A systematic review of randomised clinical trials using posterior discectomy to treat lumbar disc herniations

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Abstract The focus of this study was to examine the safety and effectiveness of three different discectomy techniques using a posterior approach for the treatment of herniated lumbar discs. There are only a small number of prospective randomised studies comparing posterior lumbar discectomy techniques, and no recent systematic review has been published on this matter. Using the Cochrane Collaboration guidelines, all randomised or “quasi-randomised” clinical trials, comparing classic, microsurgical, and endoscopic lumbar discectomies using a posterior approach were systematically reviewed. No statistically significant differences were found between these techniques regarding improvement in pain, sensory deficits, motor strength, reflexes, and patient satisfaction. Current data suggest that the microsurgical and endoscopic techniques are superior to the classic technique for the treatment of single level lumbar disc herniations with respect to volume of blood loss, systemic repercussions, and duration of hospital stay. All three surgical techniques were found to be effective for the treatment of single level lumbar disc herniations in patients without degenerative vertebral deformities. No conclusions could be drawn from the clinical randomised studies reviewed regarding the safety of the three techniques studied due to insufficient data on postoperative complications.

Résumé L’objectif de cette étude est d’évaluer trois techniques différentes de discectomie après abord postérieur du rachis lors du traitement des hernies discales

lombaires. Il existe un petit nombre d’études prospectives randomisées comparant les techniques de discectomies par voie postérieure lombaire. Aucune revue systématique n’a été publiée. En utilisant la base de Cochrane, nous avons étudié de façon systématique un certain nombre d’études comparant les discectomies par voie micro chirurgicale classique ou par endoscopie. Aucune différence significative n’a été trouvée entre toutes ces techniques tant sur le plan de l’amélioration de la douleur que des déficits sensoriels, des problèmes moteurs ou des réflexes et de la satisfaction des patients. Les données de la littérature suggèrent que la micro chirurgie et les techniques d’endoscopie sont supérieures aux techniques classiques dans le traitement d’une hernie à un seul niveau, notamment en ce qui concerne les pertes sanguines, les complications systémiques et la durée de séjour. Ces trois techniques sont des techniques qui peuvent être utilisées pour les hernies discales à un seul niveau chez les patients qui ne présentent pas de déformations dégénératives de la colonne vertébrale. Aucune conclusion ne peut être donnée concernant la revue des études cliniques randomisées, notamment en ce qui concerne l’absence de complications sur les trois techniques utilisées. Ceci est secondaire à l’insuffisance des données de la littérature sur les complications post-opératoires.

Introduction

Lower back pain is the most common and onerous cause of chronic incapacity in adults under 45 years of age and is one of the most frequent causes of early retirement in industrialised countries [8, 33]. According to the World Health Organisation (WHO), about 20:1000 people complain of lower back pain and 11.6:1000 of sciatica every year [36]. It is estimated that 77% of the population will

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present with back pain and 35% with sciatica at least once during their lifetime [10].

The first surgical procedure to remove a lumbar disc was described by Mixter and Barr in 1934 [20]. The herniated disc was approached through a laminectomy and opening of the dural sac. Later, Semmes improved the technique, describing the hemi-laminectomy/partial laminectomy and retraction of the dural sac in order to remove the herniated disc, which became known as the classical discectomy technique [34].

The extensive soft tissue manipulation involved in the original technique motivated a number of independent authors to propose an alternative microdiscectomy approach for the treatment of lumbar radiculopathy [4, 34, 37]. With the aid of a microscope, bone resection to approach the intervertebral disc became unnecessary or minimal. These and other authors who reproduced the microscopic techniques demonstrated a reduction in operative time, a shorter hospital stay, and a faster return to work [9, 19, 35].

In 1993, Mayer and Brock [18], and in 1997, Smith and Foley [7] described endoscopic discectomy techniques. These techniques, considered minimally invasive, used tubular retractors to approach the intervertebral space allowing less soft tissue manipulation [7, 18]. These authors proposed that the use of an endoscope shortened the operating time and hospital stay even more significantly, improved early recovery.

There are only a small number of prospective randomised studies comparing posterior lumbar discectomy techniques, and no recent systematic review has been published on this matter in western literature. This article has the objective of evaluating the effectiveness and safety of the different discectomy techniques using a posterior approach for the treatment of herniated lumbar discs.

Materials and methods

A systematic literature review using the Cochrane Collaboration guidelines [6] was carried out on all randomised or “quasi-randomised” (this method of allocation does not use drawings and includes birth dates or other dates) clinical trials, comparing classic, microsurgical, and endoscopic lumbar discectomies using a posterior approach to treat herniated lumbar discs.

