

Original Article

What were the advantages of microendoscopic discectomy for lumbar disc herniation comparing with open discectomy: a meta-analysis?

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Abstract: The purpose of this study was to compare the safety and efficacy of micro-endoscopic discectomy (MED) and open discectomy (OD) for lumbar disc herniation (LDH). Randomised controlled trials (RCTs) comparing MED with OD for LDH were searched comprehensively in PubMed, EMBASE, the Cochrane Library. Relevant studies retrieved, data extracted and the quality of included studies were independently performed by two authors. RevMan software (Version 5.2.0) was used to analyse and synthesis relevant data of the included studies. Nine RCTs involving 774 patients were obtained and reported the relevant outcome measures. Compared with OD group, there were significant difference in the general operation indicators including operation time, blood loss, site of incision, hospital stay and time of return to work, biochemical indexes including C-reactive protein (CRP) and interleukin-6 (IL-6) in MED group. Meanwhile, there were no difference in effective rate, complication including total complications, dural leaks occurred and recurrence of the disc herniation, compared MED group with OD group. MED had slighter trauma, milder blood loss and shorter healing time than OD. The results demonstrated MED has great efficacy and safety comparable to OD. So we think that MED can be used routinely for LDH patients, especially the patients of old and intolerable major surgery. Meanwhile, it is necessary for surgeon to master indication and contraindication of MED and improve the operative technique.

Keywords: Lumbar disc herniation, micro-endoscopic discectomy, open discectomy, efficiency, meta-analysis

Introduction

Lumbar disc herniation (LDH) is a frequently-occurring and common spine-related disease in orthopaedic, which is the most common cause of low back and leg pain. It has bothered the lives' quality of the patients. Severely, the long-term chronic low back pain may cause disability, according to the statistics of World Health Organisation [1].

It is reported [2] that 80%-90% patients of LDH experienced mild symptoms and could be treated by conservative therapy. However, a considerable part of the patients have occurred typical symptoms such as the symptoms of nerve root compression, defecation function disturbance, and must be experienced operative therapy. Also, if the patients who have serious or typical symptoms can't be healed more than six

months by conservative treatment, operation will be considered as the only one effective method [3].

Two main surgical methods were used: open discectomy (OD) and minimally invasive discectomy (MID). OD has been proved to be effective and also was widely used. As a new minimally invasive operative method, microendoscopic discectomy (MED) was initially introduced by Smith and Foley in 1997 [4]. In recent years, the efficacy of MED has been reported constantly. Zhou et al [5] performed a study with a five-year follow-up which proved MED is both feasible and efficacious for the management of LDH in 2009. Kunert et al [6] and Kulkarni et al [7] reported that MED for the patients who have experienced symptomatic LDH had greatly improved in the quality of lives in 2010 and in 2014, respectively. In order to prove the long-

term efficacy of MED, Wang et al [8] performed a ten-year follow-up study and outcome indicated that the long-term clinical outcomes of MED are satisfactory and better than traditional discectomy. However, there maybe have some disadvantages for MED, such as high lever of operation, high cost and complications.

By searched a lot of literatures, we found that there was a meta-analysis [9] which included four studies concerning the MED for LDH, and it was performed to assess the efficacy of comparing MED with microdiscectomy (MD) or OD. In order to compare with the efficacy and safety of MED and OD, this new meta-analysis was preformed which included nine studies.

Materials and methods

Inclusion criteria

According to the purpose of the study, the inclusion criteria were as follows: (1) the eligible studies were RCTs and should be published as a full paper; (2) the age of the patient who experienced LDH was older than 18 years; (3) the interventions of controlled group must be used OD for LDH patients; (4) the outcome measures were at least one included in the RCT.

