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Modified sacrospinalis muscle pedicle bone graft for fusion of isthmic spondylolisthesis

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Abstract We treated 20 patients with symptomatic L4–5 isthmic spondylolisthesis (ten grade I, nine grade II and one grade III) surgically. All patients complained of low back pain and nine had additional radicular pain. Bilateral posterolateral fusion using the sacrospinalis muscle as a muscle pedicle bone graft was carried out in all patients. Decompression was added in patients with radiculopathy. Follow-up ranged from 12 to 28 months. Pain relief was graded as excellent in 18 patients, radiographic fusion as excellent in 17 patients and functional outcome as excellent in 19 patients.

Résumé Nous avons traité chirurgicalement 20 patients porteurs d'un spondylolisthésis isthmique L4-L5 symptomatique (dix grade I, neuf grade II et un grade III). Tous les patients se plaignaient de lombalgies et neuf avaient aussi des douleurs radiculaires. Chez tous les patients une arthrodèse postérolatérale bilatérale a été faite en utilisant le muscle sacrospinalis pour pédiculer la greffe osseuse. Une décompression a été effectuée chez les patients avec radiculopathie. Le suivi a été de 12 à 28 mois. Le soulagement de la douleur a été noté comme excellent pour 18 patients, la fusion radiographique comme excellente chez 17 patients et le résultat fonctionnel comme excellent pour 19 patients.

Introduction

The aim of this retrospective study was to evaluate the results of using a muscle pedicle bone graft from the iliocostalis part of the sacrospinalis muscle in fusion of isthmic spondylolisthesis as described by Baksi [1].

Materials and methods

Twenty patients with symptomatic L4–5 isthmic spondylolisthesis (ten grade I, nine grade II and one grade III) underwent surgery after failing a trial of conservative therapy. All patients complained of low back pain and nine patients also had radicular pain (Table 1).

Preoperative evaluation focused on the determination of nerve root compression in addition to an overall evaluation of the lumbar spine. Plain radiographs of the lumbosacral spine (including anteroposterior, lateral, oblique and flexion-extension stress views) were done preoperatively in all patients and repeated at the final follow-up. Patients with radiculopathy were also evaluated by CT myelography. Electromyography (EMG) of the paraspinal muscles was done in all patients. To assess the fusion success, the preoperative and final follow-up radiographs were analysed and compared.

Bilateral posterolateral fusion using the iliocostalis part of the sacrospinalis muscle as a muscle pedicle bone graft (MPBG) fixed to the osseous bed by transpedicular screws was performed in all patients. In addition to the fusion, decompression was carried out in nine patients with radiculopathy. The technique differed from the one described by Baksi [1] as we used bilateral MPBG and we used transpedicular screws for the fixation of the graft.

Fixation of the MPBG to the osseous bed was carried out using two 4-mm cancellous screws and two washers for each side. Screws were inserted through the iliac bony part of the MPBG and the pedicles of L4 and L5 vertebrae. Exact localisation of the pedicles is an essential prerequisite for the insertion of the screws. The objective was to insert the screws through the centre of the pedicles, approximately parallel to the upper end plate or angled downward. This technique maintained the MPBG secured in position to the osseous bed.

Walking was allowed within the first postoperative week. A brace was used for 2 months and exercises for the spinal muscles were started after 4 months.

Results

The follow-up period ranged from 12 to 28 months. The clinical, radiological and functional outcome was assessed (Table 1).

Pain relief was graded according to Stauffer and Coventry [5]. Before surgery, all patients had low back pain and nine had additional radiculopathy. At the final follow-up pain relief was graded as excellent in 18 patients, good in one and fair in one.

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Table 1 Pre- and postoperative data of the patients studied ($n=20$; *bac./rad.* back/radicular, *MUP/interf.* P motor unit potential/interference pattern, *occ.* occasional, *interm.* intermittent, $\pm$ doubtful)

Case no.	Age (years)	Sex	Preoperative		Decompression			Follow-up (months)	Postoperative			Results		
			Grade	Pain bac./rad.	EMG	CT	Myel.		Pain bac./rad.	Fusion R/Lt	EMG			
													MUP in MV /Interf. P	
1	46	Male	II	+/-	5	Full	-	28	-/-	+/+	5	Full	-	Excellent
2	44	Female	II	+/+	3	Full	+	27	-/-	±/±	3	Full	Sacroiliac pain (2 ms)	Excellent
3	21	Female	I	+/-	4	Full	-	26	-/-	+/+	3	Full	-	Excellent
4	30	Female	II	+/+	4	Full	+	25	-/-	+/+	4	Full	-	Excellent
5	48	Female	III	+/+	4	Full	+	25	+/- intermit.	±/±	3	Mild reduction	Screw loosening (lt. side)	Fair
6	25	Male	I	+/-	5	Full	-	24	-/-	+/+	4	Full	-	Excellent
7	38	Male	II	+/-	5	Full	-	23	-/-	+/+	4	Full	-	Excellent
8	45	Female	II	+/+	5	Full	+	22	-/-	+/+	5	Full	-	Excellent
9	24	Female	I	+/-	4	Full	-	21	-/-	+/+	3	Full	-	Excellent
10	35	Female	II	+/+	3	Full	+	20	+/- occ.	+/±	3	Full	-	Excellent
11	42	Male	I	+/-	5	Full	-	19	-/-	+/+	4	Full	-	Excellent
12	33	Female	II	+/-	4	Full	-	19	-/-	+/+	4	Full	-	Excellent
13	27	Male	I	+/-	4	Full	-	18	-/-	+/+	4	Full	-	Excellent
14	39	Female	I	+/+	4	Full	+	17	-/-	+/+	3	Mild reduction	-	Excellent
15	28	Female	I	+/-	3	Full	-	16	-/-	+/+	3	Full	-	Excellent
16	47	Female	II	+/+	3	Full	+	16	-/-	+/+	3	Mildn reduction	-	Excellent
17	31	Male	I	+/+	5	Full	+	15	-/-	+/+	5	Full	-	Excellent
18	40	Female	I	+/-	5	Full	-	14	-/-	+/+	4	Full	-	Excellent
19	32	Male	II	+/+	4	Full	+	13	-/-	+/+	4	Full	-	Excellent
20	36	Female	I	+/-	5	Full	-	12	-/-	+/+	5	Full	-	Excellent