Inclusion criteria were both male and female adults, age range from 20–60 years, a single level lumbar disc herniation diagnosed through physical examination and imaging (myelography and/or computed tomography and/or magnetic resonance), and not responding to conservative treatment. Exclusion criteria were the presence of a herniated disc involving more than one anatomical level,

degenerative narrowing of the spinal canal, spondylolisthesis, and re-operations.

Electronic databases, manual search, and personal communications found 1,360 titles for preliminary review. Articles were primarily selected by titles and abstracts. Only 25 studies met the inclusion criteria and were then fully read. In a consensus meeting the authors further discarded another 15 articles: Wilson et al. [35], Kho et al. [17], Nystrom et al. [22], Kahanovitz et al. [14], Silvers et al. [27], Andrews et al. [1], Barrios et al. [3], Caspar et al. [5], Striffeler et al. [28], Stevens et al. [29], Schmidt et al. [26], Aydin et al. [2], Nakagawa et al. [21], Toyone et al. [30], and Schizas et al. [25]. Reasons for exclusion of these articles are described in Table 1.

Thus, the current systematic review was based on ten original articles that met the inclusion criteria: Tullberg et al. [31], Kelly et al. [16], Mayer et al. [18], Henriksen et al. [11], Hermantin et al. [12], Schick et al. [24], Tureyen et al. [32], Huang et al. [13], Katayama et al. [15], and Righesso Neto et al. [23] (Table 2).

Results

The majority of randomised clinical trials included in this review compared the classic, microsurgical, and endoscopic techniques regarding improvement in pain, sensibility, motor strength, reflexes, and patient’s self evaluation and found no statistically significant difference between the techniques [11, 12, 15, 18, 23, 31, 32]. Moreover, the three above mentioned techniques proved to be effective in treating single level lumbar disc herniations in both female and male adults between 20 and 60 years of age.

Table 1 Summary of the primary research articles excluded from this review

Identification of the study	Reason for exclusion
1. Wilson et al. [35] (1981)	Retrospective study
2. Kho et al. [17] (1986)	Retrospective study
3. Nystrom et al. [22] (1987)	Case series
4. Kahanowitz et al. [14] (1988)	Case series
5. Silvers et al. [27] (1988)	Retrospective study
6. Andrews et al. [1] (1990)	Retrospective study
7. Barrios et al. [3] (1990)	Retrospective study
8. Caspar et al. [5] (1991)	Retrospective study
9. Striffeler et al. [26] (1991)	Retrospective study
10. Stevens et al. [29] (1997)	Descriptive revision
11. Schmidt et al. [26] (2000)	Case series
12. Aydin et al. [2] (2002)	Retrospective study
13. Nakagawa et al. [21] (2003)	Retrospective study
14. Toyone et al. [30] (2004)	Case series
15. Schizas et al. [25] (2005)	Case series

