

Ipsilateral recurrent lumbar disc herniation

A PROSPECTIVE, CONTROLLED STUDY

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We analysed prospectively 26 patients who had revision operations for ipsilateral recurrent radicular pain after a period of pain relief of more than six months following primary discectomy. They were assessed before the initial operation, between the two procedures and at a minimum of two years after reoperation. MRI was performed before primary discectomy and reoperation. Fifty consecutive patients who had a disc excision during the study period but did not have recurrent radicular pain, were analysed as a control group.

Of the study group 42% related the onset of recurrent radicular pain to an isolated injury or a precipitating event, but none of the control group did so ($p < 0.001$). T2-weighted MRI performed before primary discectomy showed that patients in the study group had significantly more severe disc degeneration compared with the control group ($p = 0.02$). Intraoperative findings revealed recurrent disc herniation in 24 patients and bulging of the disc in two, one of whom also had lateral stenosis. Epidural scarring was found to be abundant, intraoperatively and on MRI, in eight and in nine patients, respectively.

At the last follow-up, the clinical outcome was satisfactory in 85% of patients in the study group and in 88% of the control group ($p > 0.05$). Work or daily activities had been resumed at the same level as before the onset of symptoms by 81% of the patients in the study group and 84% of the control group. No correlation was found between the amount of epidural fibrosis, as seen intraoperatively and on MRI, and the

result of surgery. The recurrence of radicular pain caused no significant changes in the psychological profile compared with the assessment before the primary discectomy.

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Recurrent herniation has been reported in 5% to 11% of patients after disc excision.¹⁻⁵ Since the overall rate of unsatisfactory results after discectomy is between 5% and 20%,⁶⁻⁹ it is therefore a major cause of surgical failure.

Several conditions have been termed 'recurrent disc herniation' such as recurrence at the same disc and side as the primary herniation,^{2,4,8-10} contralateral herniation at the same disc^{4,10,11} or new herniation at a different level.^{1,4,8,12} Recurrent herniation (re-herniation) at the same level and side differs from other types, since the annular incision performed at primary discectomy may be a predisposing factor for recurrence. Moreover, the presence of scar tissue may affect the clinical results in the case of reoperation.¹³

There have been many studies on recurrent disc herniation, but they have analysed mixed patient populations including either patients with different causes of failed back surgery^{3,10,14,15} or those with herniation at a new level or side compared with that of the primary discectomy.^{1,2,4,8,10,12} Although it has been reported that a pain-free interval after primary discectomy plays an important role in both the diagnosis of a recurrent herniation^{10,16,17} and the prediction of the result of reoperation^{10,15,17-19} no prospective investigation has been carried out on patients with recurrent herniation after successful disc excision.

Our aim was to assess whether there were any risk factors for recurrent disc herniation and whether the proportion of satisfactory results after reoperation was comparable to that reported after primary discectomy or if, as for patients with failed back surgery, a lower success rate should be predicted.

Patients and Methods

From January 1991 to December 1993, a total of 365 patients had microdiscectomy for herniation of a lumbar

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disc at two orthopaedic hospitals. Inclusion in the study required a period of relief from pain of more than six months after primary discectomy, the presence of recurrent radicular pain unresponsive to non-operative treatment and the appearance on MRI of recurrent herniation at the same disc and side. In patients in whom MRI was inconclusive, imaging studies should have excluded concomitant spinal conditions at other vertebral levels. Patients with a clinical history of previous spinal surgery before primary discectomy and those who had had primary discectomy at other hospitals were excluded. A control group consisted of 50 patients who had had disc excision during the study period and who had experienced no recurrence of leg pain until the most recent follow-up. In patients who were not included in either the study group or the control group, the clinical status was assessed by telephone 24 months to five years after surgery to check on the possibility of recurrent symptoms.

Of the 365 patients who had disc excision during the study period, two died from causes unrelated to the operation at 9 and 22 months after surgery, respectively, and 12 could not be contacted by telephone. Of the remaining 351 patients, 30 complained of recurrent ipsilateral radicular pain. Four of these (one of whom had a small recurrent disc herniation on MRI) were treated successfully without surgery. The remaining 26 patients (7.4%), who met the inclusion criteria, were entered into the study group. Their mean age was 47 years (27 to 67) compared with 44 years (29 to 70) in the control group ($p > 0.05$). There were 18 men (69%) and 8 women (31%) in the study group and 28 men (56%) and 22 women (44%) in the control group ($p = 0.05$) (Table I).

