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DEGENERATIVE LUMBAR SPINAL STENOSIS

Results of Operative Treatment

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The results of decompressive laminectomy in 22 patients with degenerative lumbar spinal stenosis are reported. The average follow-up period was 29 months. Twelve of the 15 patients with marked stenosis (a minimum anteroposterior (a.p.) diameter of the spinal canal in extension of 10 mm or less) and all 7 patients with moderate stenosis (a minimum a.p. diameter between 11–14 mm) obtained relief from leg pain. A pseudovascular syndrome was observed in 12 of the 15 patients with marked and in 2 of the 7 patients with moderate spinal stenosis. Of these patients, 10 obtained increased (7 patients unlimited) walking distance postoperatively.
Vertebral fusion was not performed in any of the patients. Slight vertebral slip (2–5 mm) occurred postoperatively in 4 out of 20 patients whose follow-up examination included dynamic roentgenogram of the spine.
Five of the 15 patients with marked spinal stenosis also suffered from severe osteoarthritis of the hip. Total hip replacement subsequent to laminectomy was performed in 4 patients and excellent results were achieved for both the spinal and the hip operations.

Key words: lumbar spine; measurements; stenosis; surgery

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Most authors, writing on the subject of lumbar spinal stenosis, have stated clearly that the main cause of patient symptoms is impairment of the spinal nerve roots due to the narrow spinal canal (Ehni 1969, Epstein et al. 1962, Kirkaldy-Willys et al. 1974, Wilson 1969). In spite of this, early reports contained sparse numerical data about the size of the narrow spinal canal.

An extensive, computer based, review of the literature revealed only three reports where the size of the stenotic canal was related to the results of decompressive surgery (Paine 1976, Sortland et al. 1977, Verbiest 1977). Unfortunately, the cited authors all used quite different methods of measurement to establish the size of the stenotic canal.

Thus, it is virtually impossible to assess if the patients in the three series cited above suffered from the same type of stenosis. Furthermore, reoperated patients were mixed with patients not previously operated on in these series and one cannot exclude that this factor (previous operation/reoperation) also influenced the severity of the stenosis and the results. There is obviously a need to define a nomenclature for spinal stenosis based on measurement criteria and the character of the changes in the spinal canal (Grabias 1980).

This retrospective study was undertaken to assess the results of surgical treatment in patients with different degrees of stenosis of the lumbar spinal canal. Only patients with stenosis caused by degenerative spondylarthritis were selected for this study.

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PATIENTS AND METHODS

Throughout this paper, the definitions of lumbar spinal stenosis given by Arnoldi et al. (1976) are used. All measurements of the size of the lumbar spinal canal were made on myelograms performed with the patient in the upright position with hyperextended lumbar spine. With the view to obtaining a clearly defined patient group, all patients with previous lumbar spine surgery (mostly disc surgery) and all patients with spondylolytic (isthmic) spondylolisthesis were excluded.

With respect to the size of the spinal canal, all patients in this report were classified into two groups: marked and moderate spinal stenosis. For the group with marked stenosis the midsagittal (a.p.) diameter of the lumbar spinal canal at the most constricted level did not exceed 10 mm. For patients included in the group of moderate stenosis this diameter ranged between 11–14 mm. All patients in both groups had intact circulation in the lower extremities.

Evaluation of all preoperative myelograms and selection of the patients relevant for this study were done independently by the radiologist. The surgeon was completely excluded both from selection of the patients and from evaluation of postoperative results.

During the period 1974–1979, a total of 33 patients presented with the diagnosis of lumbar spinal stenosis and were operated on. Of these, 16 patients fulfilled our criteria for marked and 7 patients for moderate degenerative spinal stenosis and were thus selected for further study.

Twenty patients attended the follow-up, two patients only answered a detailed questionnaire and one patient died during the follow-up period of causes unrelated to the spinal disease.

The average follow-up period for both groups together was 29 months (range 14–70 months). The follow-up included examination of the circulation in the lower extremities, dynamic roentgenogram of the lumbar spine and a neurological examination. The circulation in the lower extremities was assessed by measurements of the distal arterial pressure using ultrasound.

In both patient groups taken together there were 13 men and 9 women, and the mean age of the patients was 64 years (range 47–76 years).

There were three basic patterns of presenting symptoms in our patients: 1) Those complaining of typical unilateral sciatica (2 patients, both in the moderate stenosis group). 2) Those complaining of numbness or paraesthesiae in one leg, starting in the thigh and spreading to the calf or foot. These symptoms were provoked or aggravated by walking or standing upright (3 patients in the marked and 3 in the moderate stenosis group). 3) Those with the pathognomonic picture of intermittent claudication in both legs as described by Blau & Logue (1961) (12 patients in the marked and 2 in the moderate group).

