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ORIGINAL

Observing the Clinical Outcomes of Single Port Endoscopic Posterolateral TLIF in Retired Athletes

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ABSTRACT

Objective: To investigate the clinical outcomes of single port endoscopic posterolateral transforaminal lumbar interbody fusion (TLIF) in athletic patients. **Methods:** Retrospective analysis was done on the clinical information of 82 athletic patients suffering from degenerative scoliosis who were operated at our hospital's spine surgery department from April 2020 to December 2021. They were split into an observing and a controlling group using the random number table approach, with 41 cases per group. The controlling group had open TLIF therapy, whereas the observing group received single-hole endoscopic TLIF. Both groups' operational indicators were scrutinized. We contrasted the preoperative and postoperative results of both groups for the Visual Analog Scale (VAS), Oswestry Disability Index (ODI), Japanese Orthopedic Association score (JOA), Cobb angle, lumbar lordosis angle, sacral inclination angle, and Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36). Both groups' postoperative bone graft fusion was seen. **Results:** Athletic Patients in the observing group underwent operations with considerably less time and blood loss versus to those in the controlling group (P <0.05). In terms of surgical drainage volume and hospital stay, there was no clinically meaningful variation among both groups (P > 0.05). The VAS and ODI scores of both groups were substantially lower after surgery than before, whereas the JOA score was substantially greater (P

<0.05). After the procedure, the observing group's VAS and ODI scores were substantially lower versus to those of the controlling group, although their JOA scores were substantially higher (P <0.05). The lumbar lordosis angle and sacral tilt angle were substantially greater versus to those before surgery (P <0.05), whereas the Cobb angle of the both groups was substantially lower after surgery versus to it was before. After the procedure, there was no clinically meaningful variation in the Cobb angle, lumbar lordosis angle, or sacral inclination angle among the observing and controlling groups (P > 0.05). Following surgery, both groups' ratings for physiologic function, psychological function, social function, and everyday living were considerably greater versus to they were before surgery (P <0.05); and after the procedure, the observing group's ratings for everyday living, social function, psychological function, and physical function were all considerably higher versus to those in the controlling group's (P <0.05). In the observing group, there were 39 cases of bone graft fusion; the fusion rate was 95.12%; in the controlling group, there were 38 cases; the fusion rate was 92.68%; the discrepancy in the fusion rates among the both groups was highly meaningful (P <0.05). **Conclusion:** Patients with degenerative scoliosis can considerably minimize operation duration and intraoperative blood loss by undergoing TLIF with a single port endoscope and can relieve postoperative pain and improve spinal function. At the same time, it can improve lumbar function, treat lumbar deformity, and enhance patients' quality of living.

KEYWORDS: Degenerative scoliosis; Single port endoscope; Transforaminal interbody fusion; Spinal function; Athletes

INTRODUCTION

Lumbar degenerative disease refers to the disease caused by the natural degradation and functional decline of lumbar intervertebral disc, lumbar articular cartilage and surrounding ligaments. The disease occurs in middle-aged and elderly people, which is one of the important reasons for their low back and leg pain (Ao et al., 2020; Aoki et al., 2020). Athletic Patients with lumbar degenerative disease are usually accompanied by clinical symptoms such as lumbar stiffness and pain, numbness of the lower limbs, and most athletic patients will also have L4-5 degeneration of the lumbar spine, with the incidence increasing year by year (Xue et al., 2021; Zhu et al., 2021). Degenerative scoliosis is a common type of lumbar degenerative lesions, which mostly occurs in the thoracolumbar and lumbar segments.

When the disease's course is prolonged, its clinical symptoms can advance to severe degenerative lesions, which can further cause persistent discomfort and negatively impact athletic patients' physical, emotional, and quality of living (Lotzke et al., 2016; Wagner et al., 2020). Conservative treatment is the first choice for degenerative scoliosis, and surgical treatment is used after ineffective conservative treatment. TLIF is a classic operation for the treatment of this disease, which can rapidly improve the pain and deformity of the spine of athletic patients, and has good effects of nerve decompression and interbody fusion (Wang et al., 2022; Zhu et al., 2022). However, the incision of TLIF is relatively long, which can lead to nerve and tissue damage, thereby leading to postoperative persistent pain (Kim et al., 2018).