All patients had had MRI before primary discectomy. The degree of degeneration of the herniated disc was assessed on T2-weighted sagittal sequences. Degeneration of the nucleus pulposus was classified according to Horton and Daftari²⁰ in which a point value is given to the signal intensity of the nucleus (white, 0 points; speckled, 1 point; dark, 2 points).²¹ In addition, a score was given for the presence of a high-signal intensity line within a disc with reduced signal intensity (absent, 0 points; present, 1 point); this finding has been related to the presence of fluid within cystic spaces or fissures in markedly degenerated discs.²² Annular degeneration was graded on the basis of the height of the disc (normal or slightly decreased, 0 points; moderately or markedly decreased, 1 point). The overall disc degeneration was then calculated on a scale of 0 to 4 (0, no degeneration; 4, marked degeneration) from the sum of the nuclear and the annular score. We had previously determined that inter- and intraobserver agreement for this classification was 82% and 87%, respectively.

On axial and sagittal MRI sequences, disc herniation was defined as 'contained' if there was a focal extension of the disc beyond the posterior margin of the vertebral body, 'extruded' if disc tissue had migrated through a defect in the outer annular fibres but was connected to the disc, and

'free fragment' if the herniated tissue was no longer connected to the disc. Patients in the study group had pre-operative MRI before and after the administration of gadolinium. Recurrent herniation was diagnosed as the presence of abnormal epidural tissue that did not enhance after contrast injection and epidural fibrosis as abnormal epidural tissue showing enhancement with gadolinium. The extent of scar tissue was noted in the nerve-root canal and in the central spinal canal, and rated as scant, moderate or abundant. Assessments of MRI were performed independently by a neuroradiologist and an orthopaedic surgeon who were blinded to the identity of the images.

Operative technique. In all patients microdiscectomy was carried out through a standard interlaminar approach. A limited laminotomy associated with the excision of the medial one-third of the facet joints was performed. In patients with lateral stenosis (five patients in the study group and eight in the control group), the laminotomy was extended caudally to allow adequate decompression of the nerve root. In 320 patients we performed a complete discectomy through a rectangular incision in the annulus, removing the herniated tissue and the posterolateral annulus. A subgroup of 40 patients had partial discectomy with a smaller annular incision and removal of only the herniated tissue. No patient had a radical excision of the disc involving curettage of the disc space. Care was taken to preserve the epidural fat around the nerve root, but in no patient was the exposed dura covered with autogenous fat graft. A surgical drain was used in the presence of moderate or abundant epidural bleeding.

Walking was allowed on the day of surgery or the day after if operation was performed late in the afternoon. The mean time in hospital was 1.5 days (1 to 3). The post-operative course included a progressive resumption of daily activities from the seventh day. Stretching exercises were encouraged after the tenth day and lasted a minimum of 30 days. Sedentary workers were allowed to return to work between 15 and 25 days after operation while manual or heavy workers returned after 1.5 to 2 months. Sport was allowed after four to six months.

All the operations were performed by one of the two senior authors (FP, SME) and the type of annular incision, the amount of disc tissue excised and the type and site of the herniated disc were noted as was the presence of lateral stenosis. The amount of scar tissue and the mobility of the involved nerve root were recorded by the two surgeons and the results were compared with the neuroradiological evaluation.

The clinical outcome was assessed by means of a self-reported questionnaire evaluating patient satisfaction, severity of pain, need for analgesics and psychological status. Visual analogue scales were used to determine the severity of radicular and back pain (0, no pain; 10, unbearable pain) and patient satisfaction (0, completely dissatisfied; 10, very satisfied). The functional outcome was determined by the ability to resume work and/or to perform

