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Microsurgical decompression without laminectomy in lumbar spinal stenosis

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ABSTRACT

Our objectives were to study a/ the clinical results of microsurgical decompression without laminectomy compared to those reported from standard decompression laminectomy in patients with central lumbar spinal stenosis, and b/ if the microsurgical technique could prevent post-operative instability and concomitant symptoms.

Twenty-one patients were treated, 11 men and 10 women, aged 47–81 years. Fourteen patients had "pure" stenosis whereas 7 had additional diseases that compounded the symptoms of stenosis. Independent examiners saw the patients pre-operatively and a mean of 27 months post-operatively. Plain X-ray films were taken of 14 patients a mean of 5 years post-operatively to study possible slippage.

Among the 14 patients with "pure" stenosis the results were excellent in 13 and fair in 1. Among the 7 with additional diseases the outcome was excellent in 1, fair in 1, unchanged in 3 and worse in 2. The technique did not prevent post-operative slippage, which occurred in 3 of 14 patients. However, the clinical outcome was not related to slippage.

We found the microsurgical technique safe and gentle with excellent possibilities for decompression of the complete spinal canal without laminectomy. The results following this procedure were well comparable to or even better than those reported following standard decompression laminectomy.

INTRODUCTION

Although some investigators have observed that several patients with lumbar spinal stenosis manage well with conservative treatment (9, 12, 20, 23) surgery is generally considered the treatment of choice for these patients and results are mostly good (23). In a recent randomized prospective study, Amundsen et al. (1) found that the results for patients treated surgically were considerably better than for those treated conservatively. Atlas et al. (3) found similar results in a prospective non-randomized study. In order to increase space around vascular and nervous structures in the spinal canal, wide laminectomies, complete or partial facetectomies and removal of osteophytes, disc protrusion and even discs have been found useful. The rate of complications has been modest, the results varying (16) but mostly good (1, 7, 10, 23). However, following this type of surgery, post-operative spondylolisthesis has been reported to be rather frequent (8, 11, 13). Therefore, a more gentle surgical procedure

retaining more of the weight-bearing tissues was called for. Some such techniques in which laminotomies are performed instead of laminectomies, have shown promising results (2). Although applied mostly in cases of lateral recess stenosis (4, 5), laminotomy has recently been used to treat central stenosis as well (22, 25).

At Strängnäs Clinic of Spinal Surgery a technique has been developed favouring these principles. The questions that arose were 1/ how did the clinical results following this intervention compare with those reported from standard decompression laminectomy, and 2/ did this microsurgical procedure prevent post-operative instability and concomitant symptoms? The present prospective study was undertaken to evaluate these issues.

MATERIAL AND METHODS

Twenty one consecutive patients, median age 68 years (range 47–81) were recruited to the study and underwent surgery between October 1990 and August 1994. There were 11 men, median age 65 years (47–81) and 10 women, median age 73 years (53–80). Seven patients were at work, 13 were retired (receiving old age pension) and one was sick-listed.

Of these 21 patients vertebral claudication was reported by 19 with a median walking distance of 80 metres. The remaining two patients reported only increasing numbness of the legs upon walking. Eleven patients reported weakness, eleven altered sensation, four paraesthesia, and two pollakiuria, and 16 had lumbar pain of 72 months´ median duration (Table 1). The symptoms were bilateral in 18 patients and unilateral in 3. On examination slight neurological deficits were found in 18 patients (Table 1).

The radiological investigations comprised myelography with computer tomography (CT) in 12 patients, myelography, CT, and magnetic resonance imaging (MRI) in 1 patient, CT alone in 1 patient, CT and MRI in 1 patient, myelography and MRI in 1 patient and MRI alone in 5 patients. Spinal stenosis was found at one level in 5 patients, at two levels in 7 patients, at three levels in 6 patients and at four levels in 3 patients. Six patients had a degenerative spondylolisthesis (range 2–10 mm) and 1 patient had a herniated disc at one of two stenotic levels. Stenosis was found both centrally and laterally to varying degrees.

