COMPARISON OF THE RESULTS OF SPINAL FUSION FOR SPONDYLOLISTHESIS IN PATIENTS WHO ARE INSTRUMENTED WITH PATIENTS WHO ARE NOT

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ABSTRACT

Eighty-five patients who had surgery for spondylolisthesis were studied retrospectively both clinically and radiologically to determine if instrumentation lead to better fusion rates and clinical outcome. Degenerative spondylolisthesis accounted for 57 cases and patients who had instrumentation did have a better fusion rate and clinical outcome, with 60% of patients having complete relief from pain.

In the group with isthmic spondylolisthesis (28 patients), there was also an improved fusion rate with instrumentation. However, these patient took a longer time before returning to work and had to be protected in a polythene brace. The improved fusion rate radiologically with instrumentation did not translate to better clinical results with regard to pain relief and disability. One patient developed ascending epidural haematoma with instrumentation and resulted in paraplegia. She had incomplete recovery during the follow-up.

Keywords: *spondylolisthesis, fusion rate, clinical outcome, instrumentation.*

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INTRODUCTION

Spondylolisthesis is derived from the Greek word "Spondylos" meaning vertebra and "olithanein" meaning slip. It was coined to refer to the ventral displacement of one vertebra relative to the subjacent one. The aetiology of spondylolisthesis has been classified by Wiltse[1] into five types; namely dysplastic, isthmic, degenerative, traumatic and pathologic.

Degenerative spondylolisthesis is the commonest type whereby hypertrophic arthritis of the facet joints and disc degeneration lead to segmental instability and resulting in a forward slip of the vertebral body. Symptoms may be due to impingement of nerves in the spinal and root canals causing neurogenic claudication and radiculopathy. Segmental lumbar instability causes low back pain. This condition is seen most commonly in women in their fifth decade.

Isthmic spondylolisthesis occurs frequently in children and young adults. Studies by Baker and McHollick[2] show that the lesion is not present at birth but is present in 5% of the children by age of 6. Children involved in certain sports (eg gymnastics) have a much higher incidence and this appears to be especially related to repetitive hyperextension stresses. Results of many studies[3] suggest that there is a genetically determined tendency to develop stress fractures of the pars interarticularis during the first few years of an upright posture. However, most of these patients remain asymptomatic and can only be detected by routine radiographic surveys.

In the practice of everyday orthopaedics, the spinal surgeon will encounter mainly degenerative and isthmic spondylolistheses. The other forms are rare. In this study, the patients have thus been divided into the two major groups (Table I).

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Table I – Distribution of the type of spondylolisthesis and implants used

	Total	Non-Instrumented	Instrumented
Isthmic	28	13	15 (9 RC, 2CD 3 AO, 1S)
Degenerative	57	47	10 (5 RC, 3AO 2 L &W,)

RC – Roy Camille plate and pedicle screws
CD – Cotrel Dubousset instrumentation
AO – AO plating
S – Steffee plate and pedicle screws
L&W – Luque rectangle and Wisconsin wiring

Surgery is not always necessary in spondylolisthesis. Often an adequate course of spinal and abdominal rehabilitation, restriction of activities and other conservative measures will be sufficient. However, persistent pain in the lower back, buttocks and thighs, sciatica or neurological deficits are sometimes severe enough to warrant fusion.

There are many different fusion techniques and opinions vary as to the proper operation in spondylolisthesis. Posterior rather than anterior fusions are preferred by most because its technique is more flexible; it permits exploration of the defects, nerve roots and intervertebral discs[4]. In recent years, there has been increasingly popularity in the use of implants (especially a screw-plate construct for pedicle fixation) in patients who undergo spinal fusion[5]. The main aim is to have rigid fixation to bony elements in the area of attempted fusion and hopefully to improve fusion rates and eventual outcome.

This study is based on a retrospective review of 85 cases of spondylolisthesis (57 degenerative and 28 isthmic). It attempts to look into:

1) The profit of patients coming for surgery
2) Length of hospitalisation
3) Type and duration of wearing a brace
4) Duration before returning to work
5) Level and degree of slip
6) Operations done
7) Early complications
8) Pain relief
9) Disability
10) Late complications
11) Fusion

This will hopefully help the surgeon determine what results to expect from surgery for spondylolisthesis and possibly help to outline the indication of instrumentation when attempting spinal fusion.

MATERIALS AND METHODS

Eighty-five patients were operated on at the Department of Orthopaedics "O", Singapore General Hospital between November 1988 and December 1991.

The distribution of the type of spondylolisthesis, whether or not instrumentation was used and type of implants are shown in Table I.

The length of follow-up ranged from 6 months to $3^1/_2$ years. On follow-up, the patients were analysed with regard to several aspects of the patient's post-operative course: the length of absence from work, duration on a brace, post-operative pain relief and disability. The status of the fusions were evaluated by means of radiographs in the antero-posterior and lateral projects. A solid fusion was concluded when the radiographs showed solid bridge of bone connecting the transverse processes of the vertebral bodies.

