

## Clinical Article

# 20 years follow-up after the first microsurgical lumbar discectomies in Iceland

M. Jensdottir, K. Gudmundsson, B. Hannesson, and G. Gudmundsson

Department of Neurosurgery, Landspítali University Hospital, Reykjavík, Iceland

Received June 26, 2006; accepted October 25, 2006; published online December 21, 2006

© Springer-Verlag 2006

## Summary

**Background.** Microsurgical discectomies are an established procedure in spinal surgery. This operating technique was first used in the Department of Neurosurgery in Iceland in 1981 and has become standard operative treatment for herniated lumbar discs. There is a great variability in outcome reports regarding recurrence rate and re-operation rate. Few articles are based on follow-up of more than 10 years. This article presents the results of a 20 years follow-up study.

**Methods.** A retrospective study of all patients undergoing microsurgical discectomy for herniated lumbar disc, from June 1, 1981 to December 31, 1984. Outcome, based on recurrence rate, return to work and patient satisfaction was determined by a self-evaluation questionnaire, phone interviews and patient medical records.

**Findings.** Of the 170 patients, 134 (78.8%) were included in the study (M:F, 58:42%). Preoperative symptoms: back pain with sciatica 108 (80.6%), sciatica 20 (14.9%), back pain 2 (1.5%). Mean follow-up time was 20.7 years (19.5–22.8). Recurrence rate was 12.7%. 19 patients (14.2%) underwent a subsequent lumbar operation at a different level or side. A majority of patients 108 (80.6%) returned to previous level of work, 26 (19.4%) lost some or all working capabilities. Patient satisfaction was high, 91.1% reporting excellent (68.7%) or good (22.4%) results. 5.2% of patients rated the outcome fair and 3.7% poor. Women reported worse outcome than men, excellent M:F 74.7:60.7%, and poor 7.1:1.3%. There was no significant difference in patient satisfaction in patients undergoing additional operations or those with recurrence of the herniated disc.

**Conclusions.** Outcome was very good with 92.0% return to work and 91.1% patient satisfaction. The recurrence rate was 12.7% with a substantial number of cases occurring 10–20 years after operation. To conclude, microsurgical discectomies maintain a high success rate in the long-term.

**Keywords:** Microsurgical discectomy; disc herniation; outcome; follow-up.

## Introduction

Microsurgical discectomies have become an established procedure in spinal surgery. Since the first de-

scription of a herniated lumbar disc and the surgical management, by Mixter and Barr [17], there has been a vast progress in the surgical procedure. The microsurgical technique was introduced during the 1970s. Caspar, Yasargil and Williams all reported their experience and described their technique independently in 1977–1978 [6, 33, 36]. This operating technique was introduced in the Department of Neurosurgery in Iceland in 1981 and is currently the operative treatment of choice for herniated lumbar discs. The microsurgical technique offers an excellent exposure with a less traumatic procedure through a small incision.

There have been a number of studies on the outcome of surgery for herniated lumbar discs. Previous studies on the outcome of microsurgical discectomies vary from moderate figures of 75–80% success rate [2, 5, 8, 21, 24, 26] to very high rates of 90–95% [1, 16, 18, 22, 34]. The evaluations are highly dependent on the criteria used to define success and few studies are based on a uniform, standardized method [12, 13, 26]. Most studies however use one or more of the following measures: subjective rating of the patient or surgeon and some measure for treatment failure, i.e. recurrence of a herniated disc [11]. Previous studies have reported highly varying recurrence rates, from a few percent [1, 8, 14, 21, 24, 32, 34] to moderate and high rates of up to 10–15% [2, 10, 18, 19, 26]. Little has been published on the appropriate length of follow-up after lumbar discectomies, with time ranging from months to years [11, 25]. Furthermore, there is no consensus on the definition of long-term follow-up. However, only few studies report a

follow-up duration of 10 years or more [1, 8, 10, 11, 18, 26, 30, 34].

The purpose of our study was to evaluate whether the previously reported good short term outcome of microsurgical discectomies, including a previously published outcome of our study group with 1–3 years follow-up [27], is maintained over a longer period. This article presents a 20 year outcome of microsurgical discectomies focusing on recurrence rate of herniated lumbar disc, postoperative working abilities and patient satisfaction.

## Methods and materials

The study was approved by the National Bio-ethics Committee and the Data protection Authority in Iceland. All participants gave informed consent.