Study search strategy and selection

Electronic and manual search were performed in this meta-analysis. PubMed, EMBASE and the Cochrane Library were searched comprehensively up to June 2015. The following keyword were used: "lumbar disc herniation", "LDH", "microendoscopic discectomy", "open discectomy", "MED", "conventional discectomy", "METRx". Meanwhie, two authors (Mu and Li) checked the Chinese core journal in orthopaedic which included Chinese Journal of Spine and Spinal cord, Orthopedic Journal of China by manual search. All of the authors can read the full articles by using English and Chinese, so the languages of relevant studies were limited. The potential randomised controlled trials (RCTs) or similar meta-analysis was acquired. For the references of the eligible studies, the strategy requested to retrieve. The full papers of eligible studies must be downloaded and the specific data included in the studies. When there weren't concrete data of included studies, the author should be contacted. The grey literature and the review were excluded.

Data extraction

Two authors (Mu and Li) extracted independently the relevant data by reading the full articles carefully. The following data must be recorded: author name, the time of literature published, study design, the number of trial and controlled group, random method, allocation concealment, blind, follow-up, outcome measure, etc. For the outcome measure, two authors have different views in biochemical indexes, such as IL-6 and CRP. We attempted to solve this problem, but failure always followed us. Finally, we extrated the biochemical indexes by consulting the third parties. The characteristics of the included studies in this meta-analysis were assembled in **Table 1**.

Assessment of study quality

According to the method guidelines in the Cochrane Collaboration, quality of the studies included were evaluated by two authors independently. If the discrepancies are occurred, two authors should try to solve by negotiation. The second opinions will be followed when they can't reach an agreement. The following standards should be performed [10]: randomization, allocation concealment, participants and outcome assessor blinding, selective outcome reporting, incomplete outcome data and other.

Statistical method

In this meta-analysis, we used the RevMan software (5.2.0 version) which was provided by the Cochrane Collaboration to analyse and pool relevant data. The mean difference (MD) and 95% confidence intervals (95% CI) were used to analyse continuous data which had a same units of measure. Otherwise, the standard mean difference (SMD) was used. For dichotomous data, we used the risk ratio (RR) and 95% CI. $I^2 < 50\%$ was considered the low heterogeneity and the fixed-effect model can be used. The random-effect model were used to pooled the high heterogeneity among the studies, namely, $I^2 > 50\%$.

Results

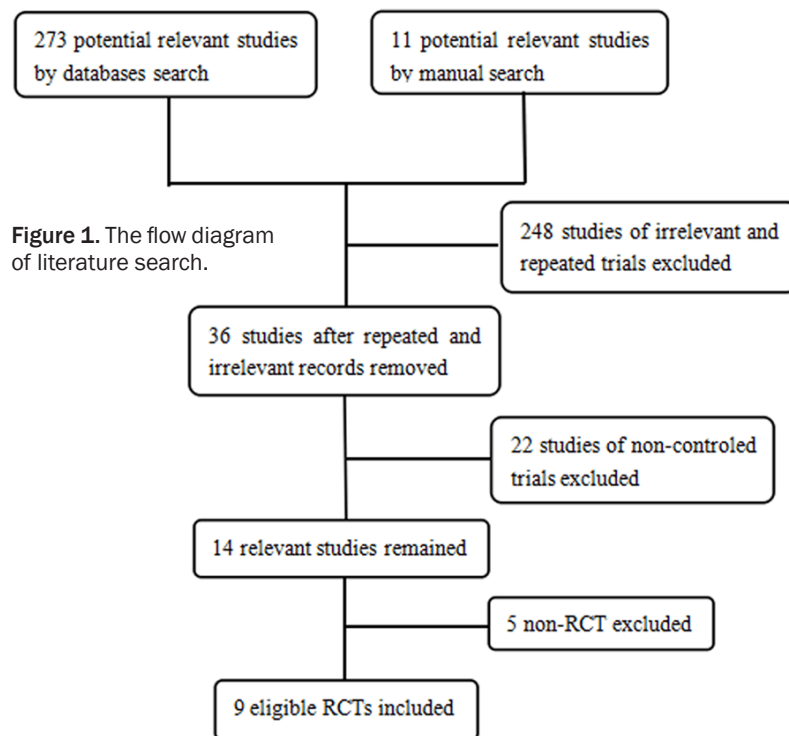
Results of literature search and study quality

