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ORIGINAL ARTICLE

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Outcome of transpedicular screw fixation and posterior spinal fusion for degenerative spondylolisthesis

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Abstract *Aims*: (1) To assess the results of decompression instrumentation and posterior spinal fusion for degenerative spondylolisthesis in a district general hospital. (2) To establish whether this procedure can be performed safely outside a specialised unit. *Methods*: Thirty-one consecutive patients were included for this study. All underwent decompression instrumentation, pedicle screw fixation and posterior spinal fusion for degenerative spondylolisthesis in our unit. The average age was 56 (range 34–72) years with a mean follow-up of 3.7 years. Patients were assessed by their operative and post-operative complications, radiographic analysis and postal questionnaires; 25 (81%) patients replied to the questionnaire. *Results*: Two cases each of dural tears, instrumentation failure and superficial wound infection, and one case of deep wound infection were found. There were no cases of neurological deficit, radiculopathy, recurrent stenosis or progression of deformity at the fused level. Radiological fusion rate was 87% and 88% were satisfied with the overall results; two (8%) patients said they would not have the same procedure again. An improvement in score outcome in terms of pain, mobility, sleep, analgesia and quality of life ($P < 0.0001$) was also noted. *Conclusions*: Overall complications were 17%. An improved outcome was noted in terms of radiological fusion and patients' functional and satisfaction outcome in all those who underwent decompression pedicle screw fixation in our unit. We conclude that posterior spinal fusion can be performed safely outside a specialised unit.

Keywords Degenerative spondylolisthesis · Posterior spinal fusion · Pedicle screw fixation

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Résultats de l'ostéosynthèse et de l'arthrodèse postérieure pour spondylolisthésis dégénératif

Résumé *Buts*: (1) Evaluer les résultats de la décompression / ostéosynthèse et arthrodèse postérieure du spondylolisthésis dégénératif dans un service d'hôpital public. (2) Définir si cette méthode peut être réalisée en toute sécurité dans un service non spécialisé. *Méthodes*: 31 patients d'une série consécutive ont été inclus dans cette étude. Tous bénéficièrent d'une décompression avec ostéosynthèse par vissage pédiculaire et d'une arthrodèse postérieure pour spondylolisthésis dégénératif et furent tous opérés dans notre service. L'âge moyen était de 56 ans (extrêmes 34–72) avec un recul moyen de 3,7 années. Les patients furent évalués par leur complications opératoires, post-opératoires, les documents radiographiques et par l'envoi d'un questionnaire par la poste. 25 patients (81%) ont répondu à ce questionnaire. *Résultats*: 2 cas de déchirure durémérienne, de démontage de l'ostéosynthèse et d'infection de plaie superficielle et 1 cas d'infection profonde furent notés. Il n'y eut aucun cas de déficit neurologique, de radiculalgie, de sténose récidivante ou d'aggravation du glissement du niveau opéré. Le taux de fusion radiologiquement visible a été de 87%. 88% des patients sont satisfaits avec le résultat global; 2 patients (8%) nous ont fait savoir qu'ils ne souhaiteraient pas avoir la même opération une nouvelle fois. Une amélioration siginificative du score concernant la douleur, la mobilité, le sommeil, la prise d'analgésiques et la qualité de vie ($P < 0{,}0001$) a été notée. *Conclusion*: Les complications toutes confondues ont été de 17%. Une amélioration du score concernant la qualité de la fusion osseuse radiologique et le résultat fonctionnel ainsi que la satisfaction des patients a été trouvée dans les cas de décompression / ostéosynthèse par vissage pédiculaire / arthrodèse postérieure opérés dans notre service. Nous concluons de cette étude que cette technique peut être réalisée en toute sécurité dans un service non spécialisé en chirurgie du rachis.

Mots clés Spondylolisthésis dégénératif · Arthrodèse postérieure du rachis · Ostéosynthèse par vissage pédiculaire

Introduction

Degenerative spondylolisthesis is forward displacement of one vertebral body on another secondary to intervertebral disc and facet joint degeneration. This usually is associated with chronic low-back pain. Women seem to be more affected than men. The common site affected is L4–L5.