All patients undergoing a microsurgical discectomy for lumbar herniated disc in the time period between June 1st 1981 and December 31st 1984 were identified retrospectively from the operating records of the Department of Neurosurgery in Iceland. The indication for operation was radicular pain with or without associated back pain and a positive myelogram, indicating a herniated lumbar disc. Patients previously operated or with signs and symptoms of spinal stenosis were excluded. These patients had previously participated in an outcome study conducted in 1985 [27]. All participants were patients at a single institute, and the operations were performed by either one of the departments two chief surgeons. The operating technique used was essentially the one described by Caspar [6].

All participants received a letter with a self-evaluation questionnaire, followed by a telephone interview. The questionnaire included questions about their current employment status, employment at the time of surgery and whether they had to change work after surgical treatment. Furthermore they were questioned on subsequent operations because of back symptoms. Finally patients were asked to rate their satisfaction with the results of surgery by evaluating their relief of pain according to a given criterion (Table 1). During data processing the categories excellent and good were classified as satisfactory results, and the fair and poor categories were classified as unsatisfactory results. Additional data, on pre-operative symptoms and information on subsequent operations, were collected from patient records.

We defined outcome primarily in objective terms of recurrence and return to work. Furthermore we looked at the patient's satisfaction with the results of surgery according to their subjective rating of pain relief. Recurrence was defined as a lumbar herniated disc at the same level and side. Working capabilities were defined to one of three categories: previous level of work, change to lighter work due to back symptoms and finally worker's compensation cases.

Data items were compiled on a Microsoft EXCEL® database and analysis were performed with the SPSS® statistical package for Windows, version 12.0. Comparison between subgroups was made with  $\chi^2$  and Fisher's exact test where appropriate.  $p < 0.01$  was considered significant.

Table 1. Patient satisfaction – criteria for outcome

Parameter	Criteria
Excellent	85–100% relief of pain
Good	50–85% relief of pain
Fair	<50% relief of pain
Poor	No relief or worsening of pain

Table 2. Patient characteristics

	Total	Female	Male
Patients	134	56 (41.8%)	78 (58.2%)
Age*	37.0 (17–58)	38.3 (21–58)	36.1 (17–58)
Preop. symptoms†			
– Back pain/sciatica	108 (80.6%)	42 (75.0%)	66 (84.6%)
– Sciatica	20 (14.9%)	12 (21.4%)	8 (10.3%)
– Back pain	2 (1.5%)	1 (1.8%)	1 (1.3%)
Level of disc herniation			
– L5-S1	56 (41.8%)	31 (55.4%)	25 (32.1%)
– L4-L5	71 (53%)	25 (44.6%)	46 (59%)
– L3-L4	6 (4.5%)	0	6 (7.7%)
Employment status			
Working	127 (94.8%)	52 (92.9%)	75 (96.2%)
– Strenuous work/ blue collar	49 (36.6%)	10 (17.9%)	39 (50.0%)
– Medium	63 (47.0%)	34 (60.7%)	29 (37.2%)
– Sedentary work/ white collar	15 (11.2%)	8 (14.3%)	7 (9.0%)
Worker's compensation	7 (5.2%)	4 (7.1%)	3 (3.8%)
Follow-up*	20.7 (19.5–22.8)	20.5 (19.5–22.7)	20.8 (19.5–22.8)

\* Years (range).

† Missing data from 4 patients.

## Results

Of the 170 patients found in the hospital records, 134 (78.8%) were included in the study. Three patients were lost to follow-up due to emigration, 16 patients were deceased, 15 patients could not be reached despite extensive attempts and two patients refused to participate.

Demographic and descriptive data of the participants are shown in Table 2. Average length of follow-up was 20.7 years (range 19.5–22.8) and the mean age at time of operation was 37 years (range 17–58), with no difference between the gender subgroups. Presenting symptoms were radiating back pain with or without sciatica in the vast majority of patients. In reviewing the patient records it was not possible to assess sensory deficits. Severe motor deficits,  $\geq 50\%$  reduction of muscle power, were registered in the records of 7 patients (M:F, 3:4), of which one patient had paraparesis. The diagnosis of a lumbar herniated disc was confirmed by myelography, the investigation of choice at the time, in all cases. 95% of patients were working at the time of operation. Seven patients were on workers compensation, no difference in numbers between gender subgroups.