The establishment of a successful fusion was strictly derived from radiographic confirmation of continuous bony mass traversing the grafted segment with no evidence of motion on the flexion-extension radiographs. Pseudarthrosis was judged to be present if there was no continuity in the fusion mass or if lateral flexion-extension radiographs demonstrated more than 2° of angular motion between the adjacent vertebral end plates or more than 2 mm of sagittal motion at the location of spondylolisthesis. The radiographic status of the fusion was graded according to Fischgrund et al. [2] (Fig. 1).

Preoperatively patients had an average of 4 mm (range 3–16 mm) of sagittal motion and 7° (range 4–10°) of angular motion. Postoperatively, sagittal and angular motion decreased to less than 2 mm and 2°, respectively, and the status of spinal fusion was graded as excellent in 17 patients, good in two and fair in one.

EMG studies of the paraspinal muscles revealed no significant changes in the motor unit potential or in the interference pattern, which was full in all patients and mildly reduced in three postoperatively.

Function was considered as a composite of pain expression and performance of daily activities and was rated according to Stauffer and Coventry [5]. The result was considered to be excellent if the patient resumed unrestricted activity and had nearly complete relief of pain in the back, lower limbs, or both. A good result indicated that there was occasional discomfort in the back or lower limbs, necessitating occasional medication. Patients with a good result had significant improvement, compared with the preoperative condition, and had resumed unrestricted activity. A fair result was defined as intermittent discomfort in the back, lower limbs, or both; improvement compared with the preoperative condition; restriction of activities; and an occasional need for medication. The patients who had a poor result had marked discomfort in the back, lower limbs, or both, not responding to non-narcotic medication. The patients in this category noted no improvement compared with the preoperative condition and had significant restriction of activities.

At the final assessment, the functional improvement was excellent in 19 patients and fair in one.

There were no instances of further neurological compromise or infection. One patient had a painful bone graft donor site due to sacroiliac joint penetration during harvesting of the graft. Pain subsided 2 months postoperatively. Loosening of the transpedicular screws and lateral displacement of the graft on one side occurred in one patient.

Discussion

Isthmic spondylolisthesis is the most common type of non-traumatic spondylolisthesis but symptomatic isthmic defects are infrequent [4]. It is estimated that 10–20% of adults with symptomatic spondylolisthesis will have persistent pain despite conservative measures [6]. Factors such as age, lifestyle, bone quality, degree of facet arthropathy, response to bracing, and medical condition may influence operative indications.

In the literature there is disagreement as to whether fusion correlates with the clinical outcome in the treatment of lumbar spinal disorders. A direct relationship between failure to achieve fusion and an unsatisfactory pain relief was reported in the prospective study of McGuire and Amundson [4] as well as in the retrospective study of West et al. [8]. Stromqvist [7] reported that the clinical results of postero-lateral fusion do not always correlate with the radiographic appearances but the outcome is certainly better if fusion is achieved.

In this series, satisfactory osseous fusion occurred in 19 patients out of 20 compared to 20 patients out of 23 on the side where MPBG was used in the series of Baksi [1]. The high incidence of satisfactory fusion together with an improved functional outcome in our series was probably attributed partly to the fact that the majority of the patients had less slip (ten grade I, nine grade II and one grade III), the use of bilateral MPBG and fixation to the osseous bed by transpedicular screws.

Some authors recommended decompression and fusion and others recommended fusion alone as Johnson et al. [3]. In our series, decompression was carried out in nine patients who had radicular pain. Decompression does not appear to improve the outcome of fusion of low-grade isthmic spondylolisthesis in patients without a serious neurological deficit. The relief of pain in the early postoperative period is thought to be due to the decompression whereas relief at a later stage may result from the spinal stability ensured by a satisfactory fusion.

In our series, EMG studies revealed no significant changes in motor unit potential and the interference pattern was comparable. There was no postoperative spinal deformity or weakness of the back muscles. This is attributed to the fact that the muscle had been detached bilaterally and reattached and fixed to lumbar spine near the original place of insertion.

In patients with low-grade symptomatic L4–5 isthmic spondylolisthesis a vascularised MPBG using the iliocostalis part of the sacrospinalis muscle is a good alternative to achieve satisfactory fusion and to improve the functional outcome.

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◀ **Fig. 1 a, b** Preoperative radiographs of a female aged 35 years showing L4–5 isthmic spondylolisthesis (grade II). **c, d** Sixteen months postoperative radiographs showing bilateral satisfactory osseous fusion with restoration of height of L4–5 disc in the lateral radiograph

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