Failure of conservative treatment and progression of disease are indication for surgical intervention. The choice of procedure is still debatable. Studies have shown reasonable outcome with decompression alone [1], but further vertebral slippage is always a possibility [2, 3]. Most advocate spinal arthrodesis to prevent spinal instability and vertebral slippage [1, 2, 4, 5].

Fischgrund et al. [6] conducted a randomised prospective study comparing decompression and fusion with and without the use of instrumentation. A two-year follow-up showed an increase in fusion in the instrumentation group, but there was no advantage in clinical outcome. Fusion options are floating fusion [1], posterior inter-transverse fusion [2] and anterior and posterior instrumentation fusion alone or combined [7, 8, 9, 10].

The aim of our study was to determine the outcome in patients undergoing treatment for degenerative spondylolisthesis with decompression, pedicle screw fixation and posterior spinal fusion. We based our study on findings from clinical review (including operative and post-operative), radiological assessment, patient satisfaction and functional outcome. All these aspects were looked at to establish if this procedure could be performed safely in our unit outside a specialised clinical setting.

Materials and methods

31 patients were identified to have treatment for degenerative spondylolisthesis all of whom had severe neurogenic claudication caused by stenosis at the level of spondylolisthesis. The study period was from December 1989 to February 1999. Three different aspects were analysed: a clinical review, a radiographic assessment and a questionnaire (Figs. 1 and 2) designed to assess patients' functional and overall satisfaction.

There were 11 (35.5%) men and 20 (64.5%) women. Average age was 56 (range 34–72) years. The study group was under the practise of one consultant orthopaedic surgeon. Every patient had a minimum of 1 year follow-up in the clinics. Mean follow-up was 3.7 years. Seventeen patients had up one to three visits; the rest had four or more. Twenty-eight patients had at least three X-rays; the remaining three had more than three X-rays in the follow-up clinics. The most common site of deformity was L4–L5 ($n=16$; 51.5%) followed by L5–S1 ($n=12$; 38.7%). One patient had a lesion at L3–L4, and two at L4–L5–S1.

All 31 patients underwent decompression and pedicle screw fixation over at least one motion segment. Pedicle screws were placed under direct visualisation after a wide laminectomy. The position of the screw was confirmed with either an intra-operative or an immediate post-operative check X-ray. Lateral recess decompression and foraminotomy was performed as indicated. Autogenous iliac crest bone grafting was performed in all patients. Intra-operative antibiotics (cefuroxime) were administrated to all patients. Patients began ambulating on postoperative day 1. Physiotherapy was started pre-operatively and was continued after the operation.

A questionnaire was designed using questions from the Scoliosis Research Society (SRS) Instrument for Outcome assessment, The American Academy of Orthopaedic Surgeons (AAOS) and Nork's functional outcome assessment form. Suitable alterations were made in order to gain a functional and satisfaction outcome and also took into account the fact that a postal questionnaire was being used. A 1–10 scale was devised. All patients were sent the questionnaire. Patients were encouraged to contact the clinic by telephone if they encountered any confusion regarding the questions. Twenty-five (81%) returned their questionnaire. Reasons for not returning the questionnaire included serious illness ($n=2$) and inability to locate the patient ($n=4$). Substantial effort was made to locate the patients lost to follow-up, including calls to general practitioners and visits to next-door neighbours. Data was analysed by using the chi-square and Friedman ANOVA tests.

Standing coronal and lateral radiographs were obtained pre-operatively and at the time of the study. An independent radiographer evaluated X-rays and looked for degree of spondylolisthesis, disc height and degree of fusion, and pseudoarthrosis. It was not routine to obtain follow-up flexion and extension lateral radiograph, thus a dynamic evaluation was not possible. Fusion was defined as mature, visible bridging bone on X-rays. Progression of deformity was also recorded. Segmental alignment (disc height, spondylolisthesis, Cobb's angle) and fixation failure on the last follow-up visit were compared with pre-operative radiographs. Examples of fixation failure included implant failure, screw halos and progressive pull-out.

Results

Clinical review and complications

Eight (17%) patients had some form of operative or post-operative complication. There were two cases of instrumentation failure (broken screws)and, of these, one patient remained asymptomatic while the other complained of pain on the contralateral side of the broken screw. He refused any further surgical intervention. There were two cases of intra-operative dural tears. Both patients made an uneventful recovery. Two cases of superficial wound infection, one of deep wound infection (this patient was taken to theatre for wound debridement later) and one case of urinary tract infection (UTI) were recorded post-operatively. There were no cases of neurological defects, radiculopathy, recurrent stenosis, deep-vein thrombosis or pulmonary embolism.

