

## Seven- to 20-Year Outcome of Lumbar Discectomy

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**Study Design.** A retrospective, follow-up study.

**Objectives.** To assess the effects of conventional surgery for lumbar disc herniation over an extended period of time and to examine factors that might correlate with unsatisfactory results.

**Summary of Background Data.** Although the short-term results of lumbar discectomy are excellent when there is a proper patient selection, the reported success rates in the long-term follow-up studies vary, and few factors have been implicated for an unsatisfactory outcome.

**Methods.** One hundred-nine patients with surgically documented herniated lumbar disc were analyzed, retrospectively, by an independent observer. Long-term follow-up (mean 12.2 years) was done by a mailed, self-report questionnaire that included items about pain relief in the back and leg, satisfaction with the results, need for analgesics, level of activity, working capacity, and reoperations. Subjective disability was measured by the Oswestry questionnaire. Radiographic review was carried out in 66% of patients. End results were assessed using the modified Stauffer-Coventry's evaluating criteria. Several variables were examined to assess their influence to the outcome.

**Results.** The late results were satisfactory in 64% of patients. The mean Oswestry disability score was 18.9. Of the 101 patients who had primary procedures, 28% still complained of significant back or leg pain. Sixty-five percent of patients were very satisfied with their results, 29% satisfied, and 6% dissatisfied. The reoperation rate was 7.3% (8 patients), about one-third of which was due to recurrent disc herniation. Sociodemographic factors predisposing to unsatisfactory outcome, including female gender, low vocational education, and jobs requiring significant physical strenuousness. Disc space narrowing was common at the level of discectomy, but was without prognostic significance.

**Conclusions.** The long-term results of standard lumbar discectomy are not very satisfying. More than one-third of the patients had unsatisfactory results and more than one quarter complained of significant residual pain. Heavy manual work, particularly agricultural work, and low educational level were negative predictors of a good outcome. These indicators should be used preoperatively to identify patients who are at high risk for an unfavorable long-term result. [Key words: lumbar discectomy, outcome]. *Spine* 1999;24:2313-2317

Although lumbar discectomy is a common operation worldwide, valid indications for operative treatment of a patient who has herniation of a lumbar disc are still elu-

sive, and the end results of such treatment have been inconsistent.<sup>1,3,4,6,18,19,20,23-25,30,31</sup> The most likely factors leading to variable results are patient selection, varying follow-up intervals, and differences in analyzing outcomes.<sup>11,27</sup>

Reported early results of surgical discectomy have shown success rates of over 90%,<sup>9,26</sup> however, long-term results have been less positive, with success rates of 40% to 79% with a minimum 7-year follow-up.<sup>1,6,15,19,23</sup> There appears to be a significant deterioration with time after surgery.<sup>3,6,23</sup>

Sociodemographic factors have been shown to be useful in predicting the short-term results of lumbar disc surgery<sup>13</sup> in patients who present with "justified" operative criteria.<sup>16</sup>

The present study was undertaken to investigate the long-term outcome of surgical management for disc herniation in terms of clinical success, pain relief, disability, patient satisfaction, reoperation, and to identified factors associated with the surgical outcome.

### ■ Patients and Methods

Between 1973 and 1986, a total of 152 patients underwent primary surgery at a single level for lumbar disc prolapse at the Orthopaedic Clinic of Athens University, Greece. According to the medical records all the patients clearly had a clinical and a radiographic picture consistent with lumbar disc herniation.

The indications for operation were:

- a) severe radiculopathy of at least 6-weeks duration
- b) signs of neural tension
- c) evidence by myelography or computerized tomography of herniation of a disc with nerve-root compression.

Seven patients died from unrelated causes, and 28 patients were lost to follow-up, leaving a total of 117 patients (77%) available for the study. A comparison of the medical records of located and nonlocated patients demonstrated insignificant differences between the two groups with respect to age, symptoms, and disability.

All the patients were operated on using the classic technique described by O'Connell<sup>20</sup> (lumbar discectomy with curettage of the disc space through a laminotomy fenestration). The operations were performed by five senior surgeons including the senior author (G.H.).

