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ORIGINAL ARTICLE

Efficacy comparison between minimally invasive and conventional surgery for lumbar disc herniation in Chinese Han population: a meta-analysis

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Study design: The pooled data were analyzed using RevMan 5.2 software.
Objectives: The aim was to compare the efficacy of minimally invasive and conventional surgery for lumbar disc herniation (LDH) in Chinese Han population.
Setting: China.
Methods: An electronic search up to November 2013 was performed to retrieve all relevant articles. The overall standardized mean difference (SMD) for continuous outcomes and odds ratio (OR) for dichotomous variables as well as their 95% confidence intervals (CIs) were calculated to compare the efficacy of minimally invasive and conventional surgery.
Results: A total of 23 studies involving 1913 patients treated by minimally invasive surgery and 2295 patients treated by conversational surgery were included in this meta-analysis. The overall estimate indicated that minimally invasive surgery could significantly decrease the hospitalization time (SMD = −2.03, 95% CI, −2.49 to 1.56, $P<0.0001$), blood loss (SMD = −2.65, 95% CI −3.33 to 1.97, $P<0.0001$), incision length (SMD = −3.57, 95% CI, −4.39 to 2.75, $P<0.0001$), recurrence rate (odds ratio (OR) = 0.22, 95 CI: 0.08–0.60, $P=0.003$) and complications (OR = 0.47, 95% CI: 0.25–0.92, $P=0.03$) and increase the postoperative excellent rate (OR = 1.82, 95% CI, 1.44–2.31, $P<0.0001$) compared with conventional surgery. In addition, the pooled data showed that there was no statistically significant difference in the operative time (SMD = −0.58, 95% CI, −1.32 to 0.15, $P=0.12$) between LDH patients treated by minimally invasive and conventional surgery.
Conclusion: In conclusion, minimally invasive surgery was a more safe and effective treatment for treating LDH in Chinese Han population when compared with conventional surgery.
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INTRODUCTION

Lumbar disc herniation (LDH) is the displacement of disc material (annulus fibrosis or nucleus pulposus) beyond the intervertebral disc space, causing low back and/or leg pain.[1] With the clinical symptoms of lumbocrural pain,[2] it occurs in ∼18% of normal population on average in China, and the incidence reported varies from 15.2 to 30% in the world.[3]

Currently, selecting the appropriate treatment of LDH is a hot topic. Generally, the patients who meet the following conditions should be treated by surgery: patients who have not been healed by nonsurgery treatment for half a year after treatment and have become even more serious; the disease has been clearly diagnosed; the patient has typical symptoms such as nerve compression symptoms, neurogenic bowel and bladder disorders.[4] The conventional surgeries include fenestration discectomy and laminectomy discectomy.[5] Minimally invasive surgeries include percutaneous discectomy or vaporization, ozone intervention, radiofrequency ablation, microsurgical discectomy, and endo-microscopy discectomy.[6]

In recent years, with the development of modern science and technology, it becomes more and more popular to apply minimally invasive surgery for treating LDH.[7] It is a controversial topic whether minimally invasive surgery has better efficacy than conventional surgery. Although a majority of randomized controlled trials have demonstrated better efficacy of minimally invasive surgery in treating LDH than conventional surgery,[8,9] inconsistent conclusions were also reported at home and aboard. Righesso *et al.*[10] reported that the patients with LDH treated by minimally invasive surgery had higher incidence of postoperative complications than those treated by conversational surgery. In China, Xie *et al.*[11] reported that there were same postoperative excellent rates between minimally invasive and conversational surgery. Mou *et al.*[12] reported that there was no difference in the indexes of pain, function and treatment satisfaction between minimally invasive and conversational surgery. Therefore, we performed a meta-analysis of randomized controlled trials and case–control studies to compare the efficacy of minimally invasive and conventional surgery for LDH in Chinese Han population and provide a basis for the preferred therapies in clinical practice.