In recent years, with the continuous progress of endoscopic technology, it has become one of the relatievly practical surgical procedures in spinal surgery. Studies have confirmed that single hole endoscopic transforaminal approach, interlaminar approach and contralateral approach all can provide endoscopic decompression options for the treatment of degenerative spinal stenosis and disc prolapse, with good early perioperative and long-term clinical efficacy (Ruetten et al., 2009).

With the aforementioned context in mind, the goal of this paper was to investigate the application effects of single hole endoscopic posterolateral TLIF in the therapy of athletic patients with degenerative scoliosis in order to offer advice for clinical therapy of degenerative scoliosis and provide fresh ideas for enhancing the clinical therapeutic efficacy of athletic patients with degenerative scoliosis.

1. Data and methods

1.1 General information

Retrospective analysis was done on the clinical information of 82 athletic patients suffering degenerative scoliosis who were operated at our hospital's spine surgery department during April 2020 to December 2021.

The following were the inclusion requirements: (1) X-ray, MRI, and other imaging studies were utilized to detect degenerative scoliosis in all athletic patients; (2) Those who met the diagnostic criteria for the condition and accompanied by spinal canal or nerve root canal stenosis and others; (3) Those with relatively poor effects after conservative treatment; (4) Those without contraindications to surgery; (5) Athletic Patients or family members gave informed permission and consented to participate in the study; (6) The hospital ethics committee authorized it (Ethics approval number: syb091662).

Exclusion criteria: (1) Those with non-degenerative scoliosis; (2) Those who cannot tolerate surgical treatment; (3) Those with contraindications to anesthesia; (4) Those with severe osteoporosis, spinal trauma and coagulation dysfunction; (5) Athletic Patients with multiple segmental lumbar lesions. With 41 cases per each group, 82 athletic patients suffering degenerative scoliosis were separated into the observing group and the controlling group using the random number table approach. With an age range of (61.33± 4.86) years and an average illness duration of (5.53± 1.63) years, there were 25 men and 16 women in the observing group. The controlling group consisted of 14 females and 27 men, with an age range of (61.98± 4.77) years and a disease duration of (5.82 ±1.60) years, on average. There was no clinically meaningful discrepancy in the general data among the both groups (P > 0.05). See Table 1.

Table 1: Comparing of general data of both groups [n (%)（ $\bar{x} \pm s$）]

GROUPING	N	GENDER (MALE / FEMALE)	AGE (YEARS)	DURATION (YEARS)
OBSERVATION GROUP	41	25/16	61.33 ± 4.86	5.53 ± 1.63
CONTROL GROUP	41	27/14	61.98 ± 4.77	5.82 ± 1.60
X^2/T		0.210	0.642	0.840
P		0.647	0.523	0.475

1.2. Methods

After general anesthesia, the controlled group of athletic patients was operated with open TLIF therapy. They were placed in prone position, and their abdomen was suspended under C-arm fluoroscopy for positioning, and then a median incision was made to expose the articular process and lamina. After the placement of pedicle screws, the nerve root canal and spinal canal were decompressed, and the intervertebral fusion cage was removed and placed into the intervertebral space. After the operation, the drainage tube was placed and the wound was sutured.

After general anesthesia, the athletic patients in the observation group were treated by single hole endoscopic TLIF. A 2.5cm incision was made close to the median spinous process of the back while the athletic patients were lying on their backs and under the C-arm fluoroscopy. Layer by layer, the fascia, subcutaneous tissue, and skin were separated. The multifidus interspace approach was used, and the endoscope was inserted to open the pipeline. Under the C-arm fluoroscopy, the baffle was opened and the upper and lower articular processes and bony marks were exposed, and the positioning needle was inserted through the apex of the herringbone.

Through the transforaminal approach, removal of the inferior articular eminence of the upper vertebral body and part of the upper articular eminence of the inferior vertebral body using an osteotome, the ligamentum flavum was bit, the compressed nerve root and dural sac were observed under endoscope. At the same time, the nerve root was loosened, other procedures included nerve root expansion and higher and below cartilage endplate curettage. The interbody fusion cage was filled with autologous bone particles, and the autologous bone particles were placed and tamped in the intervertebral space.

The pedicle screw was screwed into the pedicle through the skin unilaterally, and the position of the implant was observed under the C-arm fluoroscopy, and then the decompression treatment was performed and the incision was closed.

