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The Outcomes of Lumbar Microdiscectomy in a Young, Active Population

Correlation by Herniation Type and Level

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Study Design. Prospective longitudinal clinical study.

Objective. The purpose of our article was to investigate the clinical outcomes with type and level of disc herniation in a young, active population undergoing lumbar microdiscectomy.

Summary of Background Data. There are few reported outcomes studies on the relationship between disc herniation level, type of disc herniation, and surgical outcomes of lumbar microdiscectomy in a young, active population.

Methods. One hundred ninety-seven (197) consecutive single-level lumbar microdiscectomies performed by a single surgeon were prospectively followed over a 3-year period. All patients had failed a period of nonoperative care including physical therapy and/or transforaminal epidural steroid injections. One hundred eighty-three patients (139 males, 44 females) with a mean age of 27.0 years (range 19–46 years) were prospectively followed for a mean of 26 months (range, 12–38 months). Outcomes were assessed using Visual Analog Scale (VAS), Oswestry disability index, patient satisfaction, return to military duty, and need for additional surgery. The type of disc herniation (contained, extruded, or sequestered) and the lumbar level of herniation were also recorded.

Results. At final follow-up, 84% (154 of 183) of patients had returned to unrestricted military duty; 16% (29) had been medically discharged. The mean decrease in VAS leg pain score was 4.7 points (from mean preoperative 7.2 to mean postoperative 2.5); 80% (146) reported a decrease of greater than 2 points. The mean Oswestry index improved from 53.6 before surgery to 21.2 at final follow-up. Overall, 85% (156) were satisfied with their surgery. Six patients had recurrent herniations (3%) with 4 of the 6 undergoing additional surgery. Patients with preoperative VAS scores consistent with a preponderance of radicular leg pain *versus* back pain demonstrated better surgical outcomes in all categories ($P < 0.001$) When classified by disc herniation type, sequestered discs at all levels demonstrated better Oswestry and VAS scores *versus* extruded or contained disc herniations. ($P < 0.001$) Disc herniations at the L5–S1 level had significantly greater improvements in both mean VAS leg and Oswestry outcome scores than disc herniations at the L4–L5 level. ($P < 0.001$) Preexisting restricted duty status at time of first surgical consultation was associated with poorer outcomes. Smokers had a significantly lower return to full active military duty ($P = 0.037$).

Conclusion. Microdiscectomy for symptomatic lumbar disc herniations in young, active patients with a preponderance of leg pain who have failed nonoperative treatment demonstrated a high success rate based on validated outcome measures, patient satisfaction, and return to active duty. Patients with disc herniations at the L5–S1 level had significantly better outcomes than did those at the L4–L5 level. Patients with sequestered or extruded lumbar disc herniations had significantly better outcomes than did those contained herniations. Patients with contained disc herniations, a predominance of back pain, on restricted duty and smoking should be counseled before surgery of the potential for less satisfaction, poorer outcomes scores, and decreased return to duty rates.

Key words: lumbar herniated disc, microdiscectomy, herniated nucleus pulposus (HNP), discectomy. **Spine 2008;33:33–38**

Over 250,000 elective lumbar spine surgeries are performed in the United States each year for persistent symptoms of sciatica. Lumbar discectomy remains one of the most commonly performed procedures.[1,2] Previous studies have reported on the natural history of lumbar disc herniations, showing improved results in surgically treated patients in the short-term, but no difference in clinical outcomes between surgical and nonoperative treatments at the 10-year mark.[1,3,4] More recent studies challenge that claim, reporting improved outcomes in satisfaction and relief of radicular pain for surgically treated patients *versus* those treated nonoperatively at 10 years.[5] Recently, Weinstein *et al* in a randomized trial intent-to-treat analysis showed small but not statistically significant differences in favor of discectomy compared with usual care.[6]

Few studies have attempted to correlate outcomes of microdiscectomy for lumbar disc herniations with the specific type or level of disc herniation.[7] Less satisfactory outcomes with smaller lumbar disc herniations have been identified in previous studies, further demonstrating that surgical outcomes are better predicted by herniation size and type than by patient age, gender, or workmen's compensation status.[8] Lumbar disc herniation

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types have been described based on anular competence and the presence of sequestered or extruded disc fragments. Carragee *et al*[7] reported the outcomes of single-level lumbar discectomy in 187 consecutive patients with a mean age of 37.5 years. They showed poorer surgical outcomes in patients with massive anular defects and those with an intact anulus and no identifiable fragment. However, little is reported on the relationship between disc herniation level and surgical outcomes of lumbar microdiscectomy in the young, active population.