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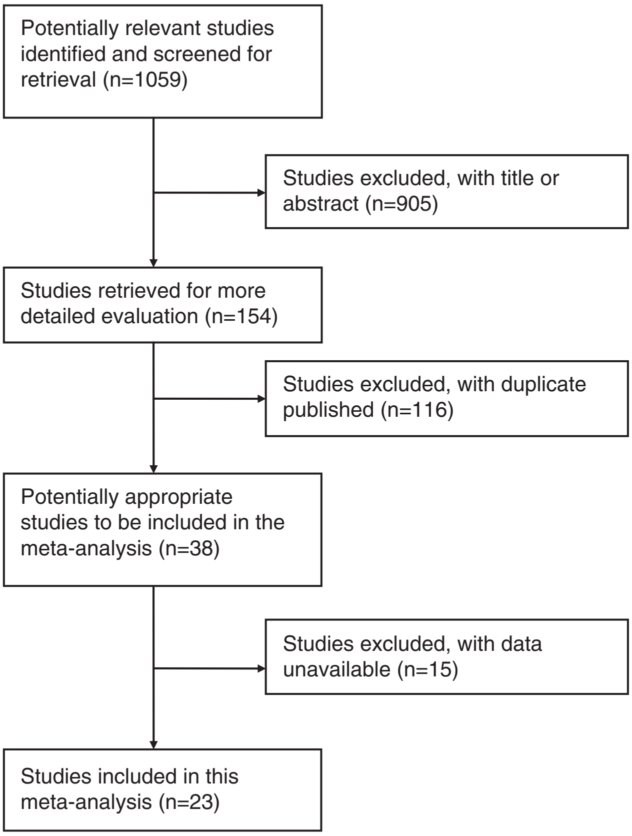


Figure 1 Selection of relevant publications, and reasons for exclusion.

MATERIALS AND METHODS

Data source

Relevant papers published before November 2013 were retrieved through searching CNKI, Wanfang, CQVIP, PubMed and Embase databases using the following terms: 'minimally invasive surgery', 'conventional surgery', 'lumbar disc herniation' and 'China' or 'Chinese'.

Inclusion and exclusion criteria

Included studies had to fulfill the following criteria: (1) the studies were randomized controlled trials or retrospective case–control studies; (2) the studies were the comparison of minimally invasive (experiment group) and conventional surgery (control group); (3) the patients with LDH were adults aged >18 years; (4) the patients must be Chinese Han; (5) at least one of the following evaluation indexes of efficacy was contained: operative time, hospitalization time, blood loss, incision length, recurrence rate, postoperative excellent rate and complications; (6) available data should be provided or obtained by calculation. Studies were excluded if there was no efficacy comparison between minimally invasive and conventional surgery for LDH. In addition, reviews, summaries, conferences and letters had to be eliminated.

Data extraction and quality assessment

Two evaluators independently selected studies and extracted data. Discrepancies were resolved by discussion with a third investigator. The following data were recorded: the first author name; year of publication; region; number, gender and age of the patients; and evaluation indexes.

The Jadad scoring system[13] was used to evaluate the quality of studies included in the meta-analysis. The studies with the score 3 to 5 were high-quality literatures.

Statistical analysis

This meta-analysis was performed by using the RevMan 5.2 software (Review Manager Version 5.2, Copenhagen: The Nordic Cochrane Centre, The