## Recurrence

Ninety-seven patients (73.1%) did not undergo any further surgery of the back (Fig. 1). Seventeen patients

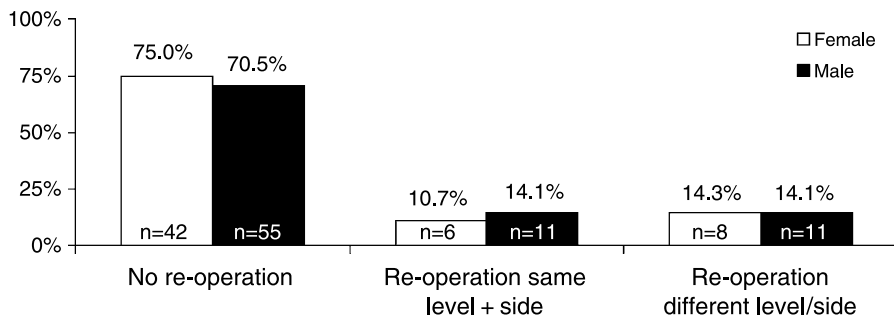


Fig. 1. The percentage within gender undergoing subsequent lumbar operations. Recurrence defined as operation for herniated lumbar disc at the same level and side. Second or more reoperations are excluded but described in the text. *N* The number of cases

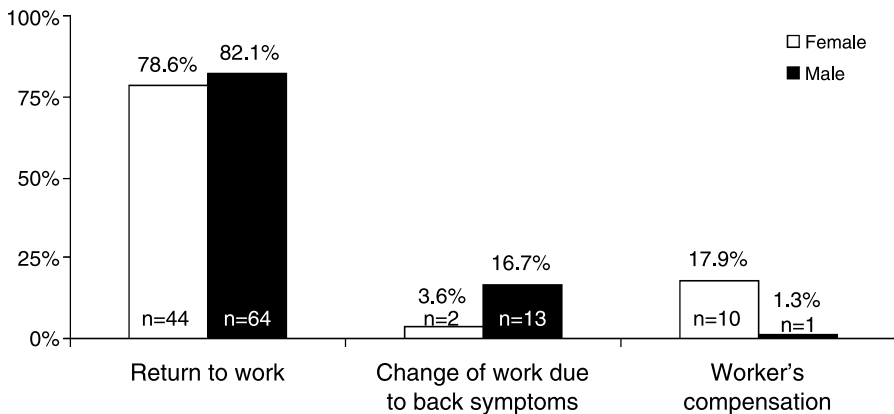


Fig. 2. The percentage within gender returning to work. *N* The number of cases

(12.7%) were treated surgically for a recurrent herniated lumbar disc. Two had a second recurrence and one male patient was operated on 3 times for a herniated disc at the same level/side. This patient was always symptom free for 3–5 years in between operations and reported almost complete relief of symptoms since the last operation, 10 years ago. Nineteen patients (14.2%) underwent a subsequent lumbar operation for a herniated disc at a different level/side or another diagnosis (i.e. spinal stenosis). One patient has had 2 subsequent operations for herniated discs at different levels.

The mean time to recurrence was 5.9 years (range 1.3–19.7) with 4 (24%) patients presenting with a recurrent disc herniation more than 10 years postoperatively.

*Return to work*

A total of 108 patients (80.6%) resumed their previous work or changed work due to other causes unrelated to disease of the lumbar spine (Fig. 2). Fifteen patients (11.2%) had to change their level of work due to back symptoms. Eleven patients (8.2%), were receiving worker’s compensation at the time of follow-up compared to 7 (5.2%) at baseline. Among those receiving worker’s compensation at time of follow-up, two cases were not due to back symptoms. There was a significant difference between

genders, with fewer men than women receiving compensation, 1.3 and 17.9%, respectively ( $p = 0.001, \chi^2$ ).

*Satisfaction*

One hundred and twenty two (91%) patients were satisfied with the results of surgery, rating the procedure outcome excellent or good (Fig. 3). Fewer women than man regard the result satisfactory, 87.5 and 93.5%, respectively ( $p = 0.238$ , Fisher’s exact test). Seven (5.2%) patients reported the outcome fair and 5 (3.7%) patients reported no relief or worsening symptoms. Fewer men than women reported an unsatisfactory outcome, 6.4 and 12.5%, respectively ( $p = 0.181$ , Fisher’s exact test).