The purpose of this study was to report on a young, active population with symptomatic lumbar disc herniations who had failed a reasonable trial of nonoperative care and then underwent microdiscectomy. Validated outcome measures, patient satisfaction, and return to military duty were correlated with type and level of herniation to determine clinical success.

■ Materials and Methods

Patient Population. One hundred ninety-seven consecutive active duty men and women who had a single-level lumbar microdiscectomy from August 2000 to January 2003 were prospectively followed in an IRB-approved outcomes study. At final follow-up 183 (93%) were available at a mean of 26 months after surgery (range 12–38 months). The final cohort of 183 patients was comprised of 139 males and 44 females, with mean age of 27.0 years (range, 19–46 years). Mean duration of preoperative symptoms was 7.9 months (range, 4–19 months).

With the exception of patients with intractable, debilitating sciatic pain or symptoms of cauda equina who underwent urgent discectomy, all patients had some type of nonoperative care including limited duty, physical therapy, anti-inflammatories, opioid analgesics, or epidural/transforaminal injections for at least 4 months. Specific inclusion criteria were radicular leg pain below the knee, positive root tension signs (straight leg raise positive between 30 and 70 degrees or positive femoral tension sign), or a corresponding neurologic deficit (asymmetrical depressed reflex, decreased sensation in a dermatomal distribution, or weakness in a myotomal distribution. Additionally, all patients had magnetic resonance imaging (MRI) proven disc herniations corresponding to the side and level of their clinical symptoms. Patients with multiple herniations were included if only one of the herniations was considered symptomatic.

Exclusion criteria included early lumbar surgery, cauda equina syndrome, scoliosis greater than 15 degrees, segmental instability (>10 degrees angular motion or >4 mm translation), spondylolisthesis, spine infection or tumor, or psychiatric illness.

Diagnostic Imaging. All patients had preoperative imaging studies consisting of postero-anterior and lateral radiographs, flexion-extension radiographs of the lumbar spine and a non-contrast MRI of the lumbar spine. A 1.5-Tesla magnetic resonance (MR) system (Signa, General Electric Medical Systems, Milwaukee, WI) was used for all studies, and all MR evaluations were obtained at our facility on 1 system. The MR sequences included axial and sagittal T1 fat saturation and T2 images from which the measurements were obtained. The images were 3 mm thick with a 1 mm interslice gap. The matrix was 256 by 192. The field of view was 14 cm for the sagittal images and 18 cm for the axial images. All MR interpretations and measurements were performed on our PACS/AFGA picture archiving workstation (Agfa-Gevaert Group, Mortsel, Belgium).

In all cases, the MRIs were read by a board certified neuroradiologist who documented the disc type and level of involvement. Disc herniation type was classified as sequestered, extruded, or contained, as described by Fardon and Milette.[9]

Surgical Technique. All patients underwent a single-level microdiscectomy on the Andrews table under loupe magnification by a single fellowship trained orthopedic spine surgeon. Intraoperative cross table lateral radiograph was used to identify the appropriate level. A 2 cm posterior midline incision was made centered over the appropriate disc space. A limited laminotomy was performed as described by Delamarter and McCulloch.[10] Using a small annulotomy if needed, the fragment of disc was removed as described by Spengler.[11] The canal was inspected and the foramen probed for residual disc material or bony pathology. The nerve root was completely decompressed and mobile.

All patients were discharged home on the day of surgery except those living in military barracks. They were discharged the following morning. All patients were allowed to do activities as tolerated with restrictions only on bending, twisting, lifting greater than 20 lbs from the floor, and high impact activity. Patients were educated on lumbar stretching and core muscle strengthening. At 6-week follow-up, duty restrictions were lifted and patients were encouraged to gradually increase running, weightlifting, and other high impact activities if required of their rate in the military. Short periods of light duty, not to exceed 6 weeks, were prescribed when indicated to protect service members from excessively strenuous training exercises, such as forced marches with full combat loads. Aviators could return to ejection type aircraft at 6 months. Helicopter and nonejection aviators and aviation personnel were allowed to return when they could pass the military fitness test.