Table 1 Characteristics of included studies

Author	*Year*	*Region*	*Experimental group/control group*			*Score*	*Outcomes*
			n	*Male (%)*	*Age (years)*		
Cheng *et al.*[9]	2012	Chongqing	42/38	61.9/65.8	43/44.5	1	a,b,c,e,g
Dai *et al.*[25]	2010	Anhui	546/625	54.0/54.7	40.7/47.2	1	e,g,
Gao *et al.*[33]	2011	Shanxi	40/40	45/55	40.4/41.3	2	e
Han *et al.*[30]	2008	Guangdong	30/20	66.7/65	41.4/46.2	1	a,c,d,e
Li *et al.*[38]	2008	Gansu	124/137	58.1/48.2	37.6/44.5	1	a,c,e,h
Li *et al.*[29]	2010	Hebei	30/30	60/53.3	40/38.7	2	b,c,d,e
Lin *et al.*[35]	2013	Henan	42/42	69/64.3	45.5/47.5	1	a,b,e,f
Liu *et al.*[17]	2013	Liaoning	12/13	66.7/61.6	37/38	3	a,b,c,d
Liu *et al.*[26]	2004	Gansu	69/52	47.8/65.4	27–72/37–72	1	e
Lu *et al.*[31]	2013	Guangxi	232/235	55.6/54.0	44/46	2	a,b,c,d,e,f
Luo *et al.*[27]	2013	Guangxi	43/43	69.8/74.4	41.5/40.7	3	a,b,c,d,g,h
Peng *et al.*[20]	2003	Hunan	25/82	72/69.5	53/51.5	1	e
Sun *et al.*	2012	Shandong	56/56	51.8	46.5	2	a,b,c,e
Tang *et al.*[21]	2012	Hunan	40/40	31.3	64.7	2	a,b,c,d,h
Tang *et al.*[36]	2011	Guangdong	60/72	61.7/55.6	42.1/37.7	1	e,g
Wang *et al.*	2012	Guangdong	112/124	54.5/54.8	41.7/42.3	1	a,c,d,h
Wu *et al.*[37]	2012	Fujian	94/346	73.4/58.1	36.7/45.7	1	e,g
Xie *et al.*[11]	2012	Guangxi	15/15	66.7/73.3	51.8/49.2	3	a,b,c,e
Yi *et al.*[24]	2011	Hunan	42/42	76.2/71.4	35.5	2	b,c,d,e
Zhang *et al.*[34]	2009	Shanxi	127/121	62.1	$\geq$20, $\leq$60	2	a,c,d,e
Zhang *et al.*[18]	2008	Henan	46/46	63/56.5	38.4/39.6	3	b,c,d,e
Zhao *et al.*[28]	2011	Shanxi	38/38	65.8	19–54	2	a,b,e,f
Zhao *et al.*[28]	2011	Yunnan	48/38	75/78.9	34.8/35.6	1	b,e,f

Abbreviations: a, operative time; b, hospitalization time; c, blood loss; d, incision length; e, postoperative excellent rate; f, recurrence rate; g, complications; h, postoperative recovery.

Table 2 The results of meta-analyses of operative time, hospitalization time, blood loss and incision length

Evaluation indexes	Total					Southern China					Northern China				
	n	SMD (95% CI)	Z-test	Heterogeneity		n	SMD (95% CI)	Z-test	Heterogeneity		n	SMD (95% CI)	Z-test	Heterogeneity	
			P	P	I^2			P	P	I^2			P	P	I^2
Operative time[a]	13	−0.58 (−1.32, 0.15)	0.12	<0.0001	98%	7	−0.75 (−1.62, 0.13)	0.09	<0.0001	97%	6	−0.39 (−1.60, 0.82)	0.53	<0.0001	98%
Operative time[b]	12	−0.77 (−1.41, −0.14)	0.02	<0.0001	97%	7	−0.75 (−1.62, 0.13)	0.09	<0.0001	97%	5	−0.81 (−1.90, 0.28)	0.15	<0.0001	97%
Hospitalization time	13	−2.03 (−2.49, −1.56)	<0.0001	<0.0001	91%	7	−1.95 (−2.53, −1.37)	<0.0001	<0.0001	90%	6	−2.12 (−3.00, −1.25)	<0.0001	<0.0001	92%
Blood loss	14	−2.65 (−3.33, −1.97)	<0.0001	<0.0001	97%	8	−3.27 (−4.38, −2.15)	<0.0001	<0.0001	97%	6	−1.89 (−2.61, −1.17)	<0.0001	<0.0001	94%
Incision length	10	−3.57 (−4.39, −2.75)	<0.0001	<0.0001	96%	6	−4 (−5.13, −2.87)	<0.0001	<0.0001	97%		−3.08 (−4.65, −1.51)	0.0001	<0.0001	96%

Abbreviations: CI, confidence interval; SMD, standardized mean difference.
[a]Results of meta-analysis before sensitivity analysis.
[b]Results of meta-analysis after sensitivity analysis.

Cochrane Collaboration, 2012). Heterogeneity was evaluated by the χ^2-based Q statistic test[14] and I^2 test with $\alpha<0.05$. Random-effect model (Dersimonian–Laird method) was applied if there was significant heterogeneity ($P<0.05$, $I^2>50\%$).[15] Otherwise, fixed-effect model (Mantel–Haenszel method) was used.[16] Differences between minimally invasive and conventional surgery were assessed using Z-test with $P<0.05$. Dichotomous variables were summarized using odds ratio (OR) and 95% confidence intervals (CIs). Continuous outcomes were summarized by the standardized mean difference (SMD) and 95% CIs. Sensitivity analysis was performed by omitting each study in turn to assess the stability of the outcomes.[17] Funnel plot was used to perform the publication bias.