For further evaluation of the effect of postoperative working abilities on patient satisfaction, the study group was categorized into two subgroups: those who reported a change of working capabilities due to back symptoms and those who did not (Fig. 4) ( $p = 0.394$ , Fisher’s exact test). Patients who were classified as working pre-operatively rated the outcome as follows: 118 patients (92.9%) regarded the results satisfactory and 9 patients (7.1%) regarded them unsatisfactory. The rating among patients receiving worker’s compensation prior to surgery was less favourable with 4 patients (57.1%) satisfied and 3 (42.9%) unsatisfied ( $p = 0.014$ , Fisher’s exact

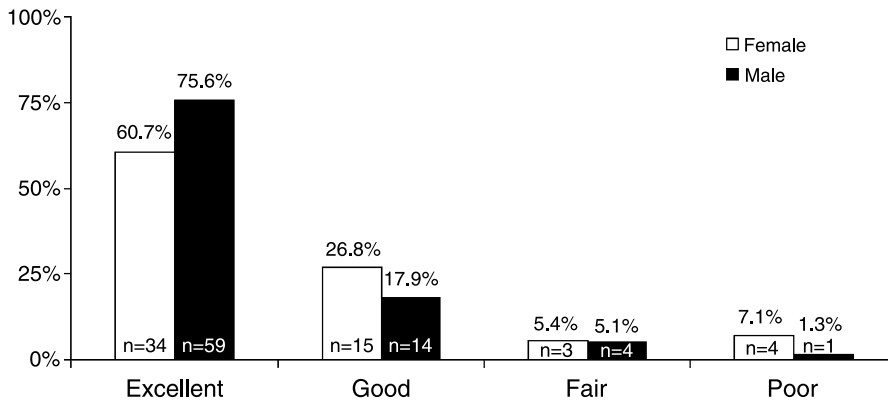


Fig. 3. Patient satisfaction, percentage within gender. *N* The number of cases. Excellent and good categories classified as satisfactory results, fair and poor categories classified as unsatisfactory results

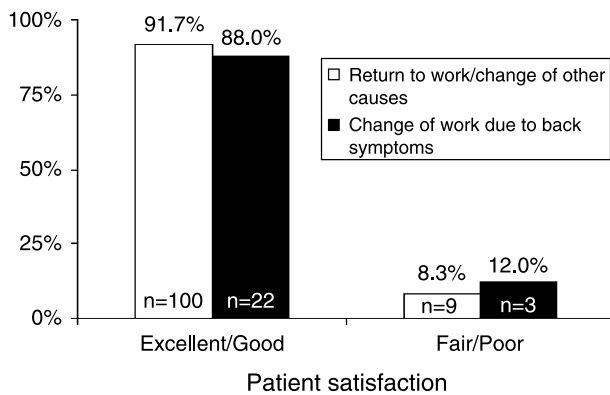


Fig. 4. Effect of employment status on patient satisfaction. *N* The number of cases

test) although a direct connection can not be affirmed and might be a coincidence or due to a “confounder”.

To evaluate the effect of recurrence on patients subjective outcome rating we divided the study group into two subgroups according to recurrence or not (Fig. 5). Patients with recurrent lumbar disc herniation and patients without recurrence reported satisfactory outcome in 82.4 and 92.2%, respectively. 17.8% in the recurrence

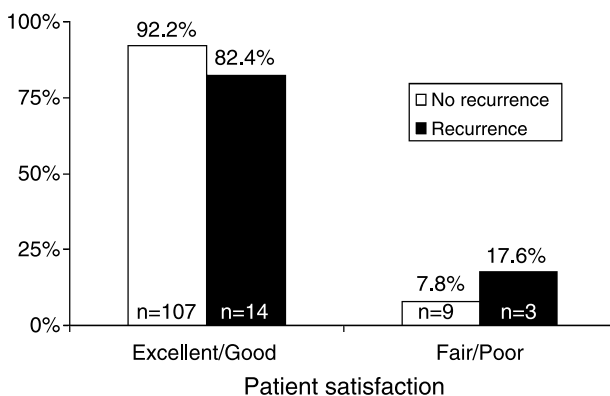


Fig. 5. Effect of recurrence on patient satisfaction. Satisfactory (excellent/good), unsatisfactory (fair/poor). *N* The number of cases

group regarded the outcome unsatisfactory compared with 7.8% in the group with no recurrence ( $p=0.180$ , Fisher’s exact test).