Nine RCTs were included in this meta-analysis. 273 potential relevant studies were initially retrieved from the databases. 248 studies

Table 1. Characteristics of the eligible trials

Study	Number (T/C)	Mean age (T/C)	Male (T/C)	DSMED	Follow up (mean)	Outcome measure
Teli et al	70/70	39/39	45/46	11 W (mean)	2 Y	①④⑥⑦⑨
Wang et al	29/31	41/43	16/17	UC	18.3 M	①②③④⑦⑧⑨
Yuan et al	50/47	35.4/35.2	33/32	6 M-12 Y	2 Y	①②④⑤⑧⑨
Righesso et al	21/19	42/46	10/13	1-6 M	2 Y	①②③④⑥⑦⑨
Wei et al	46/50	33.8/33.4	30/30	7 M-3 Y	10.4 M	①②④⑤⑧⑨
Garg et al	55/57	37/38	19/13	2 M-3 Y	12 M	①②④⑥⑧⑨
Huang et al	10/12	39.2/39.8	6/9	UC	18.9 M	①②③④⑦⑧
Hussein et al	95/90	30.2/31.5	58/54	3.04 M (mean)	8 Y	①②④⑤⑥⑨
Sasaoka et al	15/7	36.5/37.7	6/5	UC	UC	①②

W: week, M: month, Y: year, DSMED: duration of symptoms in MED, UC: unclear. Main outcome measure: ① operation time; ② blood loss; ③ size of incision; ④ hospital stay; ⑤ time to return to work; ⑥ ODI score; ⑦ VAS score; ⑧ satisfaction cases; ⑨ adverse events.



were excluded by scanning the titles and abstracts, because their directions of research were out of this meta-analysis. 22 non-controlled trials and 5 non-RCT trials were removed. 11 potential relevant studies were retrieved by manual search. Three studies were remained. Finally, nine studies including 774 patients were obtained. The process of literature search is showed in **Figure 1**. The method guidelines in the Cochrane Collaboration were used to assess study quality. Low risk, unclear risk and high risk were respectively expressed in “+”, “?” and “-”. The evaluation outcome was displayed in **Figure 2**.

General operation indicators

In this meta-analysis, operation time, blood loss, site of incision, hospital stay and time of return to work were classified as the general operation indicators. They can use to assess the efficacy and safety of the surgical method. They were reported by nine studies [11-19], seven studies [12, 13, 15-19], three studies [12, 14, 17], five studies [12, 13, 15-17] two studies [13, 18], respectively. The random were used to analysis and pooled data due to the high heterogeneity ($P < 0.00001$, $I^2 = 99\%$). The pooled results showed statistically significance in operation time (SMD =

1.26, 95% CI = 0.34 to 2.19), blood loss (SMD = -2.68, 95% CI = -3.57 to -1.79), site of incision (SMD = -6.25, 95% CI = -12.22 to -0.29), hospital stay (SMD = -2.38, 95% CI = -3.66 to -1.10) and time of return to work (SMD = -4.58, 95% CI = -9.16 to -0.02). Reading these data, it can be concluded that MED group was better than OD group in general operation indicators (**Figure 3**).