Outcomes Measures. Primary outcomes data included Visual Analog Scale (VAS) for back and leg symptoms and the Oswestry disability index,[12] which were collected by an independent examiner not affiliated with the study before surgery, after surgery at 6 months, and at the final follow-up visit. Secondary outcomes included patient satisfaction with current symptoms and care and return to active duty.

Clinical and Radiologic Findings. Of the 183 patients treated, 97 had disc herniation at the L5–S1 level, 80 at the L4–L5 level, and 8 at the L3–L4 level (Table 1). Seventy-eight patients had extruded herniations, 64 had sequestered herniations, and 41 had contained disc herniations (Table 2). The preoperative disc herniation type was confirmed by the intraoperative findings. Correlation was deemed to be 100%.

Statistical Analysis. The statistical analysis consisted of descriptive statistics of demographic variables of age, gender, time in military service, documentation of elite military duty (Navy SEAL, Reconnaissance Marine or Aviator), duration of preoperative symptoms, military rank, and duty status at initial consultation. In addition, physical examination and MRI findings of level and type of disc herniation were compared with outcomes scores and analyzed with *t* tests and 1-way analysis of

Table 1. Overall Patient Data Based on Herniation Level

Herniation Level	Total (%)	Mean Patient Age (SD)	No. Male (%)/ No. Female (%)	No. Smokers (%)	Years of Military Service (SD)
Total (all patients)	183	28 (5.4)	138 (75)/45 (25)	41/183 (22%)	8.2 (4.9)
L3–L4	5 (3%)	33.5 (5.2)	3 (67)/2 (33)	0 (0)	13.2 (3.6)
L4–L5	81 (44%)	28.8 (5.5)	65 (80)/16 (20)	19 (24)	8.4 (4.9)
L5–S1	97 (53%)	28.0 (5.5)	70 (72)/27 (28)	22 (23)	7.8 (4.8)

A total of 183 patients had single-level lumbar disc herniations at 1 of 3 segments.
SD indicates standard deviation.

variance, followed by Scheffe's multiple comparisons where dependent variables were continuous and Fisher exact test where they were categorical. Kruskal-Wallis tests were used to compare outcomes by population. A $P < 0.05$ was regarded as statistically significant.

■ Results

Overall, 183 of 197 patients (93%) were available for final follow-up. Eighty-five percent of the patients were satisfied with their outcome and 84% had returned to unrestricted active duty military service. There were a total of 7 complications—6 recurrent disc herniations and 1 superficial infection in the index surgical group. Patients with recurrent herniations were treated with revision surgery or physical therapy, as described in our results. Patients who clinically were not doing well enough to return to full duty had repeat MRI or computed tomography scan and/or flexion-extension radiographs. Those patients medically discharged were not deemed to have a surgical problem, *i.e.*, instability, reherniation, infection, adjacent segment pathology, progressive disc degeneration.

The mean postoperative VAS leg pain score at final follow-up was 2.5 points (range, 0–9), from a mean before surgery of 7.2 (range, 4–10), ($P < 0.001$). A decrease of greater than 2 points on the VAS was observed in 80% (146) of the patients. The mean VAS back pain score at final follow-up was 2.7 points (range, 0–8), from a mean before surgery of 4.3 (range, 0–10), ($P < 0.001$) (Table 3).

The mean Oswestry score demonstrated improvement from a mean score of 53.6 (range, 40–80) before surgery to 21.2 (range, 0–70) at final follow-up, ($P < 0.001$). Over 81% (147) of the patients had a decrease in Oswestry index of at least 25% (Table 3). There was a positive correlation between patient satisfaction and outcome measures.

Patients with preoperative assessment consistent with a preponderance of radicular leg pain *versus* back pain had better surgical outcomes based on the VAS back pain score ($P = 0.002$), VAS leg pain score ($P < 0.001$), and Oswestry disability index ($P = < 0.001$). Preexisting restricted duty status at time of first surgical consultation was associated with poorer postoperative Oswestry score ($P < 0.001$).