1.3. Observation indicators

(1) Operation-related indicators: The both groups' perioperative operation indicators, such as operational hours, intraoperative blood loss, postoperative drainage volume, and duration of stay, were monitored.

(2) Analysis of pain, lumbar dysfunction and spinal function: the pain, lumbar dysfunction and spinal function of the both groups were evaluated by Visual Analogue Scale (VAS), Oswestry Disability Index (ODI) and Japanese Orthopaedic Association score (JOA) before operation and 1 month after operation.

(3) Analysis of scoliosis correction: The Cobb angle, lumbar lordosis angle, and sacral inclination angle were measured simultaneously. The scoliosis spine morphology of the both groups was investigated by X-ray before operation and 6 months after surgery.

(4) Living standard analysis: The SF-36 was utilized to compare the both groups' quality of living in terms of physical function, psychological function, social function, and daily activities before and after surgery.

(5) Bone graft fusion: The rate of bone graft fusion was measured after observing the both groups' bone graft fusion 12 months following surgery.

1.4. Statistical methods

The data were analyzed using spss21.0, the pairwise comparison was carried out using the x^2 test, and the percent representation of the count data was utilized. The independent sample t-test was utilized to compare pairs of data, and a variation was deemed clinically meaningful when P 0.05 was utilized to represent the measurement data as（$\bar{x} \pm s$）.

2. Results

2.1. Analysis of operation related indicators in the both groups

Athletic Patients in the observing group underwent operations with considerably less time and blood loss versus those in the controlling group (P< 0.05). In terms of surgical drainage volume and hospital stay, there was no clinically meaningful variation among the both groups (P > 0.05). See

Figure 1 and Table 2.

Table 2: Comparing of operation related indicators of both groups（ $\bar{x} \pm s$）

GROUPING	N	OPERATION TIME (MIN)	INTRAOPERATIVE BLOOD LOSS (ML)	POSTOPERATIVE DRAINAGE VOLUME (ML)	LENGTH OF STAY (D)
OBSERVATION GROUP	41	120.37 ± 11.43	177.64 ± 16.44	120.63 ± 16.44	9.76 ± 1.23
CONTROL GROUP	41	142.78 ± 13.35	222.78 ± 23.79	125.58 ± 17.24	9.35 ± 1.38
T		8.164	9.994	1.332	1.222
P		0.000	0.000	0.187	0.225