### Discussion

#### Recurrence

Our finding of a 12.7% recurrence is a little higher than commonly reported in previous studies documenting recurrence rates lower than 10% [1, 8, 14, 19, 21, 24, 34]. In a recent publication, Atlas *et al.* [5] found a 25% re-operation rate in a 10 year follow-up of patients treated surgically for lumbar disc herniation. Their study however did not specify which patients underwent a subsequent operation for a true recurrence of lumbar disc herniation and the study population underwent macroscopical as well as percutaneous discectomies. Few studies are available for true comparison since many of those previously cited either have a much shorter follow-up [1, 14, 21, 24] or include patients who underwent macro-surgical discectomies [19, 21]. Other studies however have reported a similar [2, 18, 26] or higher recurrence rate of up to 15% although after a shorter follow-up [10]. It is important to note that of the recurrent disc herniations 24% presented more than 10 years after the operation which might explain the somewhat higher recurrence rate in our study compared with the previous best results. The present results are in accordance with a previously published outcome of the same group studied, showing a recurrence rate of only 2.7% with a mean follow-up period of 2.6 years (1.4–4.8) [27].

The present results can be compared with observations of the natural history of lumbar spine diseases causing sciatica, although publications on this subject are scarce [5, 23]. Atlas *et al.* [5], in comparing the surgical and non-surgical management in a 10 year follow-up study, found no difference in the 2 respective

patient groups with 1 in 4 patients requiring a spinal operation in the follow-up period. Our findings correlate to these results with 73.1% of patients requiring no further spinal operation in the 20 year period. Hence, the observed result in this study might be what to expect in a continuous degenerative disorder. Or as described by Robert Warren Williams: *Finally, always remember that the benign diseases of the lumbar spine that cause sciatica are degenerative, ongoing and progressive* [34].

#### *Working status*

According to our data a majority of the group studied returned to work, or 92.8% although a small proportion had to change their level of work (11.2% of the total group). This is a somewhat higher proportion than found in previous studies, reporting a return to work between 68 and 91% [1, 5, 18, 21, 34]. Donceel and Du [7] retrospectively evaluated 3956 patients treated surgically for lumbar disc herniation and found only 70% able to resume work. Moreover they concluded that most patients resumed work less than 1 year after the operation. There is a good correlation of the present results with previously published results from the same study group with 81.5% returning to previous level of work in a 3 year follow-up [27] and 80.6% in the current study, with a slight difference, although not significant, probably due to a slightly higher proportion lost to follow-up in the latter study.

There was no considerable increase in patients receiving worker's compensation after surgery. However, the gender distribution changed significantly with fewer men than women receiving worker's compensation at time of follow-up compared with the distribution pre-operatively. Little has been published on the difference in postoperative employment status between genders. Donceel and Du [7], in evaluating a large study population, found that patients receiving worker's compensation prior to surgery for lumbar disc herniation were more likely to be male. But they did not report any gender difference in post-operative outcome. However, the subgroups in our study were small and hence it will be hard to generalize from our findings.

#### *Satisfaction*

Previous studies report a widely varying outcome of microdiscectomies. Our findings, with a majority of patients (91%) rating the procedure outcome excellent or good, are comparable to studies reporting high success

rates of 90–95% [1, 16, 18, 22, 34] but somewhat higher than studies reporting moderate figures of 75–80% [2, 5, 8, 21, 24, 26]. There was no significant difference in the present results compared with the 86.3% patient satisfaction reported in the short-term study of the same group [27].

Fritsch *et al.* [10] found that significantly fewer men than women report a satisfactory result. Our findings indicate, to the contrary, that women are less satisfied. 87.5% of women compared to 93.5% of men reported the results satisfactory although this did not reach significance. Loupasis *et al.* [15] found similar results with female gender being predictive of a poor outcome. However, the majority of previous studies does not report a gender difference.

Vik *et al.* [30] and Schoeggel *et al.* [26] both reported a significantly less favourable outcome of re-operated patients compared to those not operated on again. According to our data, 17.8% of the patients with recurrent disc herniation regarded the outcome unsatisfactory compared to 7.8% of those without recurrence, indicating a similar correlation. However, this difference did not reach significance.

It is generally believed that the primary prognostic factors associated with poor outcome are worker's compensation prior to operation [3, 7, 24, 28] and long duration of symptoms [9, 20, 23, 24, 28, 31]. Our findings show a similar trend with 92.9% of the population working prior to surgery rating the results satisfactory compared to 57.1% of those receiving worker's compensation at baseline. Due to the retrospective nature of our study we were unable to gather reliable data on length of symptoms before operation. Hence, we did not assess the effect of duration of symptoms on patient satisfaction.