The time from the onset of backache to operation could not always be calculated exactly. But all the patients stated clearly that they suffered from backache, sometimes of only minor intensity, and that this backache always preceded the leg pain symptoms.

The time from the onset of leg pain to operation was more easily remembered: In 6 patients this interval was less than 1 year, in 8 it was between 1 and 2 years and in 8 it was longer than 2 years.

The presenting symptoms in both groups of stenosis were related to the time from the onset of leg pain to operation in Table 1. It can be seen that the patients with pseudovascular syndrome in the group of marked stenosis were operated on at a very late stage. The long interval between the onset of symptoms and operation in this patient group does not imply that the pain symptoms were not severe. Close analysis revealed that this delay was simply due to the fact that the diagnosis was arrived at too late. In most cases the doctor was puzzled by the discrepancy between the clinically intact circulation in the lower extremities and the typical claudicating pain.

Preoperative roentgenograms of the lumbar spine revealed degenerative spondylolisthesis in 6 patients, all of them in the group with marked stenosis. Associated osteoarthritis of the hip joint was not observed in these patients, but one of them suffered from severe osteoarthritis in both knees.

Table 1. The presenting symptoms in 22 patients with spinal stenosis related to the size of the spinal canal and to the duration of preoperative symptoms

Presenting symptom	Type of stenosis				Totals
	Marked		Moderate		
	Preoperative symptoms		Preoperative symptoms		
	<2 years	>2 years	<2 years	>2 years	
Typical sciatica	0	0	2	0	2
Numbness and paraesthesiae	3	0	3	0	6
Pseudovascular syndrome	4	8	2	0	14
	7	8	7	0	22

Osteoarthritis of the hip was observed in 4 patients in the group of marked stenosis. In 3 cases it was bilateral and the pattern of protrusio acetabuli was found in 2 cases.

Fourteen patients had neural deficits; in 3 there was involvement of only one and in 11 of two or more nerve roots. One patient had intermittent bladder incontinence.

Myelograms demonstrated stenosis at one disc level in 4, at two levels in 12 and at three or more levels in 6 patients. Stenosis was most frequently demonstrated at the L4–L5 level, followed by the L3–L4 level.

The major indication for surgery was intolerable pain in the performance of activities of daily living and progressively limited walking distance or standing endurance in spite of adequate conservative treatment. None of the patients was able to work at the time of the operation.

The operative technique consisted of a central laminectomy extended laterally to decompress the nerve roots. The extent of laminectomy was determined largely by the myelographic findings. Lateral decompression was achieved by a partial facetectomy in most cases. Only occasionally was the whole articulation facet removed when deemed necessary. The denuded dura was covered by a free fat transplant. In 2 cases a total disc prolapse was removed. Bulging discs, occasionally found at operation were left in place. Vacuum drainage was used regularly in all patients. In none of the patients was a spinal fusion performed either at the same time as the decompression operation or subsequently. The stenosis of the lumbar spinal canal was confirmed at surgery in all cases.

RESULTS

The problem was to assess the effect of surgery on a predominantly subjective condition in ageing subjects with declining functional capabilities. The overall assessment, therefore, had to be based on the subjective assessment of the patient. The following categories were used in assessing the results in the present series:

1) *Excellent:* The patient is symptom-free and has resumed all previous activities. 2) *Good:* The patient has resumed normal activities but may occasionally after heavy work have recurrent leg or back pain. 3) *Fair:* The patient has had to reduce his/her previous activities because of persistence of some pain symptoms. 4) *Poor:* The patient is frankly disabled; pain symptoms have not been reduced at all by surgery.

Measured on this four point scale, 19 out of 22, or 86 per cent, of our patients achieved excellent or good results (Table 2). From Table 2 it can be seen that all patients with fair and poor results had a spinal canal diameter of 10 mm or less. All these patients had had preoperative leg pain for more than 2 years.

Of the 16 patients with stenosis at 1 or 2 disc levels there were 15 with excellent and good results. Out of 6 patients with stenosis at 3 or more levels only 4 had excellent or good results.

Patients were further asked if the immediate postoperative result changed during the follow-up period. Out of 19 patients with substantial pain relief, 10 had unchanged lasting relief from preoperative pain and 6 experienced a slight recurrence of pain symptoms. Out of 3 patients with severe pain at the follow-up, 2 had not at any time experienced relief of pain symptoms during the postoperative period, whereas one patient was initially pain-free for 1 year postoperatively.