Seven of the 21 patients had additional concomitant diseases with symptoms that probably compounded with the symptoms of spinal stenosis, making it difficult to settle the background of their suffering. This doubt was discussed with the patients and anticipation and uncertainty of the surgical result were discussed in relation to this. All these 7 patients had radiologically demonstrated narrowing of the spinal canal. One patient showed only progressive weakness and numbness of the legs without pain upon walking, 2 patients had previously suffered a cerebral infarction (followed by pain and altered sensation), 2 patients had polyneuropathy, 2 coxarthrosis and 1 patient had an additional herniated disc at one of two stenotic levels.

Surgical procedure

Fifteen of the 21 patients in this series were operated on by one surgeon (BN) the remaining 6 by three other surgeons. The surgical procedure and technique should be identical for all patients.

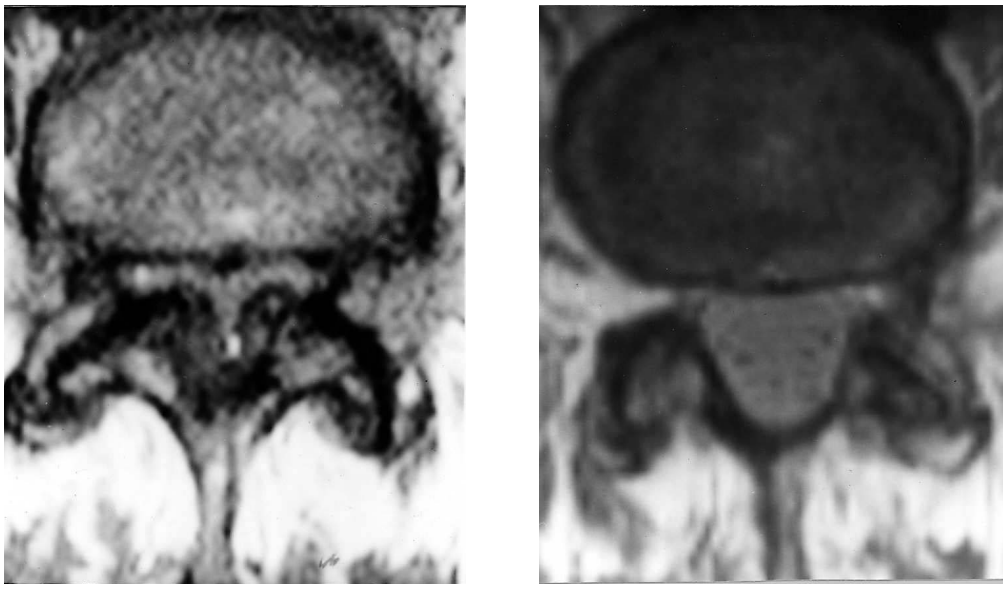
After a midline skin incision centered over the pertinent level(s) the muscle insertions on the spinal processes were detached bilaterally and the laminae exposed. The surgical microscope was introduced. The interspinous ligament and about 2 mm of the adjacent bone of the respective spinous processes were removed, thus creating an opening about 10–15 mm high. In general, the facet joints showed advanced osteoarthritis and bulged posteriorly, sometimes with new bone formation in the joint capsule. Synovial extrusions from the facet joints were frequent. The excess of bone at the posterior aspect of the facets was exstirpated, using either the rongeur or the drill. Using a small chisel an opening was created into the spinal canal, by chiselling in small steps from the lower border of the upper lamina, from the medial aspects of the facets and from the upper border of the lower lamina. The ligamentum flavum, often bulging in a convex manner into the canal, was exstirpated successively. When the medial part of the inferior articular process had been chiselled away, the medial protrusion of the superior articular process of the lower vertebra into the canal was often striking. Furthermore, the superior tip of this process often extended far cranially and ventrally, sometimes reaching the anterior wall of the canal. By successive chiselling in small steps in a medio-lateral direction the hypertrophic part of the superior articular process was also exstirpated. The chiselling was continued until a level as far lateral as the medial aspect of the pedicle was reached. This could easily be seen in the microscope. The most lateral chiselling was generally performed with specially designed angulated chisels. Similarly, using the same type of angulated chisels, the upper lamina was undercut. In this manner the dorsal opening into the canal was smaller than the decompression inside the canal forming a pyramid-like decompression. Fig. 1 shows an example of the decompression with retained lamina.