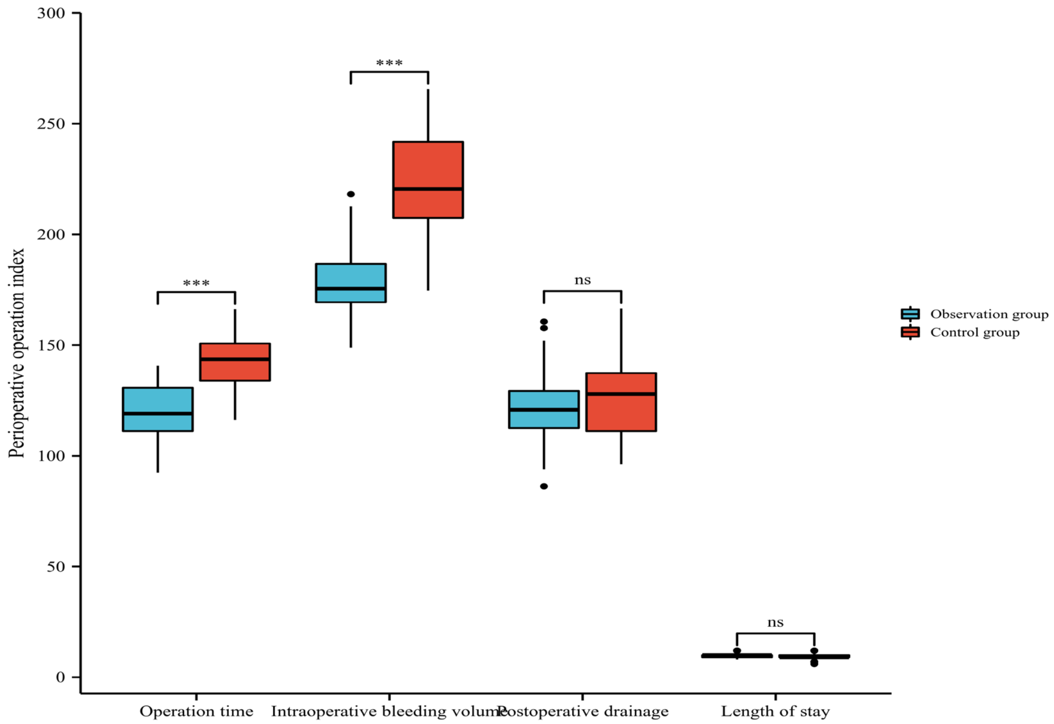

Figure 1: Comparing of the both groups of operation-related indicators

Note: ****indicates P< 0.001 when comparing to the controlling group*

2.2. Analysis of pain, lumbar dysfunction and spinal function of both groups

The VAS and ODI scores of the both groups were generally reduced after surgery versus to they were before, whereas the JOA score was vastly larger (P < 0.05). After the procedure, the observing group's VAS and ODI scores were substantially lower versus to those of the controlling group, although their JOA scores were substantially higher (P < 0.05). See Figure 2 and Table 3.

Table 3: Comparing of VAS score, ODI score and JOA score of both groups （$\bar{x} \pm s$）

Grouping	Time	Vas Score	Odi Score	Joa Score
Observation Group (N=41)	Preoperative	5.43 ± 0.62	28.47 ± 1.93	12.25 ± 3.22
	Postoperative	1.66 ± 0.47*#	14.22 ± 1.78*#	21.38 ± 2.95*#
Control Group (N=41)	Preoperative	5.29 ± 0.54	27.95 ± 2.25	12.86 ± 2.78
	Postoperative	2.56 ± 0.58*	19.66 ± 2.78*	18.24 ± 2.56*

Note: ** indicates P<0.05 versus preoperative; # indicates P<0.05 versus postoperative controlled group*

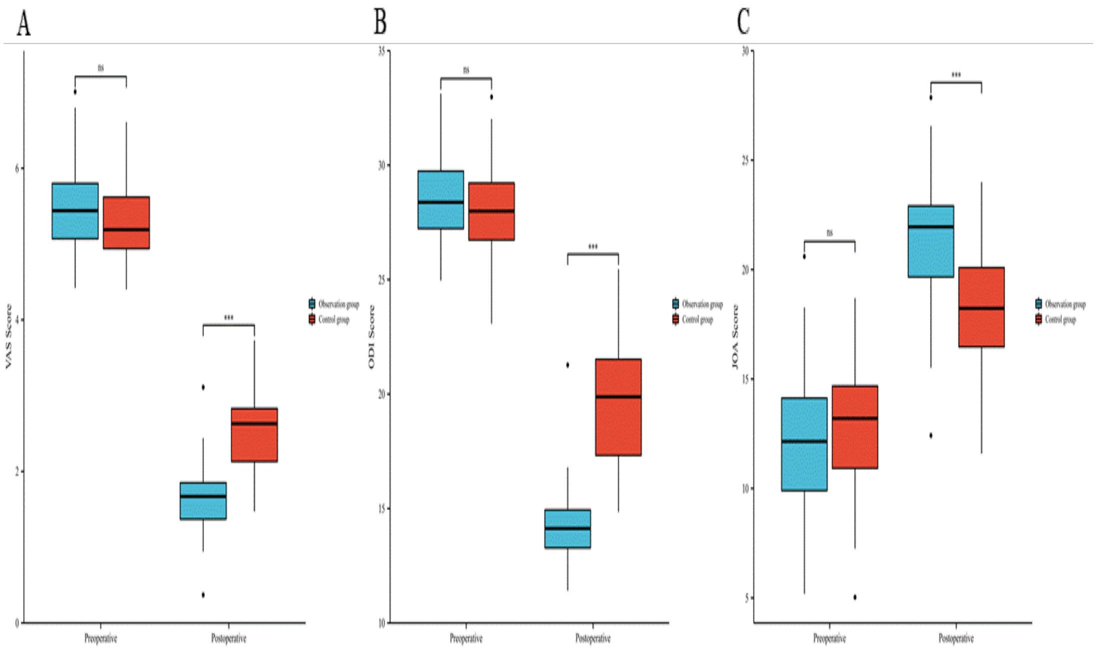

Figure 2: Comparing of VAS score, ODI score and JOA score of the both groups

Note: Comparing of the VAS scores for both groups is depicted in Figure A, the ODI rates for the both groups is illustrated in Figure B, and the JOA scores for the both groups is illustrated in Figure C. *** indicated P < 0.001 was suggested as comparing to the postoperative controlling group.

