

# Comparison of Surgical Outcomes Between Macro Discectomy and Micro Discectomy for Lumbar Disc Herniation: A Prospective Randomized Study With Surgery Performed by the Same Spine Surgeon

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**Study Design:** A prospective study was conducted on the surgical procedures for lumbar disc herniation.

**Objective:** The objective of this study is to investigate the surgical outcomes of different methods when performed by the same surgeon, using a prospective study.

**Background:** Macro discectomy is widely known as a common surgical procedure for lumbar disc herniation, while microdiscectomy in place of Caspar technique (the Caspar method) and microendoscopic discectomy by a posterior approach are reported as less invasive surgical methods for this condition. However, there have not been a significant number of prospective studies conducted to compare different surgical procedures for lumbar disc herniation.

**Materials and Methods:** The target of our study was a group of 62 patients (male: 43, female: 19) who underwent surgery by macro discectomy (A group) and 57 patients (male: 33, female: 24) who underwent surgery by microdiscectomy in place of Caspar technique (B group). The mean ages at surgery were 34 (14 to 62) years and 41 (18 to 65) years respectively, and the mean duration of follow-up was 2 years and 8 months (12 months to 4 years). For all patients, the surgery was performed by 1 of the authors. The items investigated were the operation time, amount of bleeding, duration of hospitalization, amount of analgesic agent used after surgery, pre- and postoperative scores based on judgment criteria for treatment of lumbar spine disorders established by the Japanese Orthopaedic Association score, visual analog scales (VAS, 0 to 10) for lumbago before surgery and at discharge, VAS for sciatica before surgery and at discharge, perioperative complications, and cases requiring further surgery.

**Results:** There were no significant differences between the 2 surgical procedures in the frequency of use of an analgesic agent after surgery, the pre- and postoperative Japanese Orthopaedic Association scores or postoperative VAS for sciatica. Statistically significant differences were observed in the operation time, amount of bleeding, duration of hospitalization, and postoperative VAS for lumbar pain, but the differences were not large, and may not have been clinically significant.

**Conclusions:** For herniotomy for lumbar disc herniation, both macro discectomy and microdiscectomy are appropriate, as long as surgeons have mastery of the procedures.

**Key Words:** lumbar disc herniation, partial laminectomy, microscopic lumbar discectomy

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The surgical treatment of intervertebral disc herniation has most often been approached by partial hemilaminectomy and partial removal of the disc, as described by Mixter and Barr in 1934.<sup>1</sup> In 1939, Love described the extradural approach to disc herniation.<sup>2</sup> Macro discectomy (the Love method) is widely known as a common surgical procedure for lumbar disc herniation. A new technique involving the use of an operating microscope was published by Yasagil and Casper in 1977.<sup>3,4</sup> These techniques provided the surgeon with excellent lighting and magnification of the operative field, which in turn enabled the use of a smaller incision and facilitated a less traumatic procedure. Williams published the first clinical results in 1979.<sup>5</sup> He reported very good outcome after the microsurgical technique. These results have been supported by several studies.<sup>6-9</sup> Some retrospective comparisons of the 2 methods have also shown shorter in-patient stays and time off work, and better end results with microsurgery.<sup>10-13</sup> A number of authors have reported a shorter length of stay and quicker return to work in patients treated with microsurgical techniques; however, these advantages have recently been questioned.<sup>9,13,14</sup> Other authors have reported no difference in long-term results; however, a short-term advantage to microsurgery was found.<sup>15,16</sup>

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There have not been a significant number of prospective studies conducted to compare significantly different techniques.<sup>9,17</sup> We have performed both macro- and microdiscectomy for lumbar disc herniation, and the objective of this study was to investigate the outcomes of these methods when performed by the same surgeon, using a prospective study.