Effective cases

For the patients of LDH, typical symptoms become the main cause to bother their daily

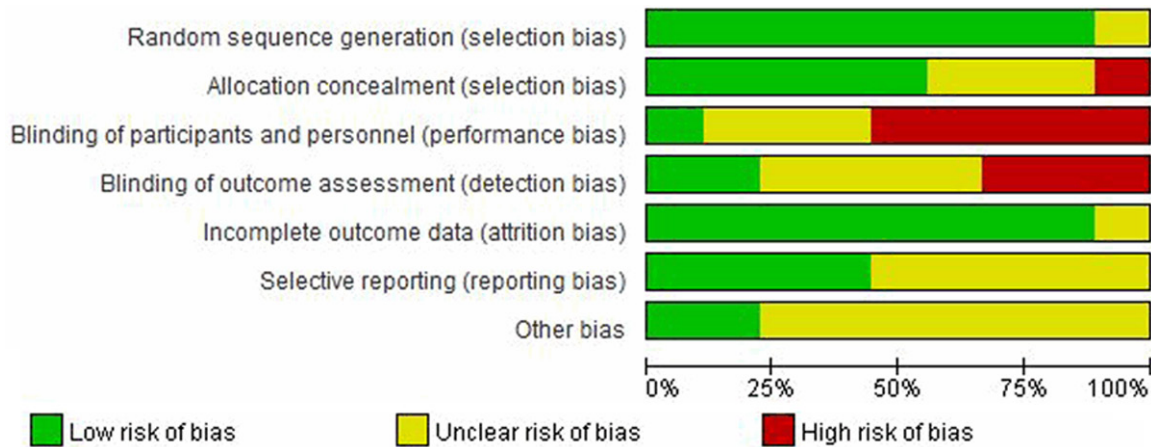


Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

life. A main purpose in the treatment of patients with LDH is to improve symptoms. As the main evaluation index, effective cases were used. Five studies [12, 13, 15-17] reported satisfaction cases. The fixed-effect model was used to analysis datas, because there wasn't the heterogeneity ($P = 0.74$, $I^2 = 0\%$). The pooled result showed that there was no statistically significance between MED group and OD group ($RR = 0.99$, $95\% \text{ CI} = 0.94-1.05$, $P = 0.79$). Therefore, the result indicated that both MED and OD can improve the symptoms of the LDH patients, but extents of improvement were similar in two group (**Figure 4**).

Biochemical indexes

Surgical trauma was connected with the level of local inflammatory responses. So, inflammatory cytokines in plasma can be detected to evaluate the extend of surgical trauma. There were three studies [12, 17, 19] reporting the CRP and IL-6, while only two studies can be pooled. The forest plots showed there were statistically significance in CRP ($MD = -16.22$, $95\% \text{ CI} = -20.88 \text{ to } -11.56$), IL-6 (4 h: $MD = -3.94$, $95\% \text{ CI} = -7.37 \text{ to } -0.50$; 8 h: $MD = -8.14$, $95\% \text{ CI} = -13.16 \text{ to } -3.12$; 24 h: $MD = -14.25$, $95\% \text{ CI} = -19.04 \text{ to } -9.45$), respectively. It can be comfired that MED group had smaller trauma than OD group (**Figure 5**).

Complication

All of surgeons and patients can't want to encounter the complications in the course of

treatment, especially in the surgery. However, the adverse events were unlikely to be completely eliminated. Total complications (TC) and dural leaks occurred (DL) were reported by seven studies [11-16, 18]. Meanwhile, four studies [11, 14, 16, 18] reported recurrence of the disc herniation (RDH). There were the low heterogeneity in the subgroup (TC: $P = 0.30$, $I^2 = 18\%$; DL: $P = 0.80$, $I^2 = 0\%$; RDH: $P = 0.42$, $I^2 = 0\%$), so the fixed-effect model were used. The pooled results showed no statistically difference in TC ($MD = 1.33$, $95\% \text{ CI} = 0.92 \text{ to } 1.91$), DL ($MD = 1.27$, $95\% \text{ CI} = 0.69 \text{ to } 2.33$) and RHD ($MD = 1.88$, $95\% \text{ CI} = 0.74 \text{ to } 1.84$). From the forest plot, we can understand that there were no differences in the occurrence of complication between two group (**Figure 6**).