Level of Disc Herniation and Overall Outcome

The level of disc herniation impacted VAS leg and Oswestry outcome scores, but not VAS back scores. Disc herniations at the L5–S1 level had significantly greater improvements in both mean VAS leg and Oswestry outcome scores than disc herniations at the L4–L5 level ($P < 0.001$). Comparisons between the L5–S1 and L4–L5 levels and L3–L4 level herniations did not reach statistical significance due to the small number of L3–L4 herniations in the study (Table 4).

Type of Disc Herniation and Outcome

The type of disc herniation also impacted VAS leg and Oswestry outcome scores, but not VAS back scores. Patients with sequestered disc fragments had significantly greater improvements in both mean VAS leg and Oswestry outcome scores than extruded or contained disc types, ($P < 0.001$). Contained discs were associated with the poorest outcomes; significantly worse than either extruded ($P < 0.001$) or sequestered ($P < 0.001$) disc types (Table 5).

Recurrent Herniations/Additional Surgeries

Six patients sustained a recurrent disc herniation at a mean of 9.3 (range 4–16) weeks after index surgery. By disc type, the recurrences included 4 extruded, 1 contained, and 1 sequestered disc herniation. By level, 4 of the recurrences were at L5–S1 and 2 at L4–L5. Two patients underwent repeat discectomy, 2 were treated

Table 2. Overall Patient Data Based on Herniation Type

Type of Disc Herniation	Total (%)	Mean Patient Age (SD)	No. Male (%)/ No. Female (%)	No. Smokers (%)	Years of Military Service (SD)
Extruded	78 (43)	29.1 (4.9)	59 (76)/19 (24)	14 (18)	8.8 (4.7)
Sequestered	64 (35)	28.3 (5.4)	52 (81)/12 (19)	18 (28)	7.8 (4.6)
Contained	41 (22)	27.9 (6.7)	27 (66)/14 (34)	9 (22)	7.8 (5.7)

A total of 183 patients had 1 of 3 types of disc herniations: extruded, sequestered, or contained.

Table 3. Overall Mean Preoperative to Postoperative Outcomes Scores and *P* Values

All Patients (n = 183)	Mean Preoperative Score	Mean Postoperative Score	*P* (Paired *t* Test)
Oswestry	53.55	21.22	<0.001
VAS leg pain	7.17	2.49	<0.001
VAS back pain	4.30	2.70	<0.001

Although the mean VAS leg scores and Oswestry scores showed significant improvement, the mean VAS back score did not.

with transforaminal lumbar interbody fusion, and 2 resolved with physical therapy alone. Of the patients with recurrent herniations, 6 out of 7 (86%) returned to full military duty within 12 months. One superficial wound infection resolved with oral antibiotic therapy and dressing changes.

Impact of Smoking

Smoking showed no statistically significant impact on any outcome measure with the exception of return to duty ($P > 0.05$). Smoking was associated with a lower return to duty and subsequent medical board and disability rating from the military (Table 6) ($P = 0.037$).

Return to Full Active Military Duty

A total of 154 (84%) of our 183 patients returned to full, unrestricted active duty by the time of their last follow-up. Twenty-nine patients (16%) were medically discharged from the military because of chronic back pain or radiculopathy. Patient satisfaction and outcomes by VAS leg and back, and Oswestry were significantly poorer when compared with those who returned to full duty ($P < 0.001$).

No specific job in the military service was shown to correlate with improved or diminished outcome scores. However, when compared with all military personnel, Navy SEALs, Reconaissance Marines, and Naval Aviators had marked improvement in outcomes, Oswestry scores were 12% more improved and VAS leg scores 21% more improved ($P = 0.037$).

■ Discussion

Our study demonstrates that young, active patients who undergo lumbar microdiscectomy for symptomatic disc herniations can return to physically demanding jobs. The complication rate was negligible, patient satisfaction was high (85%) and most were able to return to unrestricted military duties (84%) that includes heavy lifting, bending, twisting, shipboard duty, aviation, carrying back packs that can weigh in excess of 80 lbs, and mandatory physical readiness testing. These results are comparable with outcome studies of lumbar microdiscectomy in older patient populations, which report mean patient satisfaction to be in the 70% to 80% range, although return to preoperative work and activities of daily living are frequently lower.[5,13] Multiple postulations for our more favorable results can be formulated. Our patient population is, for the most part, a young, motivated group, where preinjury physical condition is superior to that of the general public. Military personnel are required to maintain weight standards and physical readiness. They must pass a physical readiness test twice a year that includes push-ups, sit-ups, running 1.5 to 3.0 miles depending on service, and/or exercise bike. At the point of initial surgical consultation, patients were educated on proper lifting techniques, posture, core muscle strengthening, and low impact fitness. They were encouraged to return to their preinjury activity level at 6 weeks postsurgery without exception. This was re-emphasized at the preoperative visit and subsequent postoperative visits.