Table I. Details of the 26 patients with recurrent herniation

Case	Age (yr)	Gender	Length of symptoms before 1st surg	Radicular pain score*	Surgical findings 1st surg	Pain-free interval (mth)	Onset of recurrent symptoms	Radicular pain score†	Surgical findings 2nd surg	Scar tissue‡	Clinical result
1	67	M	6 mth	8	Free fragment	14	Sudden while lifting	7	Free fragment	+++	Good
2	65	F	4 mth	8	Contained	12	Gradual	8	Contained narrowed nerve-root canal	+	Good
3	40	F	5 mth	7	Free fragment	24	Gradual	7	Contained	+	Good
4	33	M	2 mth	9	Contained	10	Sudden while lifting	7	Contained	+++	Good
5	46	M	6 mth	8	Extruded	31	Gradual	8	Disc bulging Lateral stenosis	++	Good
6	37	M	3 mth	8	Contained	6	Sudden while canoeing	9	Extruded	++	Fair
7	39	M	6 mth	7	Free fragment	28	Gradual	7	Contained	++	Excellent
8	65	M	2 wk	9	Free fragment	6	Sudden while lifting	6	Extruded	+++	Good
9	62	M	1 mth	9	Contained	24	Gradual	8	Extruded narrowed nerve-root canal	+++	Good
10	41	M	5 mth	8	Extruded	17	Gradual	9	Contained	++	Excellent
11	57	F	3 mth	8	Contained	23	Sudden	8	Extruded	+++	Fair
12	37	M	2 mth	7	Extruded	13	Sudden while manual working	6	Free fragment	++	Good
13	50	M	7 mth	7	Free fragment	15	Sudden while lifting	8	Free fragment	++	Good
14	60	F	8 mth	6	Contained	30	Sudden twisting while bending	7	Contained narrowed nerve-root canal	+++	Good
15	41	M	5 wk	9	Extruded	9	Sudden while playing golf	8	Extruded	+++	Excellent
16	42	M	5 mth	7	Contained	18	Gradual	7	Disc bulging	++	Poor
17	27	M	3 mth	8	Contained	14	Gradual	8	Contained	+	Good
18	39	F	6 mth	9	Extruded	12	Sudden while aerobic exercises	7	Extruded	+	Fair
19	48	M	4 mth	7	Free fragment	16	Sudden while doing housework	7	Extruded	++	Excellent
20	34	F	1 mth	9	Contained	26	Gradual	8	Extruded	+++	Good
21	58	F	2 mth	8	Extruded	11	Gradual	7	Extruded narrowed nerve-root canal	++	Good
22	28	M	6 mth	7	Contained	15	Gradual	7	Contained	++	Good
23	39	F	5 mth	8	Extruded	9	Sudden	7	Extruded	+	Good
24	58	M	10 wk	8	Extruded	18	Gradual	8	Free fragment	++	Good
25	44	M	2 mth	7	Free fragment	13	Sudden while lifting	7	Free fragment	++	Excellent
26	55	M	3 mth	8	Contained	14	Gradual	6	Extruded	+++	Good

* before primary discectomy

† after reoperation

‡ on MRI: +, mild; ++, moderate; +++, abundant

Table II. MRI disc degeneration score before primary discectomy. The figures given are the number of patients who had each score of disc degeneration

	Score				
	0	1	2	3	4
Study group (n = 26)	-	2	3	16	5
Study group (n = 24)*	-	1	3	15	5
Control group (n = 50)	-	8	18	21	3

* study group including only the 24 patients with recurrent herniation documented intraoperatively

daily or sporting activities compared with before operation. Psychological status was rated as normal or slightly or markedly distressed from questions related to anxiety, depression and self-control. Physical examination included the measurement of the spinal range of movement, nerve-root tension tests and muscle strength.

A 100-point grading system was used to assess the overall clinical outcome, with 20 points assigned to severity of pain, 30 to functional status, 20 to patient satisfaction and 30 to the result of physical examination. The outcome was rated as excellent (90 to 100), good (70 to 89), fair (50 to 69) or poor (less than 50 points).

Clinical follow-up was carried out at 6, 12 and 24 months after primary discectomy. Patients in the study group were followed up at 6 and 24 months after reoperation.

We used the *t*-test and chi-squared test for statistical analysis. A *p* value of less than 0.05 was considered significant.