Discussion

Several kinds of operative methods have been generated to improve the quality of LDH patients. However, the controversy always existed for surgeon to choose the surgical methods. As an effect technique, MED have been introduced about 15 years. The advantages and disadvantages of MED already have been reported by many studies [4-7, 20, 21].

Efficacy was evaluated by using effective rate and biochemical indexes in our study. Each of the included studies reported that there were no statistical differences in effective rate between two groups. However, stronger evidence that OD had good effect for LDH was provided in 2007 [22]. Combined with the results

Microendoscopic discectomy for lumbar disc herniation

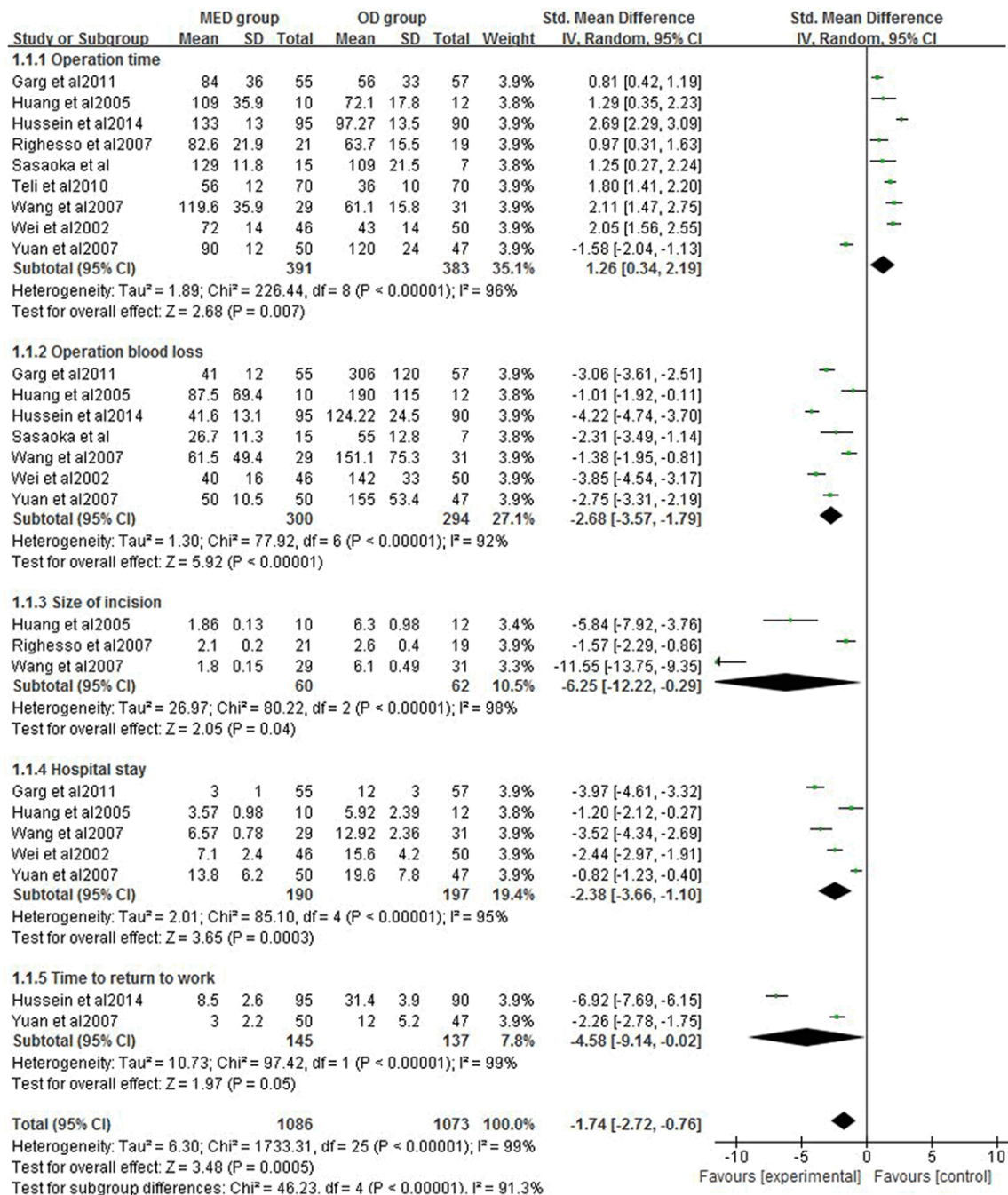


Figure 3. The forest plot of general characteristics of operation, including operation time, blood loss, size of incision, hospital stay and time of return to work.

of our study, we can safely conclude that MED for LDH patients was effective on improving symptoms. Biochemical indexes were reported in Huang et al [17], Wang et al [12] and Sasaoka et al [19], there were significant difference between two groups. It signed that MED group had slighter trauma than OD and can improve symptoms to let patients earlier return to normal life.

Safety is usually one of the most common guideline used for evaluation the surgical quality. No matter what kind of treating methods are safety is the most important one. So we used the more indicators to assess the safety of MED which compared with OD, such as surgical time, blood loss, size of incision, hospital stay and complication. The pooled results showed that there were statistical differences



Figure 4. The forest plot of effective cases.