RESULTS

The biodata and results of patients operated on for isthmic spondylolisthesis are seen in Table II and III respectively. The two groups (instrumented vs non-instrumented) were well matched with regard to the age, sex and race distribution with occupations varying from sedentary office workers to manual labourers. The majority of patients had an early Grade 1 slip of < 25% (Table III). The majority of the patients had a slip at the L5/S1 level. There was no obvious difference in the length of hospitalisation or duration of wearing a brace. However, most patients who were not instrumented were put on a simple canvas corset. The patients who were instrumented took a longer time before returning to work (Table IV). There is no obvious difference with regard to pain relief in the two groups. Intermittent backache and bone graft donor site pain continue to be the common causes of patient's complaints post-operatively. The majority of patients were able to return to full-time work or to full-time work at a less than normal level. There was no obvious difference between the two groups. There were significant complications in the patients who were instrumented (Table V). One patient who had a L3/L4 spondylolisthesis with Roy-Camille plating done developed an ascending epidural haematoma and turned paraplegic post-operatively. The haematoma was evacuated and the implants left in-situ. The patient subsequently recovered a Grade 5 power in the lower limbs and could walk with a stick. She was still left with some sensory deficits, urinary and bowel incontinence during the last follow-up. Two patients had broken implants and one had loose screws. Fusion rates were much better in patients who were instrumented (Table V).

Table II – Isthmic spondylolisthesis – biodata of patients

	Instrumented	Non-Instrumented
Age	35.33 (21 to 59)	30.62 (19 to 63)
Sex	9M : 6 F	8 M : 4 F
Race	10 Chinese 3 Malay 1 Indian 1 Eurasian	9 Chinese 2 Malay 2 Indian
Occupation	Sedentary → Manual	Sedentary → Manual

Table III – Isthmic spondylolisthesis – data on hospitalisation, bracing, level and degree of slip

	Instrumented	Non-Instrumented
Hospitalisation	13.53 days (9 - 22)	13.77 days (6 - 40)
Level L3/L4	2	0
L4/L5	2	1
L5/S1	11	11
Degree of slip		
< 25%	13	11
25 – 50%	2	2
50 – 75%	0	0
> 75%	0	0
Bracing	69.3 days (28 – 134)	67.7 days (29 – 226)
Type	All on polythene brace	10 on corset 3 on polythene brace

Table IV – Isthmic spondylolisthesis – data showing duration on medical leave and post-operative results

	Instrumented	Non-Instrumented
Duration before returning to work	120-73 days (63 – 204)	85.3 days (37 – 220)
Pain Relief-		
No	2	2
Partial	9 – 5 backache 4 donor site pain	8 – 7 backache 1 donor site pain
Complete	4	3
Disability		
Full time work	8	5
Full time work at less than normal level	5	6
Part time work	0	1
Part time at less than normal level	0	1
Not working	2	0

Table V – Isthmic spondylolisthesis – data on fusion rates and post-operative complications

	Instrumented	Non-Instrumented
Early complications	Paraplegic 1 No dural tears or infections	Urinary tract infection 2 No dural tears or neurological CX
Late complications	2 broken screws 1 loose screw	Nil
Fusion rate	13/14	7/10

The biodata and results of patients operated on for degenerative spondylolisthesis are shown in Table VI and VII respectively. The age, sex and racial distribution of the two groups were well matched. There was a marked female preponderance and the

majority of these patients operated on were housewives. The non-instrumented group was hospitalised for a longer period and were wearing a brace for a longer time (Table VII). There was no obvious difference in the length of time before returning to work. There is a predominance of the L4/L5 level in both groups. There were no significant early complications in both groups. Sixty percent of instrumented patients had complete relief whereas 61.7% of non-instrumented patients had only partial relief (Table VIII). Four patients who were not instrumented suffered from persistent sciatica and numbness of the feet. One patient had a late bone graft donor site infection (Table IX). Most patients were able to return to full time work post-operatively (Table VIII). The fusion rate was significantly better in the patients who were instrumented (Table IX). This occurred despite the fact that 50% of the patients in that group had a more than 25% slip.

Table VI – Degenerative spondylolisthesis – biodata of patients

	Instrumented	Non-Instrumented
Age	56.66 yrs (40 – 72)	56.5 (41 – 69)
Sex	2 M : 8 F	7 M : 40 F
Race	8 Chinese 1 Malay 1 Indian	39 Chinese 3 Malay 5 Indian
Occupation	6/10 Housewives	36/47 Housewives

Table VII – Degenerative spondylolisthesis – data on hospitalisation, bracing, level and degree of slip

	Instrumented	Non-Instrumented
Hospitalisation	15.66 days (13 - 27)	20.97 days (9 - 163)
Level L3/L4	0	2
L4/L5	9	40
L5/S1	1	5
Degree of slip		
< 25%	5	43
25 – 50%	4	4
50 – 75%	1	0
> 75%	0	0
Bracing	56.22 days (21 – 94 days)	68.8 days (22 – 223)
Type	7 on polythene jacket 3 on corset	3 on polythene jacket 44 on corset

DISCUSSION

Spondylolisthesis can cause disabling symptoms either due to segmental instability or canal compromise. Neurogenic claudication and radiculopathy may result from hypertrophic arthritis of the facet joints, disc degeneration and hypertrophied ligamentum flavum. Patients with significant neurological symptoms and deficits can only be successfully treated with adequate decompression.