In addition, a subgroup analysis by region was performed. The Yangtze River was the boundary between northern and southern region.

RESULTS

Included studies

Based on key words and publication time, we initially retrieved 1059 articles. Among them, 905 articles were excluded after screening based on abstracts or titles. Then, 38 articles remained after excluding duplicate articles. Finally, 23 studies[9,11,18–38] were included in this meta-analysis. The flow diagram of study selection process is shown in Figure 1.

Study characteristics

The characteristics of included studies are summarized in Table 1. A total of 4208 patients, including 1913 in the experimental group and 2295 in the control group, were included in this study. According to the Jadad scoring system, there were 4 high-quality studies[11,18,19,27] in the 23 included studies.

Analysis of evaluation indexes of efficacy

A total of 13 literatures[9,11,19,21–23,27,30–32,34,35,38] were included to analyze the difference in operative time between minimally invasive and conversational surgery. There was significant heterogeneity ($I^2=98\%$, $P<0.0001$) among the included studies. Accordingly, random-effect model was used. In the pooled data of operative time, the pooled SMD was −0.58 (95% CI, −1.32 to 0.15, $P=0.12$), suggesting that there was no statistically significant difference in operative time (Table 2).

A total of 13 literatures[9,11,18,19,21–24,27–29,31,35] reported hospitalization time. There was obvious evidence for statistically significant heterogeneity ($I^2=91\%$, $P<0.0001$) among these studies. Therefore, random-effect model was used. The pooled data (SMD = −2.03, 95% CI, −2.49 to 1.56, $P<0.0001$) showed that there was a statistically significant difference in hospitalization time. Compared with conventional surgery, minimally invasive treatment significantly decreased the hospitalization time (Table 2).

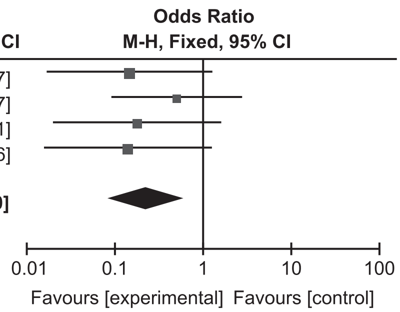
The data in 14 eligible studies[9,11,18,19,21,22,24,27,29–32,34,38] were available for analyzing the difference in blood loss. Significant heterogeneity ($I^2=97\%$, $P<0.0001$) existed in the studies. Random-effect model was used to pool the data. The combined SMD (SMD = −2.65, 95% CI, −3.33 to 1.97, $P<0.0001$) was statistically significant in favor of the experimental group. Minimally invasive treatment significantly reduced blood loss during operation (Table 2).

Incision length was assessed in 10 eligible studies[18,19,21,24,27,29–32,34] Significant heterogeneity ($I^2=96\%$, $P<0.0001$) existed among the studies, and random-effect models was used. The overall SMD (−3.57, 95% CI, −4.39 to 2.75, $P<0.0001$) was in favor of the experimental group (Table 2).

Four included studies[23,28,31,35] provided available data of recurrence rate. No heterogeneity ($I^2=0\%$, $P<75\%$) was found among the a

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Lin JF 2013	1	42	6	42	29.1%	0.15 [0.02, 1.27]
Lu XS 2013	2	232	4	235	19.6%	0.50 [0.09, 2.77]
Zhao Q 2011	1	38	5	38	24.2%	0.18 [0.02, 1.61]
Zhao SL 2011	1	48	5	38	27.1%	0.14 [0.02, 1.26]
Total (95% CI)		**360**		**353**	**100.0%**	**0.22 [0.08, 0.60]**
Total events	5		20			