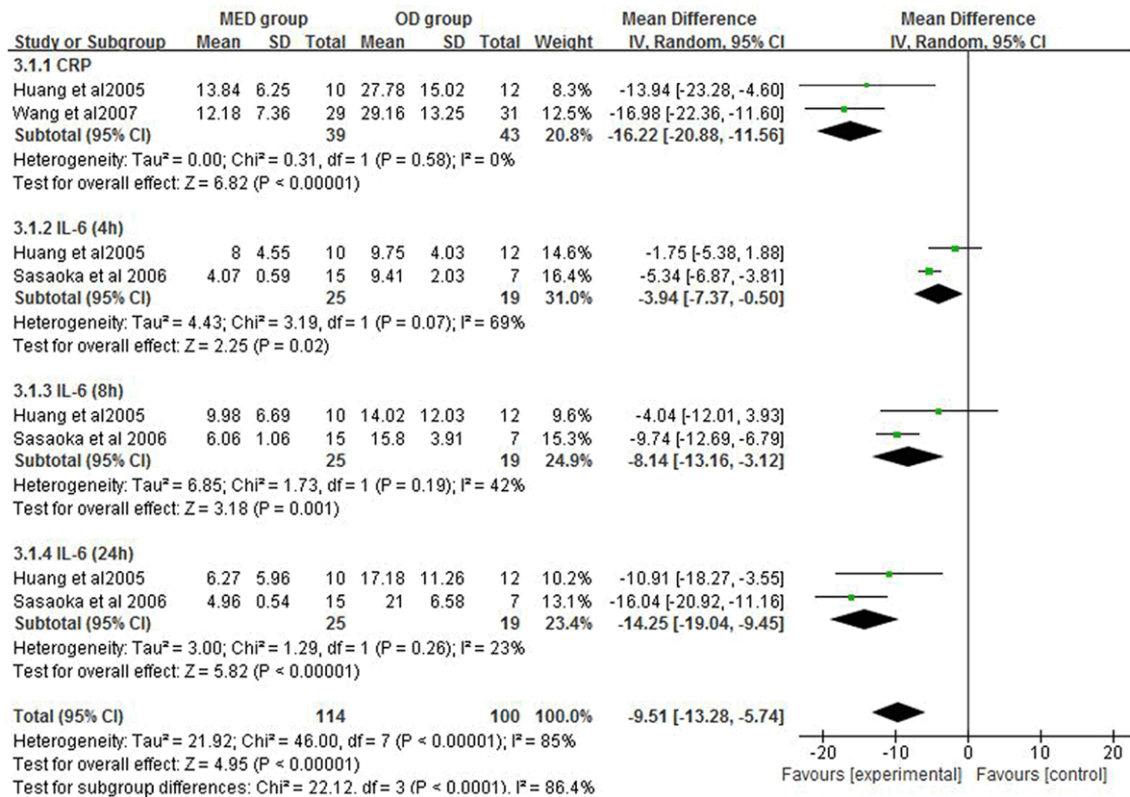


Figure 5. The forest plot of biochemical indexes, including CPR, IL-6 (4 h), IL-6 (8 h) and IL-6 (24 h).

in the general operation indicators. In terms of surgical time, Yuan et al [13] reported that OD group had shorter time compared with MED group. Hussein et al [18] performed a study which was indicated there was no significant difference between the mean operative time of MED group and OD group. However, surgical time of the early cases was longer than late cases. Complication were decomposed into three parts in this meta-analysis, namely, total complications, dural leaks occurred and recurrence of the disc herniation. Although there