2.3. Analysis of scoliosis correction of the both groups

The lumbar lordosis angle and sacral tilt angle were substantially greater versus to those before surgery (P < 0.05), whereas the Cobb angle of the both groups was markedly smaller after surgery versus to it was before.

After the procedure, there was no clinically meaningful variation in the Cobb angle, lumbar lordosis angle, or sacral inclination angle among the observing versus the controlling group (P > 0.05). See Figure 3 and Table 4.

Table 4: Comparing of Cobb angle, lumbar lordosis angle and sacral inclination angle of the

both groups （$\bar{x} \pm s$）

GROUPING	TIME	COBB ANGLE (°)	LUMBAR LORDOSIS ANGLE (°)	SACRAL INCLINATION ANGLE (°)
OBSERVATION GROUP (N=41)	Preoperative	37.88 ± 4.24	31.77 ± 5.44	27.55 ± 5.35
	Postoperative	18.74 ± 2.44*	36.67 ± 6.25*	31.64 ± 6.39*
CONTROL GROUP (N=41)	Preoperative	38.32 ± 3.75	32.42 ± 4.93	27.97 ± 4.89
	Postoperative	17.77 ± 3.23*	37.32 ± 6.44*	32.17 ± 7.35*

Note: *compared with preoperative, * indicated P < 0.05*

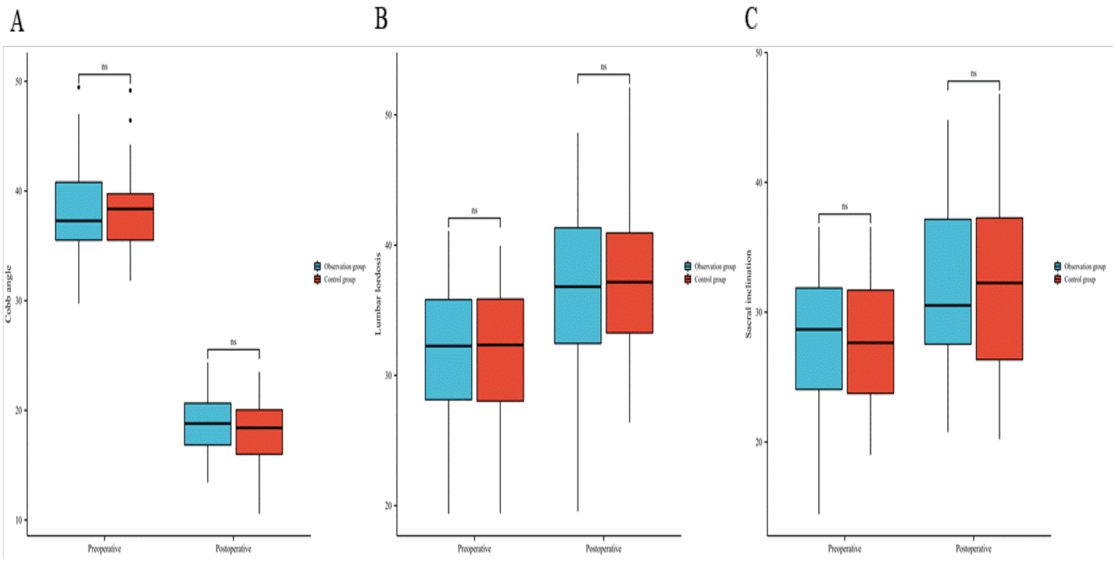

Figure 3: Comparing of Cobb angle, lumbar lordosis angle and sacral inclination angle of the both groups

Note: *Figure A: comparing of Cobb angle of the both groupss; Figure B: comparing of lumbar lordosis angle of the both groups; Figure C: comparing of sacral inclination angle of the both groups*

2.4. Analysis of quality of living of the both groups

The marks of physiological function, psychological function, social function, and everyday living in the both groups were markedly larger after the procedure versus to they had been before (P < 0.05), and the marks in the observing group were markedly larger compared with those in the controlling group after the procedure (P < 0.05). See Figure 4 and Table 5.