Results

Clinical findings. Before primary discectomy, radicular pain had lasted for a mean of 3.6 months in the study group and 3.1 months in the control group ($p > 0.05$). A sudden onset of radicular pain was reported by 11% of patients in the study group and by 14% of the control group, but in no patient in either group was the onset of radicular pain associated with an isolated injury. By contrast, before reoperation, 11 (42%) patients in the study group related the recurrence of leg pain to an isolated injury or a precipitating event ($p < 0.001$), during lifting in five and during sport in three (Table I). There was no significant difference in the results of nerve-root tension tests between the two groups; motor deficits were found in 85% of patients in the study group and 36% of the control group ($p < 0.001$).

We performed complete discectomy in all the patients of

the control group and in 23 of the study group; the remaining three had partial discectomy.

The mean period of relief from pain after primary discectomy was 16 months (6 to 31). Pain severity, on the visual analogue scale, averaged 7.8 points before primary discectomy and 7.3 before reoperation ($p = 0.05$) (Table I). **Imaging studies.** A large recurrent herniation, often larger than the primary protrusion, was found in most patients. There was no significant difference between the site (posterolateral, lateral, central) of disc herniation in the two groups. Disc degeneration was on average more severe in patients in the study group compared with the control group ($p = 0.02$) (Table II).

Patients had MRI from 7 to 33 months after primary discectomy and at a mean of 4.4 weeks after the onset of recurrent leg pain (1.5 to 7). Recurrent disc herniation was diagnosed in 21 patients on precontrast studies and in 23 patients after contrast injection, while inconclusive results were obtained in five patients on precontrast sequences and in three on postcontrast studies (Fig. 1; Table III). Overall, the sensitivity, specificity and accuracy of MRI was 83%, 50% and 95%, respectively, on precontrast studies, and 92%, 50% and 96%, respectively, on postcontrast sequences.

Epidural scarring was assessed as scant in five patients (19%), moderate in 12 (46%) and abundant in nine (35%).

Findings at reoperation. Twelve (46%) patients had a similar pattern of disc herniation at primary discectomy and at reoperation (Fig. 2). In all but two a disc fragment compressing the emerging nerve root was found at surgery. The remaining two had a bulging disc associated in one with a lateral stenosis. The latter had had nerve-root decompression at primary discectomy but this may not have been extended to the most caudal part of the root canal. Of the 24 patients with recurrent herniation, four had a narrowed radicular canal; in two, who had abundant epidural fibrosis, laminotomy was extended caudally to prevent a possible compression of the nerve root by scar tissue.

Abundant epidural scarring was noted in eight patients, but in none did scar tissue appear to be a cause of nerve-root compression, and no attempts were made to remove it once the herniation had been excised. Decreased mobility of the nerve root at the end of disc excision was observed in 16 patients (61%); in 11, however, decreased mobility of the nerve root had also been noted at the primary operation. In the control group, decreased mobility of the nerve root was found in 22 patients (44%) ($p > 0.05$).

A small dural tear, which did not require suture, occurred

Table III. Diagnostic accuracy of MRI

Recurrent disc herniation	Precontrast					Postcontrast				
	Number of patients	True-pos	False-pos	True-neg	False-neg	Number of patients	True-pos	False-pos	True-neg	False-neg
Yes	21	20	1			23	22	1		
No	5			1	4	3			1	2



Fig. 1a



Fig. 1b

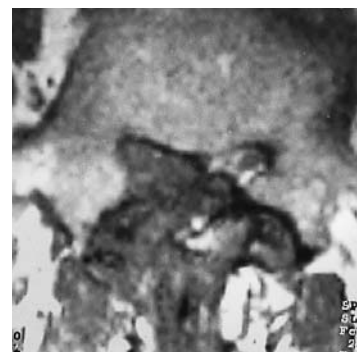


Fig. 1c

MRI before (top) and after (bottom) administration of gadolinium in patients with recurrent herniation in whom a clear diagnosis of recurrence was established on a) both pre- and postcontrast sequences, b) only in postcontrast sequences and c) in neither. The last, however, showed epidural tissue adjacent to the thecal sac which was not enhanced after the injection of contrast (arrow), possibly suggesting recurrent herniation.

in two patients. In both bed rest was prolonged until the second day after surgery and they were discharged on the fourth postoperative day.