were no statistical differences in three parts, some authors of the included studies had different viewpoints. For example, Teli et al [11] reported that MED group was statistically significantly higher with regard to dural tears and recurrent herniation. We thought that these complications usually related to surgical technology and instrument design properties. Limited space and unskill surgeon made the occurrence of the complications much easier. To overcome the limited space, Nakagawa et al [23] reported that the operation became safer

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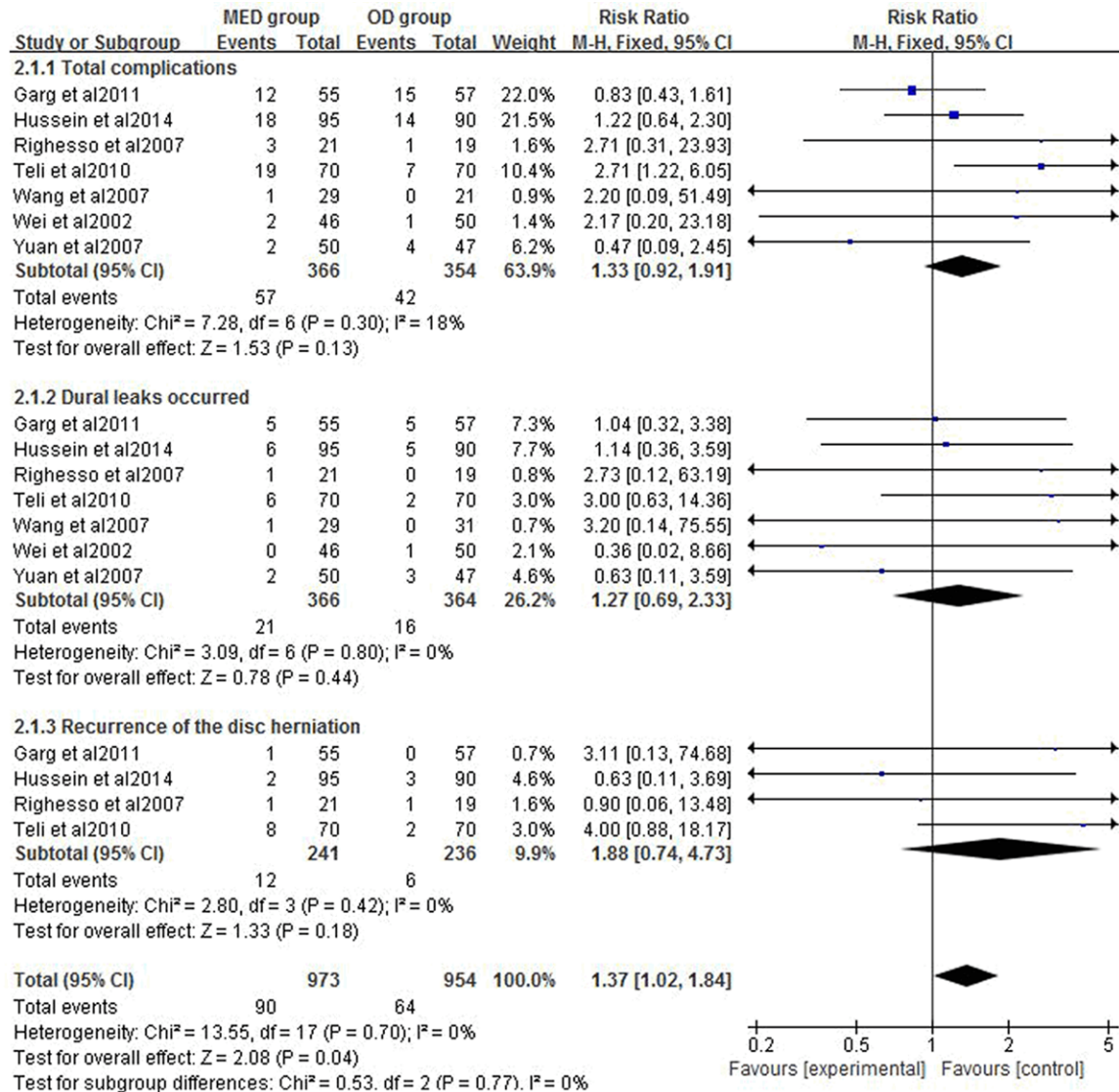