**MATERIALS AND METHODS**

One hundred nineteen consecutive patients underwent primary surgery for lumbar disc herniation. In Group A, 62 patients (male: 43, female: 19) underwent surgery by macro discectomy; in Group B, 57 patients (male: 33, female: 24) underwent surgery by microdiscectomy in place of Caspar technique. The mean ages at surgery were 34 (14 to 62) years old and 41 (18 to 65) years old, respectively, and the mean duration of follow-up was 2 years and 8 months (12 months to 4 years). The operations were all performed by the same surgeon. Prophylactic antibiotic agents were administered pre-operatively in all cases. The patients were taken to the operating room, given general endotracheal anesthesia, and placed on the operating room table with Hall frame. A spinal needle was inserted into the appropriate spinous process, and a lateral x-ray film was taken to mark the correct level.

The patients were randomly divided into 2 groups by selecting an unmarked envelope, the content of which indicated their treatment group.

**Group A**

The length of the skin incision was 5 cm. The fascia incision was of the same length as the 1 in the skin. The smallest possible partial laminectomy with removal of a variable amount of the medial facet was made. The ligamentum flavum was removed, and careful hemostasis was ensured by using bipolar diathermy. An operating microscope was not used. In each case, the disc space itself was also entered and all available disc material was removed.

**Group B**

The length of the skin incision was 2.5 cm. The fascia incision was of the same length as the 1 in the skin. A periosteal elevator was used to dissect clean the lamina, and a Caspar retractor was placed. An operating microscope was brought into play. The ligamentum flavum was removed; there was no or minimal bone excision and removal of the disc material. In each case, the disc space itself was also entered and all available disc material was removed.

In Group A 58 patients had 1 intervertebral disc requiring surgical treatment, with the affected segment being L2-L3 in 1 patient, L3-L4 in 1 patient, L4-L5 in 36 patients, and L5-S1 in 20 patients. Four patients had 2 intervertebral discs requiring surgery, with the affected segments being L3-L4 and L4-L5 in 2 patients, and L4-L5 and L5-S1 in 2 patients. In Group B, 50 patients had 1 intervertebral disc requiring surgery, with the affected

segment being L3-L4 in 2 patients, L4-L5 in 22 patients, and L5-S1 in 26 patients. Seven patients had 2 intervertebral discs requiring surgery, with the affected segments being L3-L4 and L4-L5 in 2 patients, L4-L5 and L5-S1 in 4 patients, and L3-L4 and L5-S1 in 1 patient.

The items investigated were the operation time, amount of bleeding, duration of hospitalization, amount of analgesic agent used after surgery, pre- and post-operative scores based on judgment criteria for treatment of lumbar spine disorders established by the Japanese Orthopaedic Association (JOA) score, Visual Analog Scales (VAS, 0 to 10) for lumbago before surgery and at discharge, VAS for sciatica before surgery and at discharge, perioperative complications, and cases requiring further surgery.

All the patients started to walk on the day after surgery, and discharge on postoperative day 7 was targeted, as long as no complications developed.

**RESULTS**

The mean operation time (Table 1) was 40 ± 12 minutes (26 to 60 minutes) in Group A, and 45 ± 8 minutes (32 to 62 minutes) in Group B (*P* < 0.0036, Mann-Whitney test); the mean amount of bleeding (Table 1) was 39 ± 11 g (16 to 62 g) in Group A, and 25 ± 9 g (12 to 36 g) in Group B (*P* < 0.0001, Mann-Whitney test); and the mean duration of hospitalization (Table 1) was 8.3 ± 0.8 days (6 to 10 days) in Group A, and 8.5 ± 2.3 days (5 to 25 days) in Group B (*P* < 0.0004, Mann-Whitney test); with these data showing significant differences for each parameter.

Regarding the use of an analgesic agent after surgery (butorphanol tartrate, 1 mg) (Table 1), in Group A the agent was not administered in 24 patients, and was administered once in 26 patients and 3 times in 12 patients; a mean frequency of administration of 0.8 ± 0.7 times per person. In Group B, the agent was not administered in 28 patients, and was administered once in 22 patients, twice in 6 patients, and 3 times in 1 patient; a mean frequency of administration of 0.6 ± 0.7 times per person. These data did not differ significantly between the 2 groups (*P* = 0.25, Mann-Whitney test).