If stenosis was present at more than one level the same procedure was undertaken at each level, sparing the laminae between. The discs were inspected but never opened except in one case where a disc herniation was present at one of two stenotic levels.

Of the 6 patients with degenerative spondylolisthesis, 3 were fused by inserting a bone block into the opening between the laminae followed by wiring. One further patient with stenosis at one level without olisthesis but having symptoms suggesting segmental pain was also fused. This fusion was done in the same manner but postero-lateral transplantation of bone was also added. The patients stayed in the hospital for a mean of 8 days when fusion was not done and for 11 days after fusion. They then gradually resumed normal daily activities without any particular restrictions. The non-fused patients were allowed to sit and were not to wear a corset. All returned to normal activities within 3–4 weeks. The 4 fused patients were not allowed to sit for 3 months and they were to wear a corset for the same period. Physiotherapy was given to some patients with minor muscular problems after 4–6 weeks. All patients were seen by the surgeon after 3 months.

Independent clinical examination

All patients were seen pre-operatively by an independent physician (HW) who also saw 15 of the 21 patients more than two years post-operatively. Unfortunately HW died before the study was completed and the remaining 6 patients were therefore re-



A B

Fig 1. A. Marked spinal stenosis at the L4–L5 level as seen on MRI. B. The same level post-operatively with intact lamina and facet joints.

examined by another physician (TA). The parameters recorded were pain (VAS), level of functioning (according to Roland's questionnaire, 19) and physical findings from the clinical evaluation. Special forms were filled in to secure the necessary information pre- and post-operatively. The final evaluation of treatment result was based on these forms, combining the impressions of examiner and patient. The result was stated as excellent (free of symptoms or only slight symptoms), fair (some symptoms but definitely less than pre-operatively), unchanged or worse. All but three of the patients were seen and physically re-examined post-operatively by the examiner. The remaining three lived abroad, and were interviewed by telephone. The median observation time was 27 months (24–51).

Radiological evaluation

The degree of slippage in cases of degenerative spondylolisthesis was measured on plain X-rays in lateral view. Late post-operative investigation could be performed only in 14 patients at a mean of 5 years post-operatively. At follow-up, images were taken in normal position but also in flexion and extension provocation. Slippage of more than 2 mm in any of these situations was noted.

RESULTS

Stenosis was treated at a single level in 5 patients, at 2 levels in 7 patients, at 3 levels in 6 patients and at 4 levels in 3 patients. Level L2/L3 was treated in 7 patients, level L3/L4 in 16, level L4/L5 in all 21 patients and L5/S1 in 5. Median (and mean) oper-

Table 1. Symptoms and signs in 21 patients before and after (median 27 months) microsurgical decompression for lumbar spinal stenosis. Seven of the patients had additional concomitant diseases that could interfere with the symptoms of stenosis (see text).

	14 "pure" stenosis		7 concomitant	
Symptoms/Signs	Pre-op	Post-op	Pre-op	Post-op
Lumbar pain	13	4	3	4
Sciatic pain	14	1	6	5
Claudication	13	0	6	5
Weakness	7	2	4	4
Sensory disturbance	7	0	4	5
Paraesthesia	4	0	0	0
Objective findings (signs)	13	3	5	5

ation time was 170 minutes (range 60–240). Median blood loss during surgery was 315 ml (range 100–1000 ml), mean 400 ml. There were no serious complications during the operations, no dural tears and no neural damage. Post-operatively 3 patients temporarily had cardiac arrhytmias, 1 urosepsis and 1 wound infection, all successfully treated.

At follow-up 8 patients were completely free of symptoms. Twelve were free of pain, 3 further had only minor back pain, but no leg pain, one had pain in one leg and 5 had both back and leg(s) pain. Weakness was reported by 6 patients, sensory disturbance by 5, pollakiuria by 1 and vertebral claudication by 5. At clinical examination slight neurological deficits were found in 8 patients in comparison with 18 pre-operatively (Table 1). At follow-up 7 patients were fully employed and 14 were retired (old-age pension).