Table 2. Results of decompressive laminectomy in 22 patients with spinal stenosis related to the size of the spinal canal and to the duration of preoperative symptoms

Results	Type of stenosis				Totals
	Marked		Moderate		
	Preoperative symptoms		Preoperative symptoms		
	<2 years	>2 years	<2 years	>2 years	
Excellent	2	1	5	0	8
Good	5	4	2	0	11
Fair and poor	0	3	0	0	3
	7	8	7	0	22

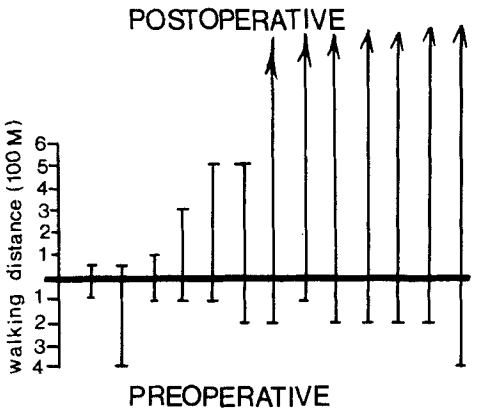

Figure 1. Change in walking distance after surgery in 13 patients. Every staple represents one patient; arrows represent unlimited walking distance.

Table 3. Residual postoperative back pain in 20 patients with spinal stenosis related to the size of the spinal canal and to the presence of postoperative vertebral slip. Numbers in brackets represent patients with vertebral slip*

Residual back pain	Type of stenosis		Totals
	Marked	Moderate	
None	3 (3)	3 (0)	9
Occasional and mild	4 (0)	4 (0)	8
Severe and lasting	2 (1)	0 (0)	3
	9 (4)	7 (0)	20

*2 patients without postoperative roentgenograms were pain-free.

The walking distance for patients with pseudovascular syndrome was assessed according to the patients' own statements both preoperatively and at the follow-up. One patient in the moderate stenosis group became immobilized during the follow-up period because of cervical myelopathy and her postoperative walking distance could not be assessed. Of the remaining 13 patients, the walking distance postoperatively was unlimited in 7 and increased in 3 (Figure 1).

Postoperative dynamic roentgenograms of the spine were performed in all 20 patients attending the follow-up. These revealed that vertebral slip occurred postoperatively in 4 patients: in 2 out of 15 patients without and in 2 out of 5 patients with degenerative spondylolisthesis. The slip never exceeded 5 mm.

Of the 4 patients with postoperative vertebral slip, 3 belonged to the group of 17 patients with only slight backache or none at all and one belonged to the group of 3 patients with severe backache (Table 3). None of the patients in the moderate stenosis group reported severe backache at the follow-up examination.

Five patients (all of them in the marked stenosis group) had osteoarthritis of the hip at the follow-up. The disorder was diagnosed preoperatively in 4 of them, but their stenotic symptoms prevailed and decompressive laminectomy was carried out first. Later, 1/2–3 years following laminectomy, total hip replacement was carried out in all of these 4 patients. In 3 cases only one hip was replaced and in one case the replacement was bilateral. The results in all patients were excellent for both the spinal and hip operations.

In one patient the osteoarthritis of one hip developed during the follow-up time. This patient refused hip surgery.

Closer study of the 3 patients with poor results revealed the following: All suffered from both back and leg pain. Two of them had unchanged symptoms of pseudovascular syndrome, and the third had numbness in the thigh aggravated by walking.

Of these 2 patients with pseudovascular syndrome, one suffered from diabetic neuropathy and the other from a non-specific collagen disease. Both diagnoses were known already before the spinal surgery was carried out. The third patient was the one who developed osteoarthritis of the hip during the follow-up time.

All 3 patients were offered a new myelographic examination but they refused. We cannot therefore exclude that their lasting pain symptoms were caused by insufficient decompression or excessive postoperative scaring.

DISCUSSION

The axiom of spinal surgery states that the more precise the location and understanding of the

origin of the pain, the more predictable are the end-results. The question, therefore, should be asked: How reliable is the definition of degenerative spinal stenosis? Is the stenosis, demonstrated on myelograms, really caused by the thickened laminae and by the abundant osteophytes that have grown around the facet joints?

A controversy still exists over the distinction between developmental and degenerative (spondylotic) stenosis. The precise determination of what constitutes lumbar spinal stenosis relies on measurements taken from roentgenograms of the spine (Dommisse 1975), cadaver dissection studies (Eisenstein 1977) and intraoperative measurements (Verbiest 1977).

The argument emerging from these three research methods, viz., whether there is a primary spondylarthrotic (degenerative) process encroaching on the canal outline, or whether there is always an underlying developmental error of the spine, seems to us of merely semantic importance.

We simply assumed that the stenosis of the lumbar spinal canal, as demonstrated on myelograms in the presence of severe osteoarthritis of the spine, is caused by this degenerative process. This assumption allows us to choose a well-defined patient group for further study.