Table 2 Summary of the primary research articles included in this review

Study	Methodology	Subjects	Intervention	Results
Tullberg et al. [31] (1993)	Randomisation: not reported Allocation: not reported Blinding: not reported	60 patients: 39 males, 21 females; mean age 43 years	Group 1: microdiscectomy ($n = 30$) Group 2: classical discectomy ($n = 30$)	Duration of surgery, amount of blood loss, patient's self evaluation after 1 year
Kelly et al. [16] (1993)	Randomisation: not reported Allocation: not reported Blinding: not reported	15 patients: 8 males, 7 females; mean age 48.1 years	Group 1: microdiscectomy ($n = 8$) Group 2: classical discectomy ($n = 7$)	Pulmonary function, body temperature
Mayer et al. [18] (1993)	Randomisation: not reported Allocation: not reported Blinding: not reported	40 patients: 26 males, 24 females; mean age 41.2 years	Group 1: microdiscectomy ($n = 20$) Group 2: endoscopic discectomy ($n = 20$)	Lower back pain, sciatica, sensory deficits, motor deficits, asymmetrical reflexes, return to previous functions (handicap)
Henriksen et al. [11] (1996)	Randomisation: not reported Allocation: not reported Blinding: not reported	79 patients: 50 males, 29 females; mean age 41.2 years	Group 1: microdiscectomy ($n = 39$) Group 2: classical discectomy ($n = 40$)	Duration of hospital stay, pain
Hermantin et al. [12] (1999)	Randomisation: not reported Allocation: adequate (sealed envelopes) Blinding: not reported	60 patients: 39 males, 21 females; mean age 39.5 years	Group 1: endoscopic discectomy ($n=30$) Group 2: classical discectomy	Patient's self evaluation before and after surgery, pre- and postoperative findings condition
Schick et al. [24] (2002)	Randomisation: "quasi-randomised" (birth date) Allocation: not reported Blinding: not reported	30 patients: 17 males, 13 females; mean age 39.5 years	Group 1: endoscopic discectomy ($n=15$) Group 2: classical discectomy	EMG activity
Tureyen et al. [32] (2003)	Randomisation: not reported Allocation: adequate (sealed envelopes) Blinding: not reported	114 patients: 65 males, 49 females; mean age 41.5 years	Group 1: microdiscectomy ($n = 63$) Group 2: classical discectomy ($n = 51$)	Pain, muscle strength, sensibility, reflexes, duration of surgery, duration of hospital stay, return to work, postoperative use of narcotics, infection
Huang et al. [13] (2005)	Randomisation: not reported Allocation: not reported Blinding: not reported	22 patients: 15 males, 7 females; mean age 39.7 years	Group 1: endoscopic discectomy ($n=10$) Group 2: classical discectomy	Duration of surgery, intra-operative blood loss, duration of hospital stay, systemic response to surgical stress
Katayama et al. [15] (2006)	Randomisation: not reported Allocation: adequate (sealed envelopes) Blinding: not reported	119 patients: 76 males, 43 females; mean age 37.5 years	Group 1: microdiscectomy ($n = 57$) Group 2: classical discectomy ($n = 62$)	Average hospital stay, average duration of surgery, average blood loss, pain
Riguesso Neto et al. [23] (2006)	Randomisation: not reported Allocation: adequate concealing Blinding: not reported	40 patients: 23 males, 17 females; mean age 44 years	Group 1: microdiscectomy ($n = 19$) Group 2: endoscopic discectomy ($n = 21$)	Duration of hospital stay, duration of surgery, blood loss, pain, return to work, motor deficits, sensory deficits, and altered reflexes

Katayama et al. [15] studied the total volume of blood loss during surgery comparing the classic and the microsurgical techniques and found a statistically significant difference in favour of the microscopic group (Fig. 1). One possible explanation is the greater facility in cauterising epidural blood vessels when using the microscope. However, the authors also noted that regardless of the statistical difference, the final blood loss of the classic group was also small and did not interfere in the final outcome or cause any significant clinical problems.

Huang et al. [13] found a smaller blood loss in the group of patients treated endoscopically when compared to those treated with the classic technique (Fig. 2). It is likely that the more conservative dissection of the paravertebral muscles using the endoscope, associated with the amplification, enabled more efficient haemostasis of the epidural vessels in a manner similar to that described by the microscopic technique.

Kelly et al. [16] tried to assess the systemic response to the surgical aggression by measuring body temperature pre-

Review: Posterior Approach Discectomy in the Treatment of Lumbar Disc Herniation
Comparison: 01 Classic Discectomy (CD) versus Microdiscectomy (MD)
Outcome: 10 Amount of bleeding (g)

Fig. 1 Forest plot representation of a single study (Katayama et al. [15]) comparing classic and microdiscectomy. The expected outcome was mean amount of bleeding. A statistically significant difference

was found in favour of the microscopic technique (WMD [PMP] 14.00 [95%CI 10.40, 17.60])

Review: Posterior Approach Discectomy in the Treatment of Lumbar Disc Herniation
Comparison: 02 Classic Discectomy (CD) versus Endoscopic Discectomy (ED)
Outcome: 08 Intraoperative blood loss (ml)

Fig. 2 Forest plot representation of a single study (Huang et al. [13]) comparing classic and endoscopic discectomy. The expected outcome was intraoperative blood loss (ml). A statistically significant difference

was found in favour of the endoscopic technique (WMD [PMP] 102.50 [95%CI 25.50, 180.50])

Review: Posterior Approach Discectomy in the Treatment of Lumbar Disc Herniation
Comparison: 01 Classic Discectomy (CD) versus Microdiscectomy (MD)
Outcome: 09 Changes in body temperature

Fig. 3 Forest plot representation of a single study (Kelly et al. [16]) comparing classic and microdiscectomy. The expected outcome was change in body temperature. A statistically significant difference was found in favour of the microscopic technique in the subcategory

24 hours postoperative (WMD [PMP] 0.51 [95%CI 0.30, 0.72]), 36 hours postoperative (WMD [PMP] 0.76 [95%CI 0.64, 0.88]), 48 hours postoperative (WMD [PMP] 0.72 [95%CI 0.53, 0.91]), and 60 hours postoperative (WMD [PMP] 33.25 [95%CI 33.03, 33.47])