Figure 6. The forest plot of complication, including total complications, dural leaks occurred and recurrence of the disc herniation.

and the operation time was remarkably shortened by using an operative magnifying glass. Also, the skilled surgical operative technique was emphasized on MED group.

In recent years, several meta-analyses were performed to evaluate the efficacy of minimally invasion (MI) for treating LDH. Chang et al [24] and Hormuzdiyar et al [25] led the meta-analysis which focused on the benefits of MI treatments for LDH, compared with OD or standard discectomy. The similar clinical results were acquired between two articles. As one of the minimally invasion, the first systematic review concerning the efficacy of MED were

performed by Gibson et al [22] in 2007 including 22 patients. Then, compared with MD or OD, Smith et al [9] analysed the efficacy of MED by another systematic review. There were four RCTs included in this systematic review. However, the meta-analysis which was just performed to compare the efficacy and safety of MED with OD for LDH patients was lacking.

The intension of evidence depended on the quality of included studies. Nine studies were included in our study. Unfortunately, the number of high quality studies was small. The main causes we analysed were allocation concealment and blind which were difficult to carry out.

Because they always maybe related to the characteristics of surgical study and ethical standards. Moreover, there was high heterogeneity which may affect the pooled results in general operation indicators, such as operation time, blood loss and so on. Through carefully reading and contrasting the included studies, we were very glad that there was no clinical heterogeneity. It gave a basic for us to pool the relevant data. The high heterogeneity came from the general operation indicators. We considered the reasons involved the high heterogeneity as follows: different operation technique for surgeons and different measuring tools. Moreover, unpublished and other languages studies except Chinese and English weren't included, so the publication bias maybe existed.

However, compared with previous meta-analysis, there were several advantages in our study. At first, the more comprehensive evaluation indexes were considered in the study than others, such as CRP, IL-6 and more details about complications. Second, the number of included RCTs was greater. Finally, compared with other meta-analysis which performed to prove the efficacy of MED, the results can be displayed directly and accurately due to statistical methods used.

Above all, although the results showed that the effective rate of operation was similar between two groups, MED had slighter trauma, milder blood loss and quicker recovery than OD. So, we think that MED can be used routinely for LDH patients, especially the patients of old and intolerable major surgery. Meanwhile, it is necessary for surgeon to master indications and contraindications of MED and improve the operative technique. Only these can help MED generate a more safer and effective role.

Disclosure of conflict of interest

None.

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