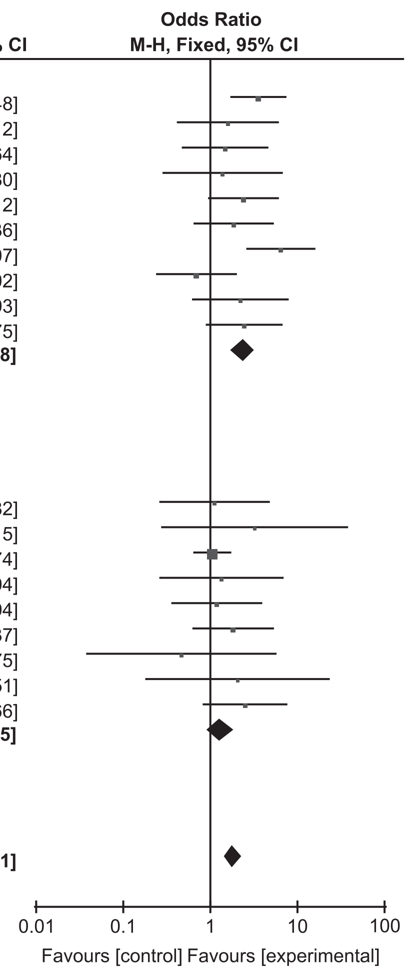
Heterogeneity: Chi² = 1.23, df = 3 (P = 0.75); I² = 0%
Test for overall effect: Z = 2.97 (P = 0.003)



b

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Fixed, 95% CI
5.1.1 Northern China						
Dai SD 2010	522	531	570	605	8.6%	3.56 [1.70, 7.48]
Gao XJ 2011	36	40	34	40	3.2%	1.59 [0.41, 6.12]
Li SH 2008	119	124	129	137	4.7%	1.48 [0.47, 4.64]
Li SK 2010	27	30	26	30	2.5%	1.38 [0.28, 6.80]
Lin JF 2013	32	42	24	42	5.5%	2.40 [0.94, 6.12]
Liu M 2004	62	69	43	52	4.7%	1.85 [0.64, 5.36]
Sun F 2012	48	56	27	56	3.7%	6.44 [2.58, 16.07]
Zhang DW 2009	105	114	101	107	7.9%	0.69 [0.24, 2.02]
Zhang S 2008	42	46	38	46	3.2%	2.21 [0.62, 7.93]
Zhao Q 2011	30	38	23	38	4.6%	2.45 [0.89, 6.75]
Subtotal (95% CI)		**1090**		**1153**	**48.6%**	**2.38 [1.73, 3.28]**
Total events	1023		1015			
Heterogeneity: Chi² = 12.51, df = 9 (P = 0.19); I² = 28%						
Test for overall effect: Z = 5.31 (P < 0.00001)						
5.1.2 Southern China						
Cheng J 2012	38	42	34	38	3.2%	1.12 [0.26, 4.82]
Han Y 2008	29	30	18	20	0.7%	3.22 [0.27, 38.15]
Lu XS 2013	197	232	198	235	28.3%	1.05 [0.64, 1.74]
Peng YQ 2003	23	25	60	67	2.5%	1.34 [0.26, 6.94]
Tang YZ 2011	55	60	65	72	4.7%	1.18 [0.36, 3.94]
Wu ZQ 2012	90	94	320	346	5.6%	1.83 [0.62, 5.37]
Xie ZZ 2012	13	15	14	15	1.8%	0.46 [0.04, 5.75]
Yi RF 2011	41	42	40	42	0.9%	2.05 [0.18, 23.51]
Zhao SL 2011	42	48	28	38	3.7%	2.50 [0.82, 7.66]
Subtotal (95% CI)		**588**		**873**	**51.4%**	**1.30 [0.91, 1.85]**
Total events	528		777			
Heterogeneity: Chi² = 3.74, df = 8 (P = 0.88); I² = 0%						
Test for overall effect: Z = 1.43 (P = 0.15)						
Total (95% CI)		**1678**		**2026**	**100.0%**	**1.82 [1.44, 2.31]**
Total events	1551		1792			

Heterogeneity: Chi² = 21.95, df = 18 (P = 0.23); I² = 18%
Test for overall effect: Z = 4.97 (P < 0.00001)
Test for subgroup differences: Chi² = 6.16, df = 1 (P = 0.01), I² = 83.8%



c

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Cheng J 2012	1	42	1	38	3.5%	0.90 [0.05, 14.95]
Dai SD 2010	3	531	9	605	28.8%	0.38 [0.10, 1.40]
Luo M 2013	1	43	5	43	16.8%	0.18 [0.02, 1.62]
Tang YZ 2011	3	60	11	72	32.7%	0.29 [0.08, 1.10]
Wu ZQ 2012	4	94	13	346	18.3%	1.14 [0.36, 3.58]
Total (95% CI)		**770**		**1104**	**100.0%**	**0.47 [0.25, 0.92]**
Total events	12		39			