Review: Posterior Approach Discectomy in the Treatment of Lumbar Disc Herniation
Comparison: 02 Classic Discectomy (CD) versus Endoscopic Discectomy (ED)
Outcome: 13 Postoperative systemic response

Fig. 4 Forest plot representation of a single study (Huang et al. [13]) comparing classic and endoscopic discectomy. The expected outcome was postoperative systemic response. A statistically significant difference was found in favour of the endoscopic technique regarding

CRP levels (C-reactive protein) 24 hours postoperative (WMD [PMP] 13.94 [95%CI 4.60, 23.28]) and the levels of IL-6 (interleukin 6) 24 hours postoperative (WMD [PMP] 12.10 [95%CI 3.38, 18.44])

Review: Posterior Approach Discectomy in the Treatment of Lumbar Disc Herniation
Comparison: 03 Microdiscectomy (MD) versus Endoscopic Discectomy (ED)
Outcome: 09 Return to work one year postoperative

Fig. 5 Meta-analysis of two studies (Mayer et al. [18] and Righesso Neto et al. [23]) that compared microscopic and endoscopic discectomy. The expected outcome was return to work 1 year

postoperative. A statistically significant difference was found in favour of the endoscopic technique (RR 0.68 [95%CI 0.49, 0.96])

Review: Posterior Approach Discectomy in the Treatment of Lumbar Disc Herniation
Comparison: 02 Classic Discectomy (CD) versus Endoscopic Discectomy (ED)
Outcome: 06 Hospital stay (days)

Fig. 6 Forest plot representation of a single study (Huang et al. [13]) comparing classic and endoscopic discectomy. The expected outcome was duration of hospital stay (days). A statistically significant

difference was found in favour of the endoscopic technique (WMD [PMP] 2.35 [95%CI 0.87, 3.83])

and postoperatively in patients treated with the classic technique compared to those treated with the microsurgical technique. Patients who underwent microdiscectomy had lower temperatures 12, 24, 48, and 60 hours after surgery (Fig. 3). Considering that the increased body temperature following surgical procedures is related to the process of tissue repair, these results suggest that patients undergoing microsurgery suffer a smaller surgical trauma. However, the authors reported no differences in the clinical response of patients in either group.

Another way of measuring the complex systemic response to surgical procedures is through markers such as interleukins (IL), beta interferon, tumour necrosis factor (TNF), etc. Huang et al. [13] compared patients submitted to the classic and endoscopic techniques 24 hours after surgery observing statistically significant differences in favour of the endoscopic technique (Fig. 4).

Mayer et al. [18] and Righesso Neto et al. [23] compared patients submitted to the microscopic and endoscopic techniques and found statistically significant results with regard to the return to work within 1 year. Patients who underwent endoscopic surgery returned to work earlier (Fig. 5). It is likely that the endoscopic group was favoured for presenting a smaller surgical trauma and, consequently, less scar tissue formation.

According to Huang et al. [13] patients submitted to endoscopic surgery had shorter hospital stay than those undergoing the classic technique (Fig. 6). This finding can be explained by the lower intensity of pain presented by the former group allowing early hospital discharge with oral analgesia.

Based on the studies included in this paper little could be concluded on the postoperative complications. Only two studies (Huang et al. [13] and Katayama et al. [15]) reported any such complications satisfactorily. According to Katayama et al. [15], who compared classic and microscopic discectomy, there was only one case of superficial infection in the classic group treated successfully with oral antibiotics. Huang et al. [13] reported one case of superficial infection in a patient submitted to endoscopic discectomy and one case of nerve laceration in a patient treated with the classic technique. Neither of the above mentioned studies presented statistically significant differences between groups.

Unfortunately, it became evident in a number of publications that little importance had been given to adequately reporting postoperative complications. This fact renders proper analysis of the safety of surgical techniques quite impaired.

Conclusions

The classic, microscopic, and endoscopic posterior discectomy surgical techniques were found to be effective for the treatment

of single level lumbar disc herniations in patients without degenerative vertebral deformities. No statistically significant differences were found between these techniques regarding improvement in pain, sensory deficits, motor strength, reflexes, and patient satisfaction.

Current data suggest that the microsurgical and endoscopic techniques are superior to the classic technique for the treatment of single level lumbar disc herniations with regard to volume of blood loss, systemic repercussions, and duration of hospital stay.

No conclusions could be drawn from the clinical randomised studies reviewed regarding the safety of the three techniques studied due to insufficient data on postoperative complications.

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