Surgical outcome. Six months after primary discectomy, 81% of patients in the study group had an excellent or good result compared with 86% of those in the control group ($p > 0.05$). At the most recent follow-up, two years after reoperation, 85% of the patients in the study group and 88% of the control group reported a satisfactory outcome ($p > 0.05$). Of the four patients in the study group who had

only fair results at the last follow-up, one had a second recurrent herniation at the same disc and side. He underwent reoperation and the surgical outcome was rated as 'good' at the three-month follow-up (after the third discectomy). One patient had postoperative discitis which required treatment with antibiotics for two months. At the most recent follow-up, there was no clinical evidence of spinal infection but the patient still complained of moderate back pain. The remaining two patients, one of whom had a bulging disc at reoperation, reported mild improvement of radicular pain. No correlation was found between the amount of scar tissue, as seen at surgery and on imaging studies, and the clinical outcome. Two patients had mild modifications of psychological status at the time of the primary discectomy, which did not require treatment; in both this was found to be unchanged after reoperation. No patients had work-related compensation claims or pending litigation.

At the last follow-up after reoperation, 17 patients had returned to full employment, one had resumed the same job but at a lower level, and one was unable to work because of persistent radicular pain. Of the seven unemployed, four returned to their daily activities at the same level as before primary discectomy and three at a lower level. Of the latter, two had resumed their daily activities at the same level as before the recurrence of symptoms and one at a lower level (Fig. 3).

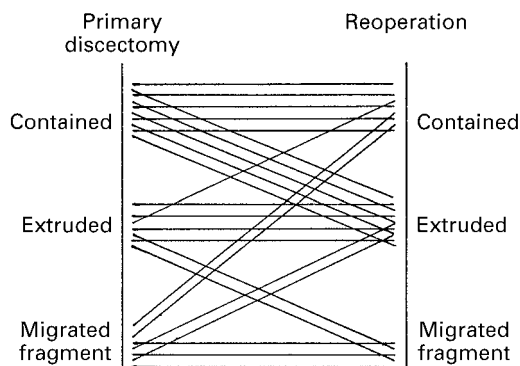


Fig. 2

Relationship between the type of disc herniation found at primary discectomy and at reoperation.

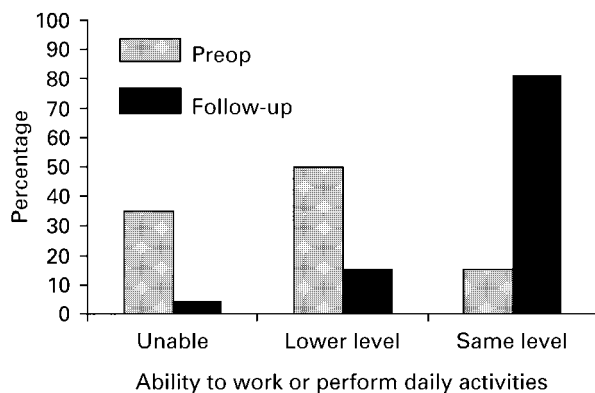


Fig. 3a

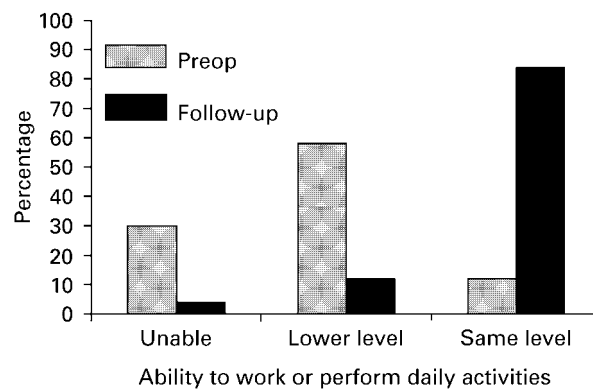


Fig. 3b

Bar graphs showing the ability to work in a) the study group before and after the excision of recurrent herniation and b) in the control group before and after primary discectomy.