Radiographic analysis

Four cases showed no mature bridging on the X-ray views; this included one case of misplaced screw. One case of pseudoarthrosis was recorded. Twenty-seven (87%) cases showed complete fusion. No case of worsening deformity of the spondylolisthesis or screw pull-out was noted.

Fig. 1 Patient questionnaire for back operations (part 1)

Name: _____ Age:_____Sex: Male ☐ Female ☐

Age at operation: _____

Score: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
(Please tick appropriately) Good Mild Mod Worst
(All sections to be filled by the Patient)

Pre operative (before op) medical illnesses

Please list:	Illness	Medication
	……	……
	……	……
	……	……

Post operative (after op) medical illnesses:

Please list:	Illness	Medication
	……	……
	……	……
	……	……

PAIN INTENSITY (BACK / LEG)

Pre-op pain intensity (back /leg)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	None			Mild			Mod		Severe	
Post -op pain intensity (Within first 6 months)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	None			Mild			Mod		Severe	
Post - op pain intensity (Now)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	None			Mild			Mod		Severe	

MOBILITY

Pre - op mobility (Just before operation)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Mobile			Mild			Mod		Severe	
Post - op mobility (Within first 6 months)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Mobile			Mild			Mod		Severe	
Post op mobility (now)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Mobile			Mild			Mod		Severe	

JOB / ACTIVITY EFFECTED

Pre - op Job / activity (Just before operation)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	None			Mild			Mod		Severe	
Post - op job / activity (Within first 6 months)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	None			Mild			Mod		Severe	
Post op activity (now)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	None			Mild			Mod		Severe	

Questionnaire outcome

Following are results of the patient questionnaire.