In 1991, all of the 117 patients were contacted by mail to answer a detailed questionnaire. Overall, 109 patients (93%) responded. In 15 of these patients, a telephone interview was necessary in order to obtain answers to some unanswered questions. There were 76 men (70%) and 33 women (30%), with mean age at the time of operation of 43 years, range 15 to 65 years.

Reliability of the questionnaire was assessed by sending the same questionnaire to all patients 2 years later. Six patients did

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**Table 1. Criteria for Outcome\***

Result	Criteria
Excellent	Complete relief (more than 90%) of pain in the back and lower extremity, returned to previous activities
Good	Relief of most (70% to 90%) of pain in the back and lower extremity Able to return to accustomed employment Physical activities not limited or slightly limited Analgesic medications used infrequently or not used
Fair	Partial relief (30% to 70%) of pain in the back and lower extremity Able to return to accustomed employment with limitations or to lighter work Physical activities definitely limited Mild analgesic medications used frequently
Poor	Little or no relief (0 to 30%) of pain in the back or lower extremity, or pain worse than before operation Disabled for work Physical activities greatly limited Strong analgesic medications used regularly

\* Modified Stauffer–Coventry's evaluating criteria.

not return the questionnaire and were contacted by phone. There was significant inconsistency in the patients' recollections about the preoperative duration of symptoms, period off work before and after the operation, and the number of disabling episodes of pain since the operation, at the time of their initial and repeat questionnaires. All these questions were finally excluded. There was, however, no significant difference in the responses to the remaining questions when comparing the initial and retest questionnaires (Pearson test).

Seventy-two patients (66%) were willing to have a standard radiographic assessment of the lumbar spine—plain radiographs and dynamic flexion-extension lateral views.

At the last review (1993) the mean follow-up period for the 109 patients was 12.2 years, range 7 to 20 years. The evaluation of the latest results was based on the completely filled-out questionnaire and was carried out by an independent observer (G.A.L.). The questionnaire had two major sections. The first section was designed to include questions that quantified pain relief in the leg and back, residual pain, ability to work, level of activity, need for further treatment, reoperations, and satisfaction with the results. In the second section the patients were asked to complete the Oswestry low back pain disability questionnaire.<sup>5</sup> The disability was graded as minimal (score 0 to 20), moderate (21 to 40), or severe (more than 41).

The overall results were classified according to the modified Stauffer–Coventry's evaluating criteria<sup>28</sup> that relied on more objective variables (Table 1). Excellent and good results were rated as satisfactory, and fair and poor results as unsatisfactory.

Several variables were analyzed to assess their influence to the surgical outcome, including nature of work before operation, educational level, surgeon, smoking, level of surgery, present of osteophytes before the operation, total and segmental mobility, and disc space narrowing at follow-up.

Occupational activity has been divided into three categories according to the criteria of physical involvement needed, i.e., light work (office job), medium strenuous work (including household task), and heavy work (construction workers, farmers).

Patients were classified in the educational level into two major categories, those with undergraduate or graduate degrees and those with grade school or high school diplomas.

The amount of narrowing at the level of the operation, measured on the lateral radiographs using the method of Pope et al,<sup>21</sup> was classified as mild (0 to 25%), moderate (25 to 50%), or severe (more than 50%). The flexion-extension radiographs were analyzed for total and segmental mobility by the method of Hanley et al.<sup>8</sup> These variables were then tested for correlation with the age of the patient, duration of follow-up, and clinical result.

Statistical analysis was performed using the  $\chi^2$  test for categorical variables, and the Student *t* test for continuous variables. *P* values less than 0.05 were considered significant.

## ■ Results

### **Reoperations**

Eight patients underwent recurrent back surgery, giving a reoperation rate of 7.3% for the 109 patients followed into the long-term period. The operation was performed an average of 5.9 years (range, 1–14 years) after the initial discectomy. The mean disability score of these 8 patients was 39.6 and for the rest of the group 17.2 ( $P < 0.05$ ) at the last review. The operative findings at reoperation were in three cases recurrence of disc herniation (at the same level), in three cases hypertrophic scar tissue, in one case instability, and in one case the reason for reoperation could not be clearly determined from the medical records.