Previous studies have suggested that patient age at the time of surgery is not predictive of outcomes.[14] However, we are not aware of any previous large case series focusing on outcomes in a young, active population. To our knowledge, the mean age of 27 years in our study is approximately 10 to 15 years younger than any other large series reported in the literature.[5–7,15,16] A significant effort was made to emphasize to our patients that they could return to their preinjury activities as soon as they felt comfortable. These young patients were made to feel that this was an injury that could be overcome like most musculoskeletal injuries.

Female gender and increased duration of preoperative symptoms have been independently associated with poor outcomes in previous studies, but we found no such correlation. Patients presenting to our clinic who had already been placed on a restricted duty status had significantly poorer outcomes than those on full duty status, mirroring trends in workmen's compensation cohorts in

Table 4. Overall Mean Preoperative to Postoperative Outcomes Scores and *P* Values, by Specific Level of Disc Herniation

Herniation Level	Mean Preoperative/Postoperative Score, *P* (ANOVA)		
	VAS Back	VAS Leg	Oswestry
L5–S1 (n = 97)	3.91/2.23, $P = 0.595$	7.48/1.96, $P < 0.001$	54.35/16.4, $P < 0.001$
L4–L5 (n = 81)	4.76/3.25, $P = 0.595$	6.79/3.05, $P < 0.001$	52.88/26.95, $P < 0.001$
L3–L4 (n = 5)	4.50/3.00, $P = 0.595$	7.17/3.50, $P < 0.001$	49.67/22.67, $P < 0.001$

Disc herniations at the L5–S1 level showed significantly greater improvements in mean VAS leg and Oswestry score when compared with discs at the L4–L5 level; $P = 0.001$.

Table 5. Overall Mean Preoperative to Postoperative Outcomes Scores and *P* Values, by Specific Type of Disc Herniation

	Mean Preoperative/Postoperative Score, *P* (ANOVA)		
Herniation Type	VAS Back	VAS Leg	Oswestry
Extruded (n = 78)	4.42/2.81, $P = 0.928$	7.03/2.63, $P < 0.001$	52.90/23.01, $P < 0.001$
Sequestered (n = 63)	3.11/1.50, $P = 0.928$	7.56/1.22, $P < 0.001$	54.72/10.81, $P < 0.001$
Contained (n = 41)	5.88/4.37, $P = 0.928$	6.83/4.20, $P < 0.001$	52.98/34.05, $P < 0.001$

Sequestered disc herniations were associated with significantly greater improvements in mean VAS leg and Oswestry outcome scores, when compared with extruded disc types ($P = 0.0001$) and contained disc types ($P = 0.0001$). Extruded disc types showed significantly greater improvements in the same outcome measures when compared with contained disc types ($P = 0.0001$).

other studies.[5,17] Additionally, the patients with more elite military jobs—Navy SEALs, Reconnaissance Marines, and Aviators, had significantly better outcomes and return to duty than their counterparts in other branches of service. This may be attributed to the character traits inherent to these more selective groups or to the point that they were encouraged to return to duty as soon as possible.

Several studies have shown that patients with lower socioeconomic status and education have poorer surgical outcomes when compared with patients with higher status and education. Surprisingly, rank and time in service in our study did not correlate with return to duty or clinical outcomes. Military officers or personnel with greater time in service did not necessarily return to full, unrestricted duty which would be expected because they are nearer retirement or were in a supervisory role.