The JOA score (Table 2) improved from 16 ± 2 points before surgery to 27 ± 1 points at the last follow-up time in both Groups A and B (improvement rate: 77%), showing no significant difference between the 2 groups (before surgery: *P* = 0.6773, after surgery:

**TABLE 1.** Summary of Operative Time, Bleeding, Inpatient Stay, and use of an Analgesic Agent

Factor	A group	B group	P
Time (mins)	40 ± 12 (26-60)	45 ± 8 (32-62)	< 0.0036
Bleeding (g)	39 ± 11 (16-62)	25 ± 9 (12-36)	< 0.0001
Inpatient stay (days)	8.3 ± 0.8 (6-10)	8.5 ± 2.3 (5-25)	< 0.0004
Use of an analgesic agent (times)	0.8 ± 0.7	0.6 ± 0.7	0.25

**TABLE 2.** Summary of Pre- and Postoperative factors in Macroscopy-treated and Microsurgery-treated Patients

	Preoperative			Postoperative		
	A group	B group	P	A group	B group	P
Mean JOA score	16 ± 2	16 ± 2	0.6773	27 ± 1	27 ± 1	0.0778
Mean VAS for lumbar pain	8.5 ± 0.7	7.6 ± 0.9	< 0.0001	1.6 ± 0.7	1.2 ± 0.4	0.0023
Mean VAS for sciatica	8.1 ± 0.9	7.9 ± 0.6	0.0537	1.3 ± 0.5	1.2 ± 0.4	0.2730

$P = 0.0778$ , Mann-Whitney test). VAS for lumbar pain (Table 2) improved from  $8.5 \pm 0.7$  to  $1.6 \pm 0.7$  in Group A, and from  $7.6 \pm 0.9$  to  $1.2 \pm 0.4$  in Group B, with these data showing significant differences between the 2 groups before and after surgery (before surgery:  $P < 0.0001$ , after surgery:  $P = 0.0023$ , Mann-Whitney test). VAS for sciatica (Table 2) improved from  $8.1 \pm 0.9$  to  $1.3 \pm 0.5$  in Group A, and from  $7.9 \pm 0.6$  to  $1.2 \pm 0.4$  in Group B, showing no significant difference between the 2 groups either before or after surgery (before surgery:  $P = 0.0537$ , after surgery:  $P = 0.2730$ , Mann-Whitney test).

Regarding complications, superficial infection occurred in 1 patient in Group A, but no complications occurred in Group B. No further surgery was required in Group A, but further surgery was performed in 2 patients in Group B. One patient underwent fusion for instability of the lumbar vertebrae 4 years after the initial surgery, and the other patient underwent fenestration for restenosis 3 years after the initial surgery.

## DISCUSSION

Macro discectomy (the Love method), first reported by Love in 1939,<sup>2</sup> is a very well known surgical treatment for lumbar disc herniation. In this procedure, the affected region is reached only by resection of the yellow ligament between the vertebral arches, without resection of bone, and the disc herniation is removed. Intra canal lumbar discectomy with posterior partial hemilaminectomy, the so-called modified Love method, is widely used in Japan. Less invasive surgical procedures have been introduced more recently: the microdiscectomy procedure has been performed by surgeons since its introduction by Yasargil<sup>3</sup> and Casper.<sup>4</sup> Although the evaluation methods and follow-up periods in the subsequent studies differed, excellent or good outcomes were obtained in 85% to 92% of patients.<sup>6-9,13,14,18</sup> There are numerous articles in the literature in which authors have reported success rates ranging from 70% to 95% for standard discectomy.<sup>5-7</sup> Compared with the standard operation, microdiscectomy has the advantage of being less invasive because the skin incision is small and dissection is performed with clear visualization of structures under a microscope.<sup>9,19</sup> Some authors have claimed greater long- and short-term success with microsurgery, but this has not been established in well-controlled studies.<sup>20</sup> Others have reported no difference in long-term results but advantages in the short-term outcome when performing microsurgery.<sup>15,16</sup> Several earlier studies have shown a significantly shorter inpatient