#### *Strengths and weaknesses of the study*

Strengths of our study include the uniformity of the study group, consisting of patients from a single center, and the exceptionally long follow-up of 19.5–22.8 years. There are no previous studies with a similar length of follow-up, as far as we are aware. Williams [34] reports a 15 year follow-up after microsurgical discectomies and several studies report a long-term follow-up of 10 years or less [1, 5, 8, 10, 18, 26, 30]. Loupasis *et al.* [15] reported outcome of lumbar discectomies with a follow-up of 20 years for some patients but included patients with a markedly shorter follow-up and the mean follow-up was 12.2 years. Furthermore, we were able to

compare our present results with initial outcome data from the same group, which is rare [8]. There was a good correlation of outcome between the studies, with similar return to work and patient satisfaction but an expected difference in recurrence rate. Woertgen *et al.* [35] however, found that outcome can be inconsistent between follow-up and that different prognostic factors might apply to outcome at different time of follow-up.

The main limitation of this study is that it is a retrospective observation and not controlled. Hence, we were not able to assess different predictors of outcome, apart from pre-operative working status. Another possible limitation might be the definition of outcome. We regard the objective parameters, recurrence and return to work as the primary outcome parameters. The subjective grading of outcome, patient satisfaction, was based on the patients grading of pain relief although not according to a standardized protocol. Many authors have discussed the lack of uniformity in outcome studies for lumbar disc surgery [12, 13, 26]. Few studies are based on a uniform, standardized method making comparison between studies difficult. In our review of the literature we found 14 outcome studies using 10 different rating scales [2, 4, 8–10, 15, 20, 21, 24, 26, 28–30, 37]. Three studies used the Oswestry Low Back Pain Disability Questionnaire and 3 studies used the Prolo functional-economic outcome rating scale while there was a different rating scale for each of the remaining studies. Assessments on three or four-step scales, similar to the one used in the current study for patient satisfaction are widely used [1, 2, 8, 18, 24]. Most studies however use a subjective rating by the patient and/or the surgeon as well as some objective measure for treatment failure, i.e. recurrence or reoperation rate [1, 2, 8, 10, 11, 15, 18, 24] making comparison possible. In order to be able to compare the present data to previously published outcome of the same group studied, as well as previous findings by other authors, we defined outcome as mentioned above.

Graver *et al.* [12], in assessing the reliability and validity of outcome evaluations after lumbar surgery, found return to work of high importance in defining outcome, as well as correlating significantly with a Clinical Overall Score (based on pain intensity, physical signs, functional status (Oswestry) and analgesics).

#### *Relation of this work to other*

The comparison of long-term outcome of microsurgical discectomy in the present study to available outcome studies of conservative treatment is favourable. Atlas

*et al.* [5] report a higher satisfaction among surgically treated patients than nonsurgically, 69 and 61%, respectively, with a generally lower satisfaction rate than in the present study. However, Weber [31] in a study of the 10 year results of operative treatment compared with conservative treatment, suggest that there is no difference in outcome in the two groups in the long-term.

Comparison of the long-term outcome of microsurgical discectomy to available data on long-term outcome of standard open discectomies is also favourable. Pappas *et al.* [21] and Loupasis *et al.* [15] report a somewhat lower satisfactory outcome than in the present study, 80 and 64%, respectively. However, they report a more favourable re-operation rate of less than 10%. Yorimitsu *et al.* [37] report a recurrence of 12.5% in a 10 year follow-up which is similar to the results of the present study but after a markedly shorter observation period.

Recent analysis of outcome of microsurgical discectomies compared to sequestrectomy shows now difference in early recurrence rate compared with microsurgical discectomies [29] and long-term results on sequestrectomies are not yet available for comparison.

There is currently no similar data available on the long-term outcome of various minimally invasive techniques for herniated lumbar discs. A well defined prospective study, comparing the long-term outcome of microsurgical discectomies with even less invasive surgical options, might provide valuable data in the future.

## **Conclusion**

The outcome of microsurgical discectomies, 20 years after operation, is very good with almost 92% of the patients fit to work and 91% patient satisfaction. Recurrence of the herniated lumbar disc continues to be a problem. Although this is not more than what might be expected in conservatively treated patients and reflects the on-going nature of benign lumbar spine disease. Our observation is in accordance with previous outcome studies and further confirms the role of microsurgical discectomies as standard treatment for herniated lumbar discs since a high success rate is maintained in the long-term.