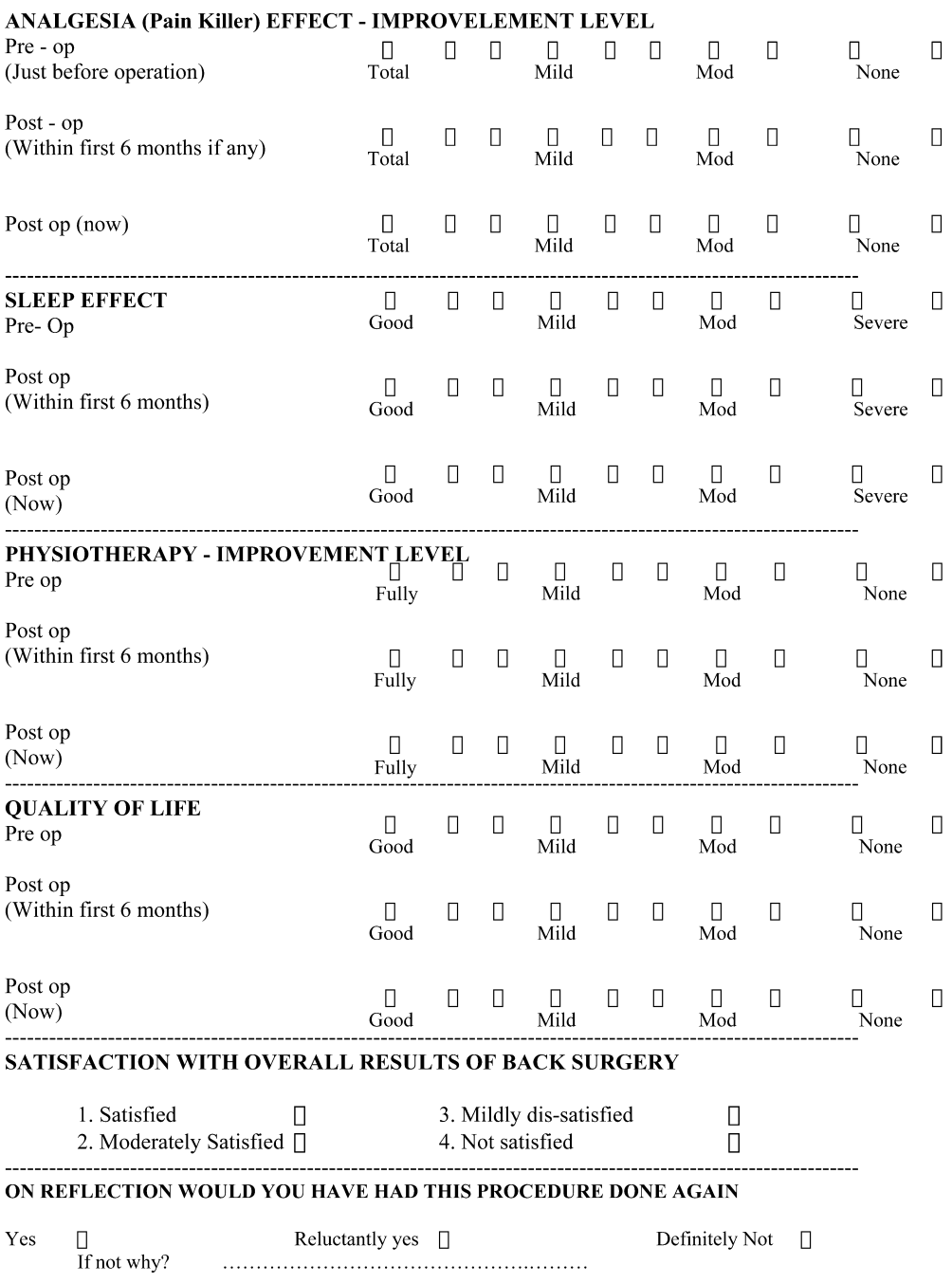
Pain

Twenty-two patients reported severe pain (8–10) before the operation, which dropped to eight patients in the following 6 months. Three (12%) patients had severe pain now ($P < 0.0001$), with 14 (56%) no or mild pain (0–4) (Table 1).

Mobility and job

Fourteen patients had severely affected mobility before the operation, whereas after the operation, four patients were affected now ($P < 0.0001$). Sixteen (64%) patients reported a 0–4 score after their operation. Similarly, 14 (56%) patients had severe (8–10) job affected scores before the operation; five (20%) had severe scores now after the operation ($P < 0.0001$) (Tables 2 and 3).

Fig. 2 Patient questionnaire for back operations (part 2)



Analgesia and sleep

Fifteen (60%) patients showed no improvement with analgesia pre-operatively, whereas only one (4%) patient is now on regular analgesia and two (8%) report having their sleep affected after the operation ($P < 0.0001$); the remaining patients all showed improvement (Tables 4 and 5).

Table 1 Pain intensity

Pain intensity	Mild (0–4)	Moderate (5–7)	Severe (8–10)
Pre-op.	0	3 (12%)	22 (88%)
Post-op. (6 months)	6 (24%)	11 (44%)	8 (32%)
Now	14 (56%)	8 (32%)	3 (12%)

Table 2 Mobility

Mobility affected	Mild (0–4)	Moderate (5–7)	Severe (8–10)
Pre-op.	3 (12%)	8 (32%)	14 (56%)
Post-op. (6 months)	12 (48%)	7 (28%)	5 (20%)
Now	16 (64%)	5 (20%)	4 (16%)

Table 3 Job activity

Job activity affected	Not working	Mild (0–4)	Moderate (5–7)	Severe (8–10)
Pre-op.	7 (28%)	2 (8%)	2 (24%)	14 (56%)
Post-op. (6 months)	7 (28%)	10 (40%)	3 (12%)	5 (20%)
Now	7 (28%)	12 (48%)	1 (4%)	5 (20%)

Table 4 Analgesia Improvement

Analgesia improvement	Mild (0–4)	Moderate (5–7)	Severe (8–10)
Pre-op.	2 (8%)	8 (32%)	15 (60%)
Post-op, (6 months)	13 (52%)	10 (40%)	2 (24%)
Now	18 (72%)	6 (24%)	1 (4%)

Table 5 Effect on sleep

Effect on sleep	Mild (0–4)	Moderate (5–7)	Severe (8–10)
Pre-op.	3 (12%)	8 (32%)	14 (56%)
Post-op. (6 months)	9 (36%)	12 (48%)	4 (50%)
Now	17 (68%)	6 (24%)	2 (24%)

Physiotherapy

Eleven (44%) patients showed no improvement with regular physiotherapy before the operation, whereas after the operation, five (20%) patients did not find physiotherapy helpful ($P < 0.0001$) (Table 6).