stay for microsurgical operations compared with a standard operation. This difference could be explained partly because these were retrospective studies, and postoperative courses of therapy may have differed. Therefore, in this study, we performed a prospective investigation of the surgical outcomes of the macro and microdiscectomy performed by the same surgeon. In particular, we focused on a comparison of the operation time, amount of bleeding, duration of hospitalization, improvement rate pain after surgery, and complications.

In our study, the mean operation time was  $40 \pm 12$  minutes for macro discectomy, and  $45 \pm 8$  minutes for microdiscectomy, showing that the microdiscectomy required approximately 5 more minutes on average. However, time for microscope preparation is required during surgery by microdiscectomy, and this may have been 1 of the reasons for the longer operation time. The mean amount of bleeding was  $39 \pm 11$  g with macro discectomy, and  $25 \pm 9$  g with microdiscectomy. Although more bleeding occurred with macro discectomy, the amounts were low in both groups, and the difference was not clinically important. The mean duration of hospitalization was  $8.3 \pm 0.8$  days after surgery by macro discectomy, and  $8.5 \pm 2.3$  days with microdiscectomy; again the difference was not large. The frequency of use of an analgesic agent after surgery did not differ significantly between the 2 methods, and the mean administration frequency was less than once per patient, suggesting that pain after either surgery was not severe.

The JOA scores improved from  $16 \pm 2$  points before surgery to  $27 \pm 1$  points for the last follow-up time for both procedures, giving an improvement rate of 77%; that shows the outcomes of both methods are good. The VAS for lumbar pain after surgeries with macro discectomy and microdiscectomy were  $1.6 \pm 0.7$  and  $1.2 \pm 0.4$ , respectively, showing a significant difference between the 2 groups, but this difference was still small. In addition, because there was a significant difference in preoperative VAS for lumbar pain between the 2 groups:  $8.5 \pm 0.7$  and  $7.6 \pm 0.9$ , respectively, it is difficult to judge whether the difference in post-operative VAS for lumbar pain was due to a difference in the surgical procedure or due to the degree of the original pain. The postoperative VAS of sciatica after surgeries by macro discectomy and microdiscectomy were not significantly different:  $1.3 \pm 0.5$  and  $1.2 \pm 0.4$ , which is the main symptom of lumbar disc herniation, improved smoothly after both types of surgery. Highly positive neurological

improvement has been evident in each group. No significant difference in complications was noted between the 2 methods. Further surgery was performed in 2 patients who received initial surgical treatment using microdiscectomy, but this may have been due to insufficient preoperative evaluation of the instability of the lumbar vertebrae.

As described above, there were no significant differences between macro discectomy and microdiscectomy in the use of an analgesic agent after surgery, the pre- and postoperative JOA scores, or postoperative VAS of sciatica. Statistically significant differences were observed in the operation time, amount of bleeding, duration of hospitalization, and postoperative VAS of lumbar pain, but the differences were not large, and may not have been clinically important.

For herniotomy for lumbar disc herniation, both macro discectomy and microdiscectomy are appropriate, as long as surgeons have mastery of the procedures.

### CONCLUSION

For lumbar disc herniation, the surgical outcomes of macro discectomy and microdiscectomy performed by the same surgeon were compared prospectively. There were no significant differences between macro discectomy and microdiscectomy in the frequency of use of an analgesic agent after surgery, in the pre- and postoperative JOA scores, or in the postoperative VAS for sciatica. There were statistically significant differences between macro discectomy and microdiscectomy in the operation time, amount of bleeding, duration of hospitalization, and postoperative VAS for lumbar pain, but the differences were not large, and may not have been clinically important. For herniotomy for lumbar disc herniation, both macro discectomy and microdiscectomy are appropriate, as long as surgeons have mastery of the procedures.

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