However, lumbar instability can only be treated with stabilisation by means of bony fusion. Many surgeons have attempted to improve fusion rates by means of instrumentation with the aim of improving clinical outcomes.

Cleveland et al[6] reported a rate of pseudoarthrosis of 17% after arthrodesis from the fourth lumbar vertebra to the sacrum and a rate of 33% after arthrodesis from the third lumbar vertebra to the sacrum. Thompson and Ralston[7], and others have reported similar fusion rates after arthrodesis without instrumentation. Ogilvie and Bradford[8] used sublaminar fixation to stainless steel rectangles in an effort to improve fusion rate and obtained a 84% fusion rate which did not significantly differ from rates obtained with non-instrumented methods. However, West et al[5] studied clinical results and fusion rates in patients who had pedicle screw-plate fixation and found a 90% fusion rate in patients with painful degenerative disease.

Table VIII – Degenerative spondylolisthesis – data showing duration on medical leave and post-operative results

	Instrumented	Non-Instrumented
Duration before returning to work	51.77 (39 – 165)	50.1 (24 – 171)
Pain Relief		
No	0	2
Partial	4 – 2 donor site pain – 2 backache	29 – 23 backache – 4 donor site pain – 2 sciatica
Complete	6	16
Disability		
Full time work	8	5
Full time work at less than normal leave	5	6
Part time work	0	1
Part time at less than normal leave	0	1
Not working	2	0

Table IX – Degenerative spondylolisthesis – data of fusion rates and post-operative complications

	Instrumented	Non-Instrumented
Fusion rate	8/9	25/31
Early complications	2 UTI	2 UTI 1 haematoma 1 bone graft done site infection
Late complications	Nil	4 persistent sciatica & numbness of feet 1 bone graft donor site infection

Denis, Lonstein and Winter[9] examined factors affecting fusion rate in the surgical treatment of adult patients with spondylolisthesis. Two factors which significantly improved fusion rates were a combined anterior and posterior fusion and rigid post-operative immobilisation in a cast. In isthmic spondylolisthesis, the fusion rate was raised from 70% when posterior fusion was used alone, to 88% when combined anterior and posterior fusion was used. In degenerative spondylolisthesis, combined anterior and posterior fusions contributed to a high overall fusion rate of 95%.

The results of this study support the findings of other authors that instrumentation improves fusion rates in both the degenerative and isthmic groups of spondylolisthesis. In the patients with degenerative spondylolisthesis, the improved fusion rates in patients who were instrumented did translate to better clinical results with 60% of patients having complete relief of pain. This was despite the fact that 50% of the instrumented group had higher degrees of slip of more than 25%.

In the isthmic groups, instrumentation did not lead to a longer hospitalisation or period of bracing. However, the patients had to be protected in a polythene brace and took a longer time before returning to work. Neurological complications are the most feared hazard of pedicle screw fixation because of the proximity

of the nerve root and an accurate position of each screw is critically important. A review by the Scoliosis Research Society revealed a 3.2% rate of neurological lesions in operations in which pedicle fixations were used. In our series, the patient who developed paraplegia post-operatively should serve as a sombre reminder to surgeons of the need to be extremely cautious when attempting pedicle screws. Furthermore, instrumentation lead to improved fusion rates radiologically but the clinical results with regard to pain relief and disability post-operatively were similar. DePalma and Rothmans[10] found that 50% of patients who had pseudoarthrosis were asymptomatic. Furthermore, a successful fusion did not always lead to a decrease in symptoms; the rate of clinical failure is approximately 10% higher than that of pseudoarthrosis[9]. Patient factors such as Workmen's Compensation may play a part in giving us the answer but patients with continued pain after a successful fusion remain a perplexing problem and the role of rigid fixation is not yet clear.

CONCLUSION

Recently there has been an upsurge in the use of instrumentation in lower lumbar fusion. Our studies have shown that better fusion rate can be achieved in the instrumented group as compared to the non-instrumented group. However, there was no significant benefit in the use of internal fixation, as far as the relief of symptoms and the period of recuperation were concerned.

Most post operative neurological deficits reported previously were the results of direct injury to the nerve root or spinal cord. We are reporting the first case of a patient who had severe neurological compromise, following pedicular fixation, as a result of an ascending epidural haematoma. The authors would recommend that instrumentation should only be done with great care and undertaken by experienced surgeons because of relatively high incidence of neurological deficits in the instrumented group.

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