The VAS leg scores and Oswestry disability scores for patients with a larger percentage of preoperative back pain did not demonstrate as much postoperative improvement as those with a preponderance of leg pain. Overall mean VAS back pain scores did show significant improvement after surgery, suggesting that patients did experience some relief of back pain. It is difficult to assess the validity of this finding, given the poorer outcome scores in patients with more back than leg pain at the onset of treatment. Preoperative to postoperative VAS back pain scores for specific disc herniation levels or types failed to correlate with the preoperative to postoperative VAS leg pain and Oswestry score improvements, remaining a uniformly poor predictor of outcome. Our findings reinforce the accepted surgical indications for lumbar microdiscectomy as effective and predictable treatment for radicular leg pain recalcitrant to nonoperative management, not for isolated lumbar back pain.[18]

Tobacco smoking has been shown to result in diminished outcome scores in spine surgery patients.[19] Although our data did not show a significant correlation between smoking and less satisfactory outcomes by VAS leg and Oswestry scores, we did observe a significant decrease in the return to duty rate among smokers. Thirty-six percent of patients who were unable to return to full duty and were medically discharged were smokers ($P = 0.037$).

We found that surgical outcomes were significantly influenced by disc herniation type. Sequestered discs were associated with the best outcome scores, significantly better than those associated with extruded and contained disc herniations. Contained disc herniations were associated with significantly poorer outcomes than either sequestered or extruded disc types. Our findings are consistent with previous studies that have examined the correlation between disc herniation type and the outcome of surgical treatment.[7] The best surgical outcomes and lowest reherniation rates have been reported in association with small anular tears with large disc fragments, and the worst outcomes with contained herniations and no isolated fragments.[7] It has also been suggested that noncontained disc herniations may be successfully treated nonoperatively.[20] Histologic studies have demonstrated an increased inflammatory response that correlates with more complete disc herniation resorption in noncontained or sequestered disc fragments.[21]

Disc herniation level and clinical outcomes was also assessed. Patients with disc herniations at the L5–S1 level

Table 6. Comparing Outcomes Between Smokers and Nonsmokers

	Smokers	Nonsmokers	*P*	Statistical Test
Total number (%)	41 (22%)	142 (78%)	—	—
Mean VAS leg pain improvement, *P*	4.05	4.87	0.462	*t* test
Mean VAS back pain improvement, *P*	1.73	1.54	0.462	*t* test
Mean Oswestry improvement, *P*	28.63, $P = 0.15$	33.4, $P = 0.15$	0.105	*t* test
Return to duty number (%)	29/41 (70.7%)	123/142 (86.6%)	0.037	Fischer exact test
Return to duty after 6 mo limited duty	4 (9.8%)	5 (3.5%)	0.037	Fischer exact test
Medical board or discharge number (%), *P*	8/41 (19.5%)	14/142 (9.9%)	0.037	Fischer exact test

Smoking showed no statistically significant impact on any outcome measure with the exception of return to duty. Smoking was associated with a lower return to duty and subsequent medical board (disability); $P = 0.037$.

had significantly better outcomes by VAS leg and Oswestry score than did those with herniations at the L4–L5 level. We did not have an adequate number of herniations at the L3–L4 level to make similar comparisons. We postulate that because of the inherent stability afforded by the lumbopelvic ligaments, there may be less reherniations. Moreover, the neuroforamen for the S1 nerve is larger and less affected by progressive disc degeneration and foraminal narrowing. Of course, patients may develop L5 symptoms with progressive foraminal stenosis at L5–S1. We are unaware of previous studies describing the correlation between lumbar discectomy outcomes and disc herniation level.

■ Conclusion

Microdiscectomy for symptomatic lumbar disc herniations in patients with a preponderance of leg pain who have failed nonoperative treatment has a high success rate, as demonstrated by validated outcome scores, patient satisfaction, and return to active military duty. Patients should be encouraged to return to their preinjury activities as soon as possible with no restrictions at 6 weeks. Overall, patients with sequestered lumbar disc herniations fared better than those with extruded herniations, although both groups consistently had better outcomes than patients with contained herniations. Patients with herniations at the L5–S1 level had significantly better outcomes than did those at the L4–L5 level. Lumbar disc herniation level and type should be considered in preoperative outcomes counseling. Smokers had a significantly lower return to duty rate. In the carefully screened patient, lumbar microdiscectomy for symptomatic disc herniation results in an overall high success rate, patient satisfaction, and return to physically demanding activities.