Heterogeneity: Chi² = 3.83, df = 4 (P = 0.43); I² = 0%
Test for overall effect: Z = 2.22 (P = 0.03)

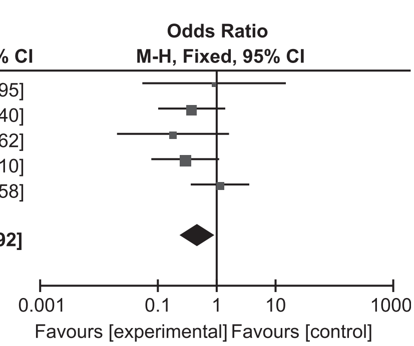


Figure 2 Forest plot displaying the results of the meta-analysis on recurrence rate (**a**), postoperative excellent rate (**b**), and complications (**c**).

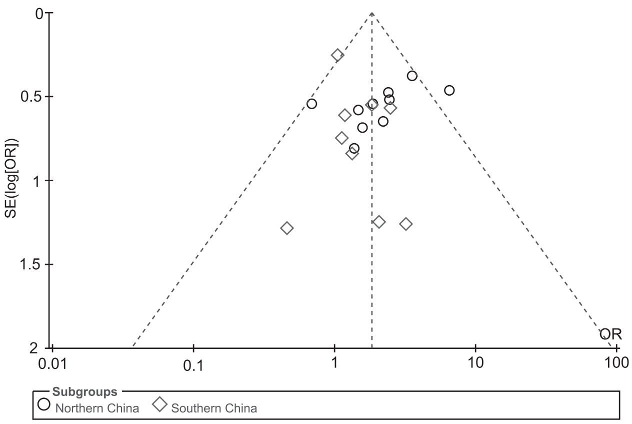


Figure 3 Funnel plot analysis of publication bias.

studies, and the fixed-effect models was used to pool the data. The pooled estimate (OR = 0.22, 95 CI, 0.08–0.60, $P = 0.003$) indicated that the recurrence rate in the experiment group was lower than that in the control group. Minimally invasive surgery significantly decreased the recurrence rate of LDH compared with conventional surgery (Figure 2a).

Nineteen eligible studies[9,11,18,20,22–26,28–31,33–38] were included to analyze the difference in postoperative excellent rate. There was no evidence for significant heterogeneity ($I^2 = 18\%$, $P = 0.23$) in these included studies. Therefore, a fixed-effect model was used. The pooled estimate (OR = 1.82, 95% CI, 1.44–2.31, $P < 0.0001$) showed that the experimental group was favored with a statistical significance when compared with the control group (Figure 2b).

Complications were reported in five included studies.[9,25,27,36,37] No heterogeneity ($I^2 = 0\%$, $P = 0.43$) existed in the studies. The overall OR (0.47, 95% CI, 0.25–0.92, $P = 0.03$) indicated that there were less complications in the experiment group compared with the control group. It suggested that the minimally invasive surgery was safer than conventional surgery (Figure 2c).

Subgroup analysis

According to different regions, the studies were divided into northern group and southern group. For operative time, there was no heterogeneity ($I^2 = 0\%$, $P = 0.64$) between northern (SMD = −0.39, 95% CI, −1.60 to 0.82, $P = 0.53$) and southern groups (SMD = −0.75, 95% CI, −1.62 to 0.13, $P = 0.09$). For hospitalization time, no heterogeneity ($I^2 = 0\%$, $P = 0.75$) existed between the northern (SMD = −2.12, 95% CI, −3.00 to 1.25, $P < 0.0001$) and southern groups (SMD = −1.95, 95% CI, −2.53– −1.37, $P < 0.0001$). For incision length, there was no evidence for significant heterogeneity ($I^2 = 0\%$, $P = 0.35$) between the northern (SMD = −3.08, 95% CI, −4.65 to 1.51, $P < 0.0001$) and southern groups (SMD = −4.00, 95% CI, −5.13 to 2.87, $P < 0.0001$). Significant heterogeneity ($I^2 = 75.8\%$, $P = 0.04$) existed between the northern (SMD = −1.89, 95% CI, −2.61 to 1.17, $P = 0.0001$) and the southern groups (SMD = −3.27, 95% CI, −4.38– −2.15, $P < 0.0001$) for blood loss (Table 2). For the postoperative excellent rate, significant heterogeneity ($I^2 = 83.8\%$, $P = 0.01$) was detected between the northern (OR = 2.38, 95% CI, 1.73–3.28, $P < 0.0001$) and the southern groups (OR = 1.30, 95% CI: 0.91–1.85, $P = 0.15$; Figure 2).