## **References**

1. Abernathy CD, Yasargil MG (1990) Results in Microsurgery. In: Williams RW *et al* (eds) Microsurgery of the lumbar spine. Aspen Publishers Rockville, pp 223–226
2. Asch HL, Lewis PJ, Moreland DB, Egnatchik JG, Yu YJ, Clabeaux DE, Hyland AH (2002) Prospective multiple outcomes

- study of outpatient lumbar microdiscectomy: should 75–80% success rates be the norm? *J Neurosurg* 96: 34–44
3. Atlas SJ, Chang Y, Kammann E, Keller RB, Deyo RA, Singer DE (2000) 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* 82: 4–15
  4. Atlas SJ, Keller RB, Chang Y, Deyo RA, Singer DE (2001) Surgical and nonsurgical management of sciatica secondary to a lumbar disc herniation: five-year outcomes from the maine lumbar spine study. *Spine* 26: 1179–1187
  5. Atlas SJ, Keller RB, Wu YA, Deyo RA, Singer DE (2005) 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* 30: 927–935
  6. Caspar W (1977) A new surgical procedure for lumbar disc herniation causing less tissue damage through a microsurgical approach. *Adv Neurosurg*, pp 74–77
  7. Donceel P, Du BM (1998) Fitness for work after surgery for lumbar disc herniation: a retrospective study. *Eur Spine J* 7: 29–35
  8. Findlay GF, Hall BI, Musa BS, Oliveira MD, Fear SC (1998) A 10-year follow-up of the outcome of lumbar microdiscectomy. *Spine* 23: 1168–1171
  9. Fisher C, Noonan V, Bishop P, Boyd M, Fairholm D, Wing P, Dvorak M (2004) Outcome evaluation of the operative management of lumbar disc herniation causing sciatica. *J Neurosurg* 100: 317–324
  10. Fritsch EW, Heisel J, Rupp S (1996) The failed back surgery syndrome: reasons, intraoperative findings, and long-term results: a report of 182 operative treatments. *Spine* 21: 626–633
  11. Gibson JN, Grant IC, Waddell G (1999) The Cochrane review of surgery for lumbar disc prolapse and degenerative lumbar spondylosis. *Spine* 24: 1820–1832
  12. Graver V, Loeb M, Rasmussen F, Lie H, Ljunggren AE (1998) Clinical overall score: outcome evaluation after lumbar disc surgery, assessments of reliability and validity. *Scand J Rehabil Med* 30: 227–233
  13. Howe J, Frymoyer JW (1985) The effects of questionnaire design on the determination of end results in lumbar spinal surgery. *Spine* 10: 804–805
  14. Kotilainen E, Valtonen S, Carlson CA (1993) Microsurgical treatment of lumbar disc herniation: follow-up of 237 patients. *Acta Neurochir (Wien)* 120: 143–149
  15. Loupasis GA, Stamos K, Katonis PG, Sapkas G, Korres DS, Hartofilakidis G (1999) Seven- to 20-year outcome of lumbar discectomy. *Spine* 24: 2313–2317
  16. Maroon JC (2002) Current concepts in minimally invasive discectomy. *Neurosurgery* 51: S137–S145
  17. Mixer WJ, Barr JS (1934) Rupture of the intervertebral disc with involvement of the spinal canal. *N Engl J Med* 211: 210–215
  18. Moore AJ, Chilton JD, Uttley D (1994) Long-term results of microlumbar discectomy. *Br J Neurosurg* 8: 319–326
  19. Morgan-Hough CV, Jones PW, Eisenstein SM (2003) Primary and revision lumbar discectomy. A 16-year review from one centre. *J Bone Joint Surg Br* 85: 871–874
  20. Nygaard OP, Kloster R, Solberg T (2000) Duration of leg pain as a predictor of outcome after surgery for lumbar disc herniation: a prospective cohort study with 1-year follow up. *J Neurosurg* 92: 131–134
  21. Pappas CT, Harrington T, Sonntag VK (1992) Outcome analysis in 654 surgically treated lumbar disc herniations. *Neurosurgery* 30: 862–866
  22. Postacchini F (1996) Results of surgery compared with conservative management for lumbar disc herniations. *Spine* 21: 1383–1387
  23. Postacchini F (1999) Management of herniation of the lumbar disc. *J Bone Joint Surg Br* 81: 567–576
  24. Quigley MR, Bost J, Maroon JC, Elrifai A, Panahandeh M (1998) Outcome after microdiscectomy: results of a prospective single institutional study. *Surg Neurol* 49: 263–267
  25. Rotherl RD, Woertgen C, Brawanski A (2002) When should conservative treatment for lumbar disc herniation be ceased and surgery considered? *Neurosurg Rev* 25: 162–165
  26. Schoeggel A, Reddy M, Matula C (2003) Functional and economic outcome following microdiscectomy for lumbar disc herniation in 672 patients. *J Spinal Disord Tech* 16: 150–155
  27. Sigurdsson AS, Gudmundsson G, Hannesson B, Gudmundsson K (1991) Microsurgical lumbar discectomies. Outcome study of the Neurosurgical department in Iceland, 1981–1984. *Icelandic Med J* 77: 249–253
  28. Solberg TK, Nygaard OP, Sjaavik K, Hofoss D, Ingebrigtsen T (2005) The risk of “getting worse” after lumbar microdiscectomy. *Eur Spine J* 14: 49–54
  29. Thome C, Barth M, Scharf J, Schmiedek P (2005) Outcome after lumbar sequestrectomy compared with microdiscectomy: a prospective randomized study. *J Neurosurg Spine* 2: 271–278
  30. Vik A, Zwart JA, Hulleberg G, Nygaard OP (2001) Eight year outcome after surgery for lumbar disc herniation: a comparison of reoperated and not reoperated patients. *Acta Neurochir (Wien)* 143: 607–610
  31. Weber H (1983) Lumbar disc herniation. A controlled, prospective study with ten years of observation. *Spine* 8: 131–140
  32. Wenger M, Mariani L, Kalbarczyk A, Groger U (2001) Long-term outcome of 104 patients after lumbar sequestrectomy according to Williams. *Neurosurgery* 49: 329–334
  33. Williams RW (1978) Microlumbar discectomy: a conservative surgical approach to the virgin herniated lumbar disc. *Spine* 3: 175–182
  34. Williams RW (1990) Results in lumbar microsurgery. In: Williams RW *et al* (eds) *Microsurgery of the lumbar spine*. Aspen Publishers Rockville, pp 211–214
  35. Woertgen C, Rotherl RD, Breme K, Altmeppen J, Holzschuh M, Brawanski A (1999) Variability of outcome after lumbar disc surgery. *Spine* 24: 807–811
  36. Yasargil MG (1977) Microsurgical operation of herniated lumbar disc. *Adv Neurosurg*, pp 81–81
  37. Yorimitsu E, Chiba K, Toyama Y, Hirabayashi K (2001) Long-term outcomes of standard discectomy for lumbar disc herniation: a follow-up study of more than 10 years. *Spine* 26: 652–657