Table 5: Comparing of SF-36 scores of the both groups（$\bar{x} \pm s$）

GROUPING	TIME	PHYSIOLOGICAL FUNCTION	PSYCHOLOGICAL FUNCTION	SOCIAL FUNCTION	DAILY ACTIVITIES

Observation Group (N=41)	Preoperative	66.90 ± 3.61	62.19 ± 3.33	67.80 ± 3.35	66.09 ± 3.53
	Postoperative	89.39 ± 3.60*#	85.60 ± 3.33*#	87.87 ± 4.09*#	91.79 ± 4.67*#
Control Group (N=41)	Preoperative	66.89 ± 3.63	61.20 ± 3.32	67.68 ± 3.78	66.08 ± 3.56
	Postoperative	79.89 ± 3.33*	78.23 ± 3.18*	80.12 ± 4.01*	78.12 ± 3.22*

Note: ** indicates P < 0.05, versus preoperative; # indicates P < 0.05, versus postoperative controlling group*

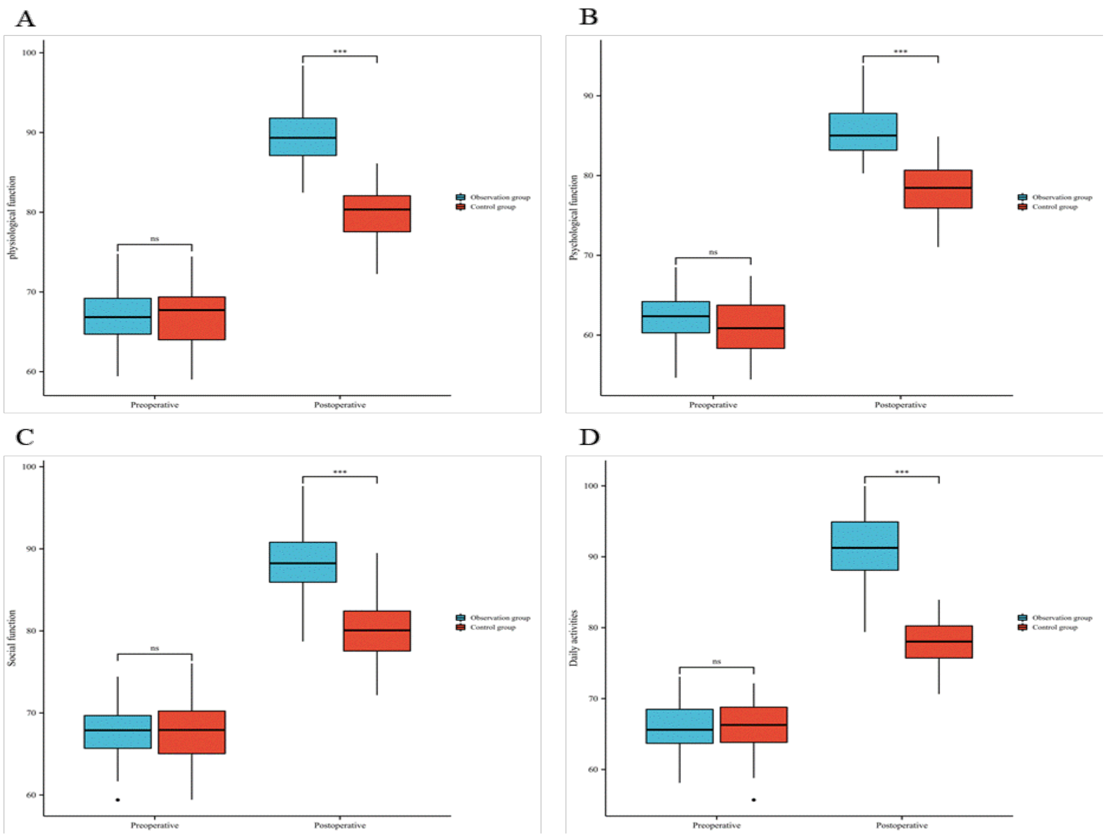

Figure 4: Comparing of SF-36 scores of the both groups

Note: *Figure A: comparing of physiological function marks of the both groups; Figure B: comparing of psychological function marks of the both groups; Figure C: comparing of social function marks of the both groups; Figure D: comparing of daily activity marks of the both groups; *** indicated P < 0.001 versus to the postoperative controlling group*

2.5. Analysis of bone graft fusion of the both groups

In the observing group, there were 39 instances of bone graft fusion, with a fusion rate of 95.12%; in the controlling group, there were 38 instances of fusion, with a fusion rate of 92.68%; this disparity in fusion rates among the both groups were clinically meaningful. (P < 0.05). See Table 6 and Figure 5.