Discussion

Of our patients who had microdiscectomy, 26 had reoperation for recurrent radicular symptoms and 24 of these (6.8%) had recurrent herniation. This percentage may possibly increase after a longer follow-up, although it has been reported that the estimated rate of reoperation for recurrent herniation decreases to 0.6% per year between the second and fifth years and to about 0.1% during the following ten years.¹⁰

Predisposing factors associated with an increased risk of primary disc herniation are a constitutional weakness of the annular tissue,²³ exposure to repetitive lifting, vibrations and smoking.²⁴⁻²⁶ Isolated trauma or injury does not seem to play a prominent role in the aetiology of disc herniation since this has been reported by only 0.2% to 10.7% of adults with documented herniation.^{25,27} Conversely, we found that 42% of patients with recurrent herniation related the onset of radicular pain to an isolated injury or a precipitating event; this is higher than previously reported (15% to 32%)^{8,12} and suggests that the annular incision performed at surgery makes the operated disc more susceptible to sudden prolapse particularly under conditions of mechanical overload such as during sport or lifting. This may also explain the higher incidence of recurrent herniation in men.^{10,11}

Several authors have suggested that recurrent disc herniation is more likely to occur in the discs of young patients with little or no degenerative changes,^{3,28,29} but in none of these studies was the severity of the disc degeneration assessed before primary discectomy. By contrast, we have found that disc degeneration as seen on preoperative MRI was on average more severe in patients who developed a recurrent herniation compared with the control group. Furthermore, the significantly higher rate of motor deficit found in the study group suggests that larger space-occupying lesions were present in these patients and such large fragments were probably extruded from markedly degenerated discs. The healing processes which occur in the outer lamellae after annular injury^{30,31} may lead to a less effective

reconstitution of the external annulus in markedly degenerated discs, so that a recurrent herniation may be more likely to occur.

It has been reported that partial discectomy may increase the risk of recurrent herniation compared with complete discectomy.^{32,33} We found no difference in the rate of recurrence associated with partial or complete discectomy, but only a subgroup of our patients had partial discectomy and therefore we cannot draw any conclusions from our study.

Previous studies have shown that imaging of the operated spine must be interpreted with extreme caution.³⁴⁻³⁷ After a successful discectomy, a persistent epidural mass has been found in 7% to 44% and in 37% to 60% of patients having CT and MRI, respectively.³⁴⁻³⁷ The accuracy of imaging studies in distinguishing whether the mass is disc or scar tissue is of some concern, because the results of reoperation for excision of scar tissue are generally poor.^{2,8,17} In our study, all patients had MRI no sooner than six months after operation, that is after the time interval during which MRI may be difficult to interpret.^{34,38} We found the diagnostic accuracy of imaging studies to be 96%, a rate similar to previous reports.³⁹⁻⁴¹

After reoperation for recurrent radicular pain, satisfactory results have been reported in 50% to 90% of patients.^{1,4,8,10,17} This wide range of variation may be related to the fact that, in previous series, patients with different conditions, including spinal stenosis, epidural fibrosis or new herniation at a different level, were analysed. Previous studies have also included patients who had no pain relief after primary discectomy,^{1,2,4,8,10-12} that is patients in whom the poor result could be related to retained disc fragments, wrong surgical indications, or causes other than a recurrent herniation. In our study we analysed only patients in whom recurrent radicular pain occurred no sooner than six months after a successful discectomy. We found no significant difference between the rate of satisfactory results in patients of the study group and in the control group after primary discectomy and reopera-

tion. The finding that the amount of scar tissue was not related to the surgical outcome would suggest that, once the disc fragment has been removed, the epidural scar is not a cause of residual radicular pain. Two of the three patients in whom MRI showed inconclusive results reported satisfactory results after reoperation. Both patients had surgery because the clinical history and physical examination strongly suggested the presence of recurrent nerve-root compression.

Unrecognised lateral stenosis has been reported to be a major cause of failure after discectomy.^{14,15,42} In our series, four patients had a narrowed nerve-root canal at reoperation, but in only one was lateral stenosis found. Lateral stenosis, however, was found at primary discectomy in five patients in the study group and in eight of the control group and the decompression of the nerve root was extended to the caudal part of the nerve root canal.

A poor psychological profile was found to be associated with an increased risk of failure in reoperated patients.^{6,9,43} Changes in the psychological status may be present at the time of primary discectomy or may occur after the operation for causes which may or may not be related to the surgical outcome. In our study only two patients had minor changes of psychological profile before primary discectomy and in none was this found to be changed once the recurrent herniation had been diagnosed. It seems, therefore, that in patients with a satisfactory result after primary discectomy, a repeat discectomy for recurrent herniation is not a factor which affects the mental status provided that there is a normal psychological profile before surgery.

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