### **Surgical Outcome**

According to the modified Stauffer–Coventry's criteria, 40 patients (37%) had an excellent result, 30 (27%) good, 26 (24%) fair, and 13 (12%) poor. Patients who had a repeat surgery were classified as having a poor result. Overall, 64% of the patients gave a satisfactory result (excellent/good) and 36% an unsatisfactory result (fair/poor). Seventy-four percent of men and 48% of women had a satisfactory surgical outcome ( $P < 0.02$ ). The mean value of the Oswestry disability score of these 109 patients was 18.9 (women, 32.1; men, 13.1;  $P < 0.01$ ). Seventy-two patients (66%) had minimal disability (mean score, 7.3), 19 (17%) moderate disability (mean score, 30.5), and 18 (17%) severe disability (mean score, 52.9). The ages of the patients did not influence significantly the differences in score between the genders, nor did they influence the general outcome.

### **Patients' Assessment**

Twenty-eight of the 101 patients (28%) who had primary procedures still complained of significant pain in the back or leg (patients with fair, little, or no relief). Eight of these patients had significant pain to both sides, back and leg. The patients' assessment of the results of surgery are given in Table 2. Satisfactory (excellent or good) pain relief in the back and in the leg was reported by 79% and 85% of patients, respectively. As expected, patients with satisfactory results had significantly fewer back symptoms ( $P < 0.02$ ), and leg symptoms ( $P < 0.03$ )

**Table 2. Patient Assessment of Results of Surgery (n = 101)\***

Pain Relief	Back [no. (%)]	Leg [no. (%)]
Excellent (> 90% pain relief)	54 (53)	54 (53)
Good (70%–90% relief)	26 (26)	32 (32)
Fair (30%–70% relief)	11 (11)	8 (8)
Little (< 30% relief)	7 (7)	3 (3)
No relief/worse	3 (3)	4 (4)

\* Only patients with primary procedures.

when compared with patients who had unsatisfactory results.

Seventy-one patients (65%) were very satisfied with the results of surgery, 31 (29%) were satisfied, and 6 (6%) were dissatisfied.

### Factors Related to the Results

Before the operation 26 patients (24%) were engaged in light work, 50 (46%) in medium strenuous work, and 33 (30%) in heavy manual work. Fifteen of the patients engaged in heavy manual labor were farmers.

Employment status before surgery significantly influenced the outcome measures. Patients engaged in heavy manual work had less satisfactory results among patients who did light work ( $P < 0.01$ ) or medium strenuous work ( $P < 0.05$ ) (Table 3). Also patients with more physically demanding occupations (heavy manual) had significantly greater complains of low-back pain ( $P < 0.04$ ), leg pain ( $P < 0.05$ ), and a higher mean disability score (35.5 vs. 14.4,  $P < 0.01$ ) comparing with those who did lighter jobs.

Patients who performed strenuous work before surgery were much less likely to get back to demanding work than those who performed light ( $P < 0.001$ ) or medium strenuous work ( $P < 0.02$ ). As a consequence of residual low-back or leg pain, 16 patients (48%) of this group changed to a lighter work or were unfit for work after the operation (Table 4).

The nature of heavy manual work, also, significantly affected the outcome. Twenty percent of 15 patients engaged in agricultural work had a satisfactory result, compared with 56% of those who did other strenuous works ( $P < 0.04$ ). Also farmers reported less pain relief than patients involved in other heavy occupations ( $P < 0.04$ ).

**Table 3. Relationship of Outcome with the Strenuousness of Occupation**

Results	Strenuousness of Occupation [no. (%)]		
	Light	Heavy	Medium
Satisfactory	21 (81)	12 (36)	35 (70)
Unsatisfactory	5 (19)	21 (64)	15 (30)

$P < 0.01$  (Light vs Heavy),  $P < 0.05$  (Heavy vs Medium)

**Table 4. Patient's Postoperative Work Status in Relation to Strenuousness of Occupation Before Surgery**

Work Before Operation	Work at Follow-up [no. (%)]			
	Previous	Lighter	Unfit*	Retired†
Light	21 (81)	0	2 (8)	3 (11)
Medium	35 (70)	7 (14)	3 (6)	5 (10)
Heavy	14 (43)	6 (18)	10 (30)	3 (9)

\* Included patients who retired early due to residual back or leg pain.

