoperative | Preoperative | 6 months postoperative |
| A group | 48 | 48.13±5.02 | 48.55±4.95 | 16.84±5.24 | 13.28±4.84* | 32.77±3.95 | 34.86±4.54 |
| B group | 48 | 49.26±5.77 | 49.81±5.28 | 17.30±4.95 | 14.33±4.32* | 31.50±4.28 | 32.97±5.10 |
| t | | -1.024 | -1.206 | -0.442 | -1.121 | 1.511 | 1.918 |
| P | | 0.309 | 0.231 | 0.659 | 0.265 | 0.134 | 0.058 |

Note: Comparison with this group*P<0.05

Table 6.
Comparison of surgical complication rates between the two groups

| Group | n | Incision infection | lung infection | Nerve root injury | Complication rate (%) |
|---|---|---|---|---|---|
| A group | 48 | 1 | 2 | 0 | 3(6.25) |
| B group | 48 | 3 | 4 | 1 | 8(16.67) |
| $\chi^2$ | | | | | 2.567 |
| P | | | | | 0.109 |