Quality of life

Fourteen patients reported a poor quality of life (8–10) before surgery, whereas only three (12%) reported poor quality of life after the operation ($P < 0.0001$). Nineteen (76%) reported a good-to-mildly-affected quality of life (1–4) (Table 7).

Overall satisfaction, and would they have the procedure again?

The overall (good-to-moderate score) satisfaction level was 88%. One patient was not satisfied, and two were mildly dissatisfied with the overall outcome. Twenty-three (92%) patients would have been willing to have the procedure again; two patients (8%) would not (Tables 8 and 9).

Table 6 Physiotherapy improvement

Physiotherapy improvement	Mild (0–4)	Moderate (5–7)	Severe (8–10)
Pre-op	14 (56%)	0	11 (44%)
Post-op. (6 months)	15 (60%)	7 (28%)	3 (12%)
Now	16 (64%)	4 (50%)	5 (20%)

Table 7 Quality of life

Quality of life	Good to mild (0–4)	Moderate (5–7)	None (8–10)
Pre-op.	2 (24%)	9 (36%)	14 (56%)
Post-op. (6 months)	10 (40%)	14 (56%)	1 (4%)
Now	19 (76%)	3(12%)	3 (12%)

Discussion

Assessment of success of a spinal operation is thought to be dependent on certain aspects, e.g. spinal fusion, worsening spondylolisthesis and complications like pseudoarthrosis, neurological deficit and stenosis, etc. Surgical results also may be compared or analysed with patient satisfaction with the procedure [15, 16].

The treatment of degenerative spondylolisthesis remains controversial with respect to the benefits of fusion with and without instrumentation. Different techniques have been used [7, 8, 9, 10, 11, 12, 13, 14] with varying results. Booth et al. [15] showed an effective 5-year outcome in pedicle screw with posterior spinal fusion. This view was further continued by other studies [16, 17, 18, 19] and a meta-analysis study of the literature from 1970 to 1993 [17], all demonstrating good results with posterior instrumentation fusion.

Our study group was retrospective, although attempts were made to gain a prospective view by modifying the questionnaire and to ask about their pain pre-surgery, 6 months afterwards and also at that time. We also understand that an argument can be made of the minimum length of follow-up (1 year, average 3.7 years) of these patients. Our study showed an improvement trend in the first 6 months and then at the time of the study in most patients. We think this is sufficient time to demonstrate the safety and effectiveness of the procedure in the majority of patients.

We also recognise that our study would have been further strengthened if the results had been compared

Table 8 Satisfaction with overall results

Satisfied	15 (60%)
Moderately satisfied	7 (28%)
Mildly dissatisfied	2 (8%)
Not satisfied	1 (4%)

Table 9 On reflection, would the patient have the operation again?

Yes	14 (56%)
Reluctantly yes	9 (36%)
Definitely not	2 (8%)

with a control group in a specialised unit. We are holding prospective trials of spinal fusions comparing results with a specialised unit. However, the aim of the present study was to assess results and safety in a non-specialised unit.

Overall radiological fusion (87%), clinical complications (17%) and patient satisfaction (88%) recorded in our study are comparable with results of other published reports on surgical treatment of degenerative spondylolisthesis [1, 2, 5, 15, 16]. Functional criteria such as pain control, mobility, effect on job, sleep, analgesia and quality of life also match other studies [15, 16].

Pedicle screw is technically demanding, requiring considerable expertise and precision to be performed successfully. It is essential to have sufficient expertise available and the requisite support in theatres, wards and outpatient departments before any attempt is made at the procedure. However, it can be performed safely and effectively outside a specialised unit.

Conclusions

Overall complications were 17%. An improved outcome was noted in terms of radiological fusion (87%) and patients' functional and satisfaction outcome in all those who underwent decompression pedicle screw fixation in our unit. We conclude that posterior spinal fusion, although a very technically demanding procedure, can be performed safely outside a specialised unit.

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