Table 6: Comparing of bone graft fusion rate of the both groups

GROUPING	N	NUMBER OF CASES OF BONE GRAFT FUSION	BONE GRAFT FUSION RATE (%)
OBSERVATION GROUP	41	39	95.12
CONTROL GROUP	41	38	92.68
X^2			0.213
P			0.644

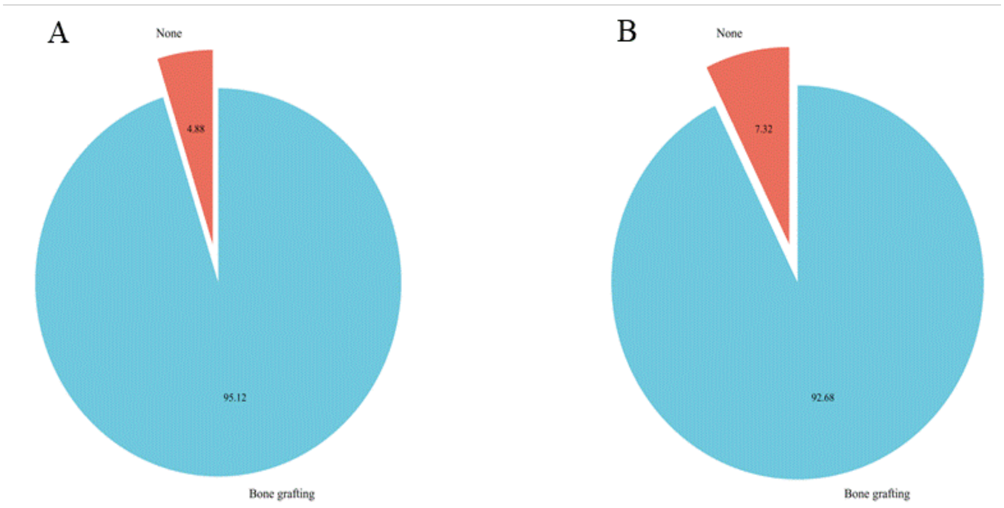

Figure 5: Comparing of bone graft fusion of the both groups

Note: *Figure A: analysis of bone graft fusion in the observing group; Figure B: analysis of bone graft fusion in the controlling group*

3. Discussion

Intervertebral disc herniation and articular process hyperplasia and cohesion can lead to degenerative disease, spinal canal stenosis and vertebral slip and others, and then cause the lateral bulge of the spine, that is, degenerative scoliosis. This disease usually occurs in the thoracolumbar and lumbar segments. Athletic Patients show symptoms such as low back pain, radicular pain, deformity, intermittent claudication (Ferrero et al., 2019; Pizones et al., 2017; Te Hennepe et al., 2022). Degenerative scoliosis is a kind of relatievly special spinal curvature, which has a relatievly long course and is relatievly difficult to treat. Conservative treatment or surgical treatment is usually used to intervene patients in clinic (Basaran et al., 2021; Bowker et al., 2022). For Athletic patients with degenerative scoliosis who fail to respond to conservative treatment, decompression, fixation and fusion treatment can be performed by giving surgery, which can fundamentally improve the clinical symptoms of Athletic patients (Rüwald et al., 2020; Toll et al., 2021).