† Patients who retired from other reasons.

Forty patients (37%) had a post-high school education. Seventy-eight percent of the patients with undergraduate or graduate degrees had a satisfactory result, compared with 57% of those with grade school or high school diplomas who had a satisfactory result ( $P < 0.03$ ).

Preoperatively, osteophytes in the lumbar spine were noted in 27 patients (25%). Fifty-six percent of these patients had a satisfactory result, compared with 70% of those without evidence of osteophytes who had a satisfactory result ( $P < 0.09$ ).

At a minimum of 7-year follow-up, all the 72 patients who were submitted to radiographic evaluation had some evidence of disc space narrowing at the level of the operation. The amount of narrowing that was seen on the radiographs was compared with the outcome measures and no significant relation was found (Table 5). Both the length of follow-up and the age of the patients at the time of the final review were compared to the amount of narrowing as determined by analysis of variance, and no correlation was found.

The total range of lumbar spine motion in patients with satisfactory results was greater than in patients with unsatisfactory results ( $29.2^\circ \pm 11.2^\circ$  vs.  $25.8^\circ \pm 10.2^\circ$ ), but this difference was not statistically significant ( $P < 0.08$ ). The range of motion at an operated interspace was not related to age of patient, duration of follow-up, or end result.

Last, the outcome of surgery was unrelated to the level of operation ( $P < 0.8$ ), surgeon ( $P < 0.07$ ), or smoking ( $P < 0.08$ ).

### Discussion

This long-term study demonstrates a high percentage of unsatisfactory results in patients who had a standard lumbar laminectomy and discectomy 7 to 20 years post-

**Table 5. Relationship of Outcome With the Amount of Disc Space Narrowing**

Results	Narrowing [no. (%)]			Significance
	Slight	Moderate	Severe	
Satisfactory	29 (58)	9 (53)	2 (40)	NS
Unsatisfactory	21 (42)	8 (47)	3 (60)	

NS = not significant.

viously. At an average follow-up of 12.2 years, 36% of patients had unsatisfactory results, and 28% complained of significant pain in the back or leg. A meaningful comparison of these results to those of other studies is rather difficult. This is due to the fact that outcome measures are different. Because objective outcome measures tend to give less favorable results than subjective outcome measures,<sup>11</sup> the success rate reported here might be pessimistic. However, literature review suggests that the results presented are by no means unique.

Short-term studies with less than a 2-year follow-up tend to give an overall optimistic success rate that exceeds 90%.<sup>9,26</sup> On the contrary, studies with long-term follow-up have shown unsatisfactory results up to 60%.<sup>6,15,23,29</sup> Davis<sup>3</sup> suggested that in order to evaluate adequately the result of surgery for herniated lumbar discs, the follow-up period should be more than 4 years.

Salenius and Laurent<sup>23</sup> reported satisfactory early results in 70% of patients that was decreased to 56% after 6 to 11 years of observation. Frymoyer et al,<sup>6</sup> in a retrospective study with a minimum 10-year follow-up, reported a 38% failure rate because of persistent symptoms or the need for reoperation. Dvorak et al<sup>4</sup> found that 23% of patients still complained of severe low-back pain and 45% had residual sciatica after 4- to 17-year follow-up. In Spangfort's<sup>25</sup> analysis of 2504 patients, more than 30% of patients complained of persistent low-back pain, while sciatic pain was found in 23% of the patients. Barr et al<sup>1</sup> reported 30% unsatisfactory results, while Lewis et al<sup>14</sup> showed somewhat more favorable results, with 14% of their patients having severe back or leg pain in a study with 5- to 10-year follow-up. Whether the fair outcome of lumbar discectomy in the long term is actually the "result" of surgery or simply the natural history of the underlying degenerative process, it should be a matter of discussion. Comparing the outcome of operative and conservative treatment in selected patients, Weber<sup>31</sup> and Nashold et al<sup>18</sup> did not find any significant difference between the final results of surgical and nonsurgical treatment after, respectively, 10 years and 20 years of observation.