Sensitivity analysis

Sensitivity analysis was conducted by reanalyzing our data after sequential omission of individual studies. After excluding the study of Li *et al.*,[38] the analysis result of operation time was changed (SMD = 0.77, 95% CI, 1.41 to 0.14, $P = 0.02$) and indicated that the operation time in experimental group was significantly lower than that in control group. Besides, no other single study influenced the overall results qualitatively as indicated by sensitivity analysis.

Assessment of publication bias

Funnel plot was used to assess publication bias. As shown in Figure 3, a symmetrical funnel plot was observed, suggesting that there was no publication bias in this meta-analysis.

DISCUSSION

LDH is one of the most common cases of lumbocrural pain, and it occurs in ∼20% in the world. Currently, minimally invasive surgery is widely used in clinical treatment. In this meta-analysis, we compared the efficacy of minimally invasive and conventional surgery for Chinese Han population with LDH. According to the results of this study, minimally invasive surgery could significantly reduce hospitalization time, blood loss, incision length, recurrence rate and complications and induce postoperative excellent rate in Chinese Han population with LDH. It was proved that minimally invasive surgery was a safe and more effective treatment than conventional surgery. When treated by minimally invasive surgery, damage to the patients during surgery could be decreased because of the reduction of blood loss and incision length. The meta-analysis showed that there was higher postoperative excellent rate when treated by minimally invasive surgery. Nevertheless, the results of subgroup analysis showed that there was no statistically significant difference in postoperative excellent rate in the southern group. Based on these results, we speculated that the difference of region might be the factor that could affect the result of this study. Further researches have to be done for proving the results of this study. In China, our findings have important guiding significance for clinical application and development of minimally invasive surgery for treating LDH.

The result of the meta-analysis showed that there was no statistically significant difference in operative time between the two types of surgery. However, the result was changed after sensitivity analysis when omitting the literature reported by Li *et al.*[38] They found that the operation time in the conventional group was shorter than that in the minimally invasive group. In this study, the authors explained that the proficiency of technique is the main limitation of the operation time of minimally invasive surgery.

The main characteristic of minimally invasive surgery is minimal scarring. Generally, the minimal scarring reduces the risks for wound infection and blood loss.[39] In addition, it was reported that minimally invasive surgery had the advantages of diminishing postoperative pain[40] and the rate of postoperative recurrence.[41] The postoperative complications are decreased after minimally invasive surgery.[42] Therefore, the hospitalization time could be reduced because of the good surgery result. High-tech equipment and cutting-edge technology are the main factors to limit the development of minimally invasive surgery.[43] Nevertheless, with the development of modern medical technology, minimally invasive surgery is booming in the world. Especially in China, the symposium of ‘the new concept of minimally invasive surgery’ hosted by Chinese Academy of Engineering was held in 2001.[44] It demonstrated that minimally invasive surgery would rapidly develop in China in the twenty-first century.

Significant heterogeneity was found among the studies when we pooled the outcomes of operative time, hospitalization time, blood loss and incision length. The heterogeneity might be caused by the difference of regions, patients' characteristics and the diverse technical specifications. However, subgroup analysis suggested that the difference of regions did not affect the results of the test for heterogeneity. Thus, further research must be done for exploring the sources of heterogeneity.

In this meta-analysis, for avoiding the influence of racial difference on the result, the subjects in this meta-analysis were Chinese Han patients. Another characteristic of this meta-analysis is that subgroup analysis was used to explore the source of heterogeneity. Although no heterogeneity was found between the region groups, it could provide basis for further study. In addition, some limitations of this meta-analysis should be acknowledged. First, the sources of heterogeneity were not found. Second, the data of ages and genders were not enough to analyze the effects of these factors on the results. Third, the subgroup analysis of recurrence rate and complications could not be performed due to lack of studies. More studies must be done to verify the results of this study.

CONCLUSIONS

In conclusion, this meta-analysis showed that minimally invasive surgery for treating Chinese Han patients with LDH had better efficacy and higher safety compared with conventional surgery. Minimally invasive surgery may dominate for treating LDH in Chinese Han population in the future.

DATA ARCHIVING

There were no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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RETRACTION

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