Open TLIF surgery is one of the commonly used methods for the treatment of degenerative scoliosis, which can effectively improve the clinical symptoms and promote the rehabilitation of Athletic patients. However, this operation can lead to extensive dissection of multifidus and local structural damage, impact on the patient prognosis (Chen et al., 2022; Wong et al., 2014). Thus, it is particularly relevant to explore methods that can offer clinical improvement with a relatively high degree of safety in Athletic patients suffering from degenerative spondylitis. At present, several studies have shown that endoscopic surgery has important value in the management of degenerative spinal conditions (Han et al., 2022; York et al., 2022). Compared with traditional decompression surgery, endoscopic TLIF surgery has a significantly increased visual field definition, which can significantly enlarge the nerve root, dura mater, venous plexus and other tissues, and can fully expose the small blood vessels on the nerve root at the same time (Hasan & Zubairi, 2020; Song et al., 2022). During the operation, clinicians can better observe the small damage on the dura mater, which is conducive to reducing the trauma caused by the operation and reducing the amount of intraoperative blood loss. In addition, it can also reduce the occurrence of intraoperative peripheral muscle dissection and traction injury and other condition (Gatam et al., 2021; Zhang et al., 2021). Combining endoscopic technology with TLIF surgery can provide better lighting effect and stereo image for surgical operation, which is conducive to amplifying the anatomical structure, fully exposing the tissues, improving the decompression and hemostasis of spinal canal, and then improving the shortcomings of traditional surgery (Kim & park, 2020 ; Zhao et al., 2021).

In this study, Athletic patients with degenerative scoliosis were treated by open TLIF surgery and single port endoscopic TLIF surgery, respectively. The findings demonstrated that the operating time and intraoperative blood loss of Athletic patients in the observing group were considerably lower versus to those of the controlling group ($P < 0.05$), demonstrating that single port endoscopic TLIF surgery may successfully shorten the operation time and minimize the intraoperative blood loss of patients having degenerative scoliosis. This may be because this operation can also reduce the surgical incision, reduce the damage degree of soft tissue and nerve root around the diseased vertebral body, reduce the rupture of dural sac, and then reduce the intraoperative blood loss when obtaining the same surgical effects of TLIF, which helps to facilitate the patient's post-operative recovery (Mobbs et al., 2015; Qiu et al., 2022). The discomfort, lumbar dysfunction, and spinal function of the both groups were examined in this study. The findings revealed that the VAS and ODI rates following operation were much reduced in both groups versus those prior to operation, while the JOA score was vastly larger versus to that of the both groups before to surgery. After the procedure, the observation group's VAS score and ODI score were much reduced compared with those of the controlling group, but the JOA score was markedly larger ($P < 0.05$). It shows that TLIF under single port endoscope can effectively relieve the postoperative pain of Athletic patients with degenerative scoliosis and improve the spinal function. This may be due to the unilateral fixation of joints, relatively high flexibility of this surgery method, and the exercise of vertebral bodies after surgical fixation, which has less restrictions on daily activities, so the Athletic patients recover faster (Buell et al., 2019; Du et al., 2021). Additionally, the findings of the X-ray scan revealed that the Cobb angles of the both groups were much lower after surgery versus to they were before.

The disparity in Cobb angle, lumbar lordosis angle, and sacral tilt angle was not present following operation, despite the fact that the lumbar lordosis angle and sacral tilt angle were clearly distinguishable between the observing group and the controlling group ($P > 0.05$). These results indicate that both open TLIF and single port endoscopic TLIF can effectively correct lumbar deformity in Athletic patients with degenerative scoliosis, which helps to encourage the restoration of lumbar function. The SF-36 measure was utilized in this study to compare the both groups of Athletic patients' postoperative quality of life.

According to the findings, both groups' scores for physiological function, psychological function, social function, and daily functioning after surgery were considerably higher versus to they were prior to surgery, and the observation group's scores were considerably higher after surgery versus to the control group's ($P< 0.05$). These findings suggest that TLIF performed via a single port endoscope can significantly enhance the quality of life for Athletic patients who have degenerative changes. The discrepancy among the observation group's bone graft fusion rate (95.12) and the control group's (92.68) was statistically meaningful ($P < 0.05$), showing that the effects of bone graft fusion of TLIF and single port endoscopic TLIF are almost the same. In conclusion, TLIF under single port endoscopy can significantly reduce the operation time and intraoperative blood loss of Athletic patients with degenerative scoliosis, and can relieve postoperative pain and improve spinal function. At the same time, it can correct lumbar deformity of Athletic patients, improve lumbar function and improve the quality of life of Athletic patients. However, the research cycle is relatively short and the sample size is relatively small, and the results are biased, so the sample size will be expanded in future researches for further verification.

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