When the results for the 14 patients with "pure" stenosis were compared to those for the 7 patients with additional concomitant diseases (possibly interfering with the symptoms of stenosis) it was found that 13 of the 14 "pure" stenosis patients had an excellent result, and one a fair result. The patients that were unchanged or worse post-operatively all belonged to the group of patients with additional concomitant diseases (Table 2). There was no significant difference in result between the sexes.

Table 2. Outcome in 21 patients treated surgically for central lumbar spinal stenosis, median follow-up time 27 months. Fourteen patients had "pure" stenosis symptoms and 7 had additional concomitant diseases that interfered with the symptoms of stenosis.

Results	14 patients, "pure" stenosis	7 patients, concomitant dis.
Excellent	13	1
Fair	1	1
Unchanged	0	3
Worse	0	2

In the group of 4 patients that underwent an additional fusion during the operation 3 showed an excellent result. The patient without a slip but presumed to have segmental pain and for that reason fused, was among these. One was unchanged, belonging to the group of 7 patients with concomitant diseases.

Among the 14 patients that could be investigated radiologically after a mean of 5 years, 3 showed post-operative slippage. The mean slip was 6 mm, (range 3–10). The 6 patients that had degenerative spondylolisthesis pre-operatively were all investigated post-operatively and the slip had increased in one, this patient belonging to the three that had an interlaminar fusion. None of the three without fusion, but with pre-operative slip showed increased olisthesis. The clinical outcome of these 6 patients (with pre-operative slip) was excellent in 5 and unchanged in 1, the patient just mentioned (with an increased slip despite fusion) belonged to the group of 7 patients with additional concomitant diseases, and suffered from coxarthrosis.

Eight of the 14 patients studied radiologically post-operatively had no slip pre-operatively but 2 showed slip at re-examination. The clinical outcome of both these patients was excellent. Thus, among the 3 patients with post-operative slippage the clinical result was excellent in 2 and unchanged in 1.

DISCUSSION

The number of patients in the present study was small as this was intended to be an initial evaluation of a new surgical technique. The investigation was prospective and employed independent examiners. Among the 74 studies listed in the meta-analysis by Turner et al. (23) only 3 were prospective and carried out by independent examiners.

When conservative measures have failed, the traditional treatment for symptomatic lumbar spinal stenosis is decompression by wide laminectomies, partial and even complete facetectomies, removal of osteophytes, disc protrusion and even discs. Complications are few and the results are usually good with 60–80 % success rates (3, 7, 10, 16, 23), although this is reported to deteriorate with time, resulting in a fairly high percentage of reoperations (15). The extensive decompression and especially the complete removal of facets might cause instability and induce further or even new symptoms. Johnsson et al. (11) reported 59 % excellent or good results and 41 % unchanged or worse. They stated that "a general tendency towards more radical decompression was seen in the poor group", the radicality being studied by post-operative CT. In cases of severe symptoms of lumbar spinal stenosis they therefore suggested decompression to be combined with stabilization as advocated also by Herkowitz and Kurz (8).

Conventional laminectomy, especially if extended to more than one level and combined with fusion and internal fixation, must be regarded as a major procedure in a person at the age of around 75 years. The unavoidable increase in blood loss during the operation should also be considered. Another possible way to solve the problem would be to perform the necessary surgical decompression in such a way that post-operative slippage would be less likely to develop and the addition of a stabilization procedure unnecessary.

The idea of microsurgical decompression, mostly for lateral recess stenosis, is not new (2, 18, 26). Caspar et al. (4, 5) described a gentle microsurgical technique, also mostly for lateral recess stenosis (54 out of a total of 58 patients). An excellent or good result was reported by 67 % of the patients, 71 % according to the surgeons. They clearly stated that the microsurgical procedure made it possible to decompress the nervous structures throughout their course within the spinal canal. They argued against previous statements that microsurgical technique would infer limited exposure as well as increased morbidity and surgery time. We strongly agree. By microsurgical technique the decompression can be performed safely and with gentle handling of the nervous structures. Bleeding is scanty, in our study a mean of 400 ml for decompression of mean 2.3 levels per patient. Mean operation time for these 2.3 levels was 170 minutes, or about one hour per level. In this context, we would like to stress that adequate decompression and gentle handling of the nervous structures are the key points of the procedure, not the time necessary.