■ Key Points

- Patients with disc herniations at the L5–S1 level demonstrated better outcomes than those at other levels.
- Patients with sequestered or extruded lumbar disc herniations had significantly better outcomes than those with contained disc herniations.
- Smoking reduced return to duty rate.
- VAS scores were most improved for those with a predominance of leg pain (instead of back pain).

References

1. Atlas SJ, Chang Y, Kammann E, et al. Long-term disability and return to work among patients who have a herniated lumbar disc: the effect of disability compensation. *J Bone Joint Surg Am* 2000;82:4–15.
2. Deyo RA, Weinstein JN. Low back pain. *N Engl J Med* 2001;344:363–70.
3. Saal JA, Saal JS, Herzog RJ. The natural history of lumbar intervertebral disc extrusions treated nonoperatively. *Spine* 1990;15:683–6.
4. Weber H. Lumbar disc herniation. A controlled, prospective study with ten years of observation. *Spine* 1983;8:131–40.
5. Atlas SJ, Keller RB, Wu YA, et al. Long-term outcomes of surgical and nonsurgical management of sciatica secondary to a lumbar disc herniation: 10 year results from the maine lumbar spine study. *Spine* 2005;30:927–35.
6. Weinstein JN, Lurie JD, Tosteson TD, et al. Surgical vs nonoperative treatment for lumbar disk herniation: the Spine Patient Outcomes Research Trial (SPORT) observational cohort. *JAMA* 2006;296:2451–9.
7. Carragee EJ, Han MY, Suen PW, et al. Clinical outcomes after lumbar discectomy for sciatica: the effects of fragment type and anular competence. *J Bone Joint Surg Am* 2003;85:102–8.
8. Carragee EJ, Kim DH. A prospective analysis of magnetic resonance imaging findings in patients with sciatica and lumbar disc herniation. Correlation of outcomes with disc fragment and canal morphology. *Spine* 1997;22:1650–60.
9. Fardon DF, Milette PC. Nomenclature and classification of lumbar disc pathology. Recommendations of the Combined task Forces of the North American Spine Society, American Society of Spine Radiology, and American Society of Neuroradiology. *Spine* 2001;26:E93–E113.
10. Delamarter R, McCulloch JA. Microdiscectomy and microsurgical laminotomies. In: Frymoyer J, ed. *The Adult Spine: Principles and Practice*. 2nd ed. Philadelphia, PA: Lippincott-Raven; 1996.
11. Spengler DM. Lumbar discectomy. Results with limited disc excision and selective foraminotomy. *Spine* 1982;7:604–7.
12. Fairbank JC, Pynsent PB. The Oswestry disability index. *Spine* 2000;25:2940–52; discussion 2952.
13. Asch HL, Lewis PJ, Moreland DB, et al. Prospective multiple outcomes study of outpatient lumbar microdiscectomy: should 75 to 80% success rates be the norm? *J Neurosurg* 2002;96(1 suppl):34–44.
14. Postacchini F. Management of herniation of the lumbar disc. *J Bone Joint Surg Br* 1999;81:567–76.
15. Findlay GF, Hall BI, Musa BS, et al. A 10-year follow-up of the outcome of lumbar microdiscectomy. *Spine* 1998;23:1168–71.
16. Loupasis GA, Stamos K, Katonis PG, et al. Seven- to 20-year outcome of lumbar discectomy. *Spine* 1999;24:2313–17.
17. Atlas SJ, Keller RB, Chang Y, et al. Surgical and nonsurgical management of sciatica secondary to a lumbar disc herniation: five-year outcomes from the Maine Lumbar Spine Study. *Spine* 2001;26:1179–87.
18. Ng LC, Sell P. Predictive value of the duration of sciatica for lumbar discectomy. A prospective cohort study. *J Bone Joint Surg Br* 2004;86:546–9.
19. Vogt MT, Hanscom B, Lauerman WC, et al. Influence of smoking on the health status of spinal patients: the National Spine Network database. *Spine* 2002;27:313–19.
20. Ito T, Takano Y, Yuasa N. Types of lumbar herniated disc and clinical course. *Spine* 2001;26:648–51.
21. Ito T, Yamada M, Ikuta F, et al. Histologic evidence of absorption of sequestration-type herniated disc. *Spine* 1996;21:230–4.