## Comments

In this manuscript the authors present a retrospective review of 134 patients who underwent surgery for lumbar disc herniations. Using an exceptionally long observation time they show outcome results after a follow up of 20 years. The overall results are encouraging in that they support the need for surgical management in these patients. However the study has some major weak points. This is not a controlled study which would ensure that all patients were included under the same conditions thereby preventing a selection bias. For the evaluation no standardized questionnaires were used. Therefore a comparison with other studies will be difficult. Detailed information about the content of the questionnaires and the classification systems used in this study is missing. This study does not offer relevant new information except for the data that a portion of 12.7% of recurrent disc herniations can be estimated after a mean observation time of 20 years.

M. Winking  
Osnabrück

In their paper the authors describe the long term outcome of 170 patients undergoing microsurgical discectomy. They evaluate a time

span of 20 years, one of the longest for this operation methodology available. They report a recurrence rate of 12.7% and a patient satisfaction of 91.1%. 80.6% of these patients resumed their previous work and 19.4% lost their working capabilities.

This is a very interesting study underlining the usefulness of lumbar microdiscectomy, provided the indication is properly set. This is a comment of my own and not a result of the study. However, as the indications show, that are reported in this study, all patients had a lumbar disc sequestration and clearly defined clinical symptoms, underlining my statement. The results reported in this paper are in the upper levels in

comparison to other published reports. The paper is clearly written and the pertinent literature quoted. The problems of this study are clearly seen and discussed by the authors. All in all this is a useful contribution.

*Alexander Brawanski*  
Regensburg

Correspondence: Margret Jensdottir, Department of Neurosurgery, Rigshospitalet University Hospital, Blegdamsvej 9, 2100 Copenhagen, Denmark. e-mail: margretjens@gmail.com