Our procedure differs from that of Caspar et al. (4, 5) and that of Aryanpur and Ducker (2). They performed laminotomies, mostly for lateral recess stenosis, and retained the interspinous ligament and also the medial portion of the ligamentum flavum. Caspar et al. (4) found no radiological signs of instability post-operatively but did not define at what time this was examined post-operatively. We found slippage in 3 out of 14 patients 5 years post-operatively, two of whom were without slippage pre-operatively and one who had degenerative olisthesis pre-operatively. The post-operative slippage was not, however, associated with a poor clinical outcome for the patients, being excellent in two and unchanged in one, the latter belonging to the group of 7 patients with concomitant diseases.

We conclude that the surgical technique we have used does not prevent pre-operative slippage from increasing (one out of 6 patients), or post-operative slippage from occurring in patients without pre-operative olisthesis (2 out of 8 patients), but this slippage was not associated with clinical symptoms. This is in agreement with the results of Jönsson (14), who also used a facet-sparing technique, but in contrast to the findings of Johnson et al. (11) who after extensive laminectomies and facetectomies found post-operative slippage twice as common among patients with a poor outcome compared to those with a good outcome. Furthermore, in their study 43 % of the patients showed post-operative slippage compared to 21 % in our material. Recently Kleeman et al. (17) using a surgical technique with preservation of the interspinous ligament and the joint capsules, showed very good clinical results and post-operative slippage in only 13 % of the patients, these latter, however, with a poor clinical outcome.

Significantly better results after laminectomy and fusion than after decompression alone in patients with stenosis and pre-operative spondylolisthesis, were reported by Herkowitz et al. (8) and in the meta-analysis by Mardjetko et al. (19). On the other hand Epstein (6) recently stated that decompression alone successfully treated patients with stenosis and degenerative spondylolisthesis since only 2.7 % required secondary fusion surgery.

One may ask whether further sparing of the posterior elements, not only the laminae and the functionally important parts of the facets but also the interspinous ligament,

would be beneficial. Kleeman et al. (17) used such a technique and their overall results at 2.5 years post-operatively, according to modified meta-analysis criteria, were good to excellent in 84 % of the patients. In a study by Weiner et al. (25) using microsurgical technique with preservation of the supra-/interspinous ligament complex and the contralateral musculature 43 % of the patients were very satisfied and another 43 % fairly satisfied. In another study by the same group (24), bilateral muscle retraction was used together with osteotomies of the spinal processes followed by laminotomies and "trumpeted" decompression without use of the microscope. This resulted in functional outcome improvement by 47 % and pain reduction by 66 %. Sixtysix percent of the patients were very satisfied with the result and another 10 % satisfied.

In our material 13 out of 14 patients (93 %) with pure stenosis symptoms had an excellent result clinically (Table 2) and when analysing quality of life (22). So far, therefore, we have no data suggesting that removal of the interspinous ligament should be of negative importance although the aim should be to preserve most of the normal anatomy. The question must also be raised as to whether our preservation of the laminae is of positive importance. Probably most surgeons agree that preservation of the facets is beneficial. We think that preservation of the laminae and the spinous processes is beneficial since it allows the muscles to insert and take part in the stabilization. Our clinical results, with an excellent or good outcome in 93 % of the "pure" stenosis patients speak for this. Our results in the group of patients with spinal stenosis together with concomitant diseases call for an even more careful scrutiny of patient parameters before the decision to suggest surgery is made. Katz et al. (16) and Jönsson et al. (15) also found co-morbidity to be a risk factor for a poor outcome.

CONCLUSIONS

We have found the microsurgical technique described here to be safe and gentle with excellent possibilities for decompression of the complete spinal canal, not only the lateral recess. We had no neurological complications and just a few mild cardiac complications post-operatively. The technique is not time consuming and blood loss is scanty, reducing or almost eliminating the need for transfusion. The results following this procedure were found to be comparable to or even better than those reported following standard decompression laminectomy.

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