Myelography remains the standard method for outlining the space in the spinal canal. Functional myelography (Sortland et al. 1977) revealed that the stenosis which can be observed worsens with extension of the spine. Therefore, only myelograms performed during hyperextension of the spine should be used for measurements. We adopted Sortland et al.'s (1977) criteria and nomenclature in defining our groups of marked and moderate spinal stenosis. However, our classification characteristics "marked" and "moderate" label only the size of the spinal canal and not the severity of the patients' symptoms.

It should be pointed out that all measurements reviewed so far concern the midsagittal (a.p.) diameter of the spinal canal and very little has been reported regarding the minimum space allowable for a nerve root within the nerve-root tunnels. Kirkaldy-Willis et al. (1974) have already demonstrated that myelography occasionally fails to reveal the presence of stenosis, particularly when protrusion of enlarged articular processes produces, on cross-section, a cloverleaf configuration of the canal. With the advance of computer tomography, there is growing evidence that the shape of the canal is as important as its sagittal transverse diameter (Lee et al. 1978).

The reasons for excluding all previously operated patients from our series were as follows: The presence of bony canal stenosis in the previously operated lumbar spine has been proven by axial tomography. Quencer et al. (1978) demonstrated bony stenosis in 28 per cent of the patients with previous discectomy. However, the canal narrowing in these cases was due not only to thickened laminae and protruding spondylotic spurs, but also to varying degrees of thickened dura and scar tissue. It is obvious that the encroachment on the space in the spinal canal due to previous surgical interventions is entirely different from the encroachment due to hypertrophic osteophytosis. Furthermore, it is a well known observation that the results of reoperation on the lumbar spine are generally inferior to the results of primary operation.

The relationship between the severity of myelographically demonstrated stenosis and the operative results was studied by Paine (1976) and Verbiest (1977). In Paine's (1976) series the best results were achieved in patients with relatively large (a.p. diameter on myelograms 11–14 mm) spinal canals. Verbiest (1977) found no major differences between patients with severe stenosis (absolute a.p. diameter less than 10 mm) and patients with moderate stenosis (diameter 10–12 mm). In Sortland et al.'s (1977) series, only patients with marked stenosis (a.p. diameter on myelograms of 10 mm or less) were operated on; for moderate stenosis (a.p. diameter 11–14 mm) conservative treatment only was sufficient in all cases.

In our series, patients with more severe and more widespread stenosis tended to have poorer results: 20 per cent of patients with a spinal canal diameter of 10 mm or less had fair and poor results, whereas no such results were found in patients with a spinal canal diameter of 11–14 mm. Patients with stenosis at three or more levels had

33 per cent (2 out of 6) fair and poor results, whereas patients with more localised forms of stenosis had only 7 per cent (1 out of 15) fair and poor results. Our results are at this point in agreement with those of Paine (1976), but the number of patients in our group of moderate stenosis is too small for valid statistical evaluation.

Our results revealed that the tendency for vertebral slip following laminectomy is greater in patients with previous degenerative spondylolisthesis. However, there was no clear evidence that this postoperative slip caused more back symptoms. This is in agreement with the findings of Cauchoix et al. (1976) and Fitzgerald & Newman (1976). We agree with them that spinal fusion is not reasonable in these elderly patients.

The frequency of osteoarthritis of the hip in our cases of marked spinal stenosis (33 per cent) greatly exceeded the frequency of osteoarthritis of the hip in the general population of the same age (0.15 per cent – Danielson 1964). This high incidence of concomitant osteoarthritis of the hip and degenerative lumbar spinal stenosis has not been mentioned previously. We found only one publication concerning this problem: Fitzgerald & Newman (1976) found a high incidence (17 per cent) of osteoarthritis of the hip in patients with degenerative spondylolisthesis of the lumbar spine. But they performed myelography in only 7 of their 43 patients and this showed stenosis in every case.

These authors put forward the hypothesis that the association of these two disorders is an expression of a generalized polyarticular form of degenerative arthritis. In our series, however, the patients with osteoarthritis of the hip joint were not those with degenerative spondylolisthesis. Further study of this phenomenon is therefore required.

The clinical relevance of this observation lies in the fact that patients with unrecognized spinal stenosis and flexion contracture of the hip joint are in danger of developing paraplegia during a hip operation if they are placed in a supine position and fully anaesthetized. Flexion contracture of the hip in this position causes forced hyperextension in the lumbar spine and the increasing pressure from the stenotic canal on the cauda equina roots can produce acute postoperative paraplegia (Walker et al. 1977, Wilkies 1980). Also without associated osteoarthritis of the hip, patients with unrecognized degenerative lumbar spinal stenosis run an increased risk of developing a neurological deficit during anaesthesia if they are lying with a hyperextended lumbar spine (Ehni 1969).

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