The female gender was predictive of a poor outcome. About 50% of the women had an unsatisfactory result with only 25% of the men with unfavorable outcome. The majority of previous studies<sup>1,14,18,19,23,25,31</sup> does not support this finding. Vaughan et al<sup>29</sup> reported about less favorable results in women, particularly in those who had an L4–L5 disc excision. Our analysis did not suggest a relationship between poorer results in women and the level of surgery, although the numbers were too small for this type of analysis to be of value.

Occupational factors seem to have a considerable influence on the prevalence of residual symptoms and on clinical results. Jobs requiring significant physical strenuousness predispose to an unfavorable outcome. Hence, patients with light occupational activity fare best. Only 19% of these had unsatisfactory results, compared with 64% of those who did heavy manual work. These find-

ings are in accordance with some authors,<sup>6,23</sup> but in disagreement with others<sup>12,31</sup> who reported no significant relation between the physical strenuousness of work and the outcome. Hurme and Alaranta<sup>12</sup> suggested that this conflict is due to difficulties in classifying the strenuousness of work from traditional job descriptions; in contrast, perceived strenuousness of work seems to correlate well with the results.

The heavier the nature of work before the operation, the higher was the percentage of patients who changed work or were unfit for work after the operation. Only 43% of the 33 patients involved in heavy manual labor before surgery were found employed in the same capacity at the time of final review. Dvorak et al<sup>4</sup> reported that return to work is directly related to postoperative residual symptoms. In contrast, other authors<sup>22,30</sup> showed that return to work is determined to only a small extent by postoperative pain and disability and is much more strongly influenced by social factors. Salenius and Laurent<sup>23</sup> suggested that in younger individuals training for a new lighter occupation is often advisable. It is possible that counseling on changes in occupation or ergonomic improvements in the workplace, help patients involved in heavy manual work in returning to work.

Agricultural workers have the highest frequency of unsatisfactory results and residual complaints among the patients who did strenuous work. This is partly understandable considering the nature of their work. A self-employed farmer must attend to his work even when incapacitated. This hypothesis can be supported by previous reports. Weinstein et al<sup>32</sup> found significantly more pain at 10 years in those patients who had returned to work before complete symptomatic recovery had occurred. Nachemson and Bigos<sup>17</sup> suggested a minimum convalescence of 3 months for heavy workers.

Vocational education correlated positively with the results—the higher the education the better the result. Low educational level has been shown to be a reliable predictor of a bad outcome of lumbar disc surgery.<sup>12,13,23</sup>

Degenerative changes at the level of surgery were without prognostic significance. Neither the presence of osteophytes on the preoperative radiographs nor the amount of narrowing on the postoperative radiographs, demonstrated any significant correlation to the clinical outcome. This lack of correlation is in agreement with the findings of other studies.<sup>7,10,12,21</sup> Similarly, the range of motion at an operated interspace was not associated with the results.

A strong association between long history of smoking and clinical outcome after an operation on a vertebral disc has not been confirmed by the results in this series.

This being a retrospective study, the data presented here must be interpreted with caution. Three variables were of particular importance and could not be accurately assessed. First, it is true that a retrospective analysis of records is subject to inherent difficulties. Second, the use of questionnaires to obtain follow-up data has a

number of pitfalls.<sup>2,5</sup> These include reliance on patient recall of past events or symptoms and inadequate patient completion of all questions. An attempt was made to reduce questionnaire bias by performing a reliability test. This was performed on the whole group of patients by sending the same questionnaire 2 years after they had completed the initial one. Inconsistent responses between the two questionnaires were eliminated. Third, reliability tests on the radiographic measurements were not performed; however, all patients had a standard radiographic assessment according to a protocol.

It is apparent from the study, that a high rate of success following surgery for lumbar disc herniation has not been achieved in this group of patients followed-up for 7 to 20 years. Less than two-thirds of them were considered as having a satisfactory outcome. Preoperative social and work-related factors, including a strenuous occupational activity and a low educational status, were significantly associated with poor outcome. It is recommended that patients with "justified" indications for surgery,<sup>16</sup> who meet the above negative prognostic factors, should be carefully evaluated and appropriately informed in relation to expected long-term results. In order to determine which patients are likely to be inappropriate candidates for disc surgery, apart from standard preoperative assessment, the use of evaluating questionnaires including social and work-related variables is strongly suggested, as other authors did.<sup>12,13</sup>

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