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Natural History of Posterior Iliac Crest Bone Graft Donation for Spinal Surgery

A Prospective Analysis of Morbidity

Peter A. Robertson, MD, FRACS,* and Alison C. Wray, MBChB†

Study Design. A prospective study was conducted to examine bone graft donor site morbidity in 106 consecutive patients undergoing posterior spinal fusion.

Objectives. To perform a prospective analysis of donor site morbidity, to document the incidence of major complications, and to collect information on the impact of autologous bone graft harvesting from the posterior iliac crest on the overall outcome of spinal surgery.

Summary of Background. Bone graft harvesting from the posterior iliac crest for spinal fusion is a source of significant morbidity. Previous retrospective case studies indicate that minor complications are common, but they do not define the natural history and complications of posterior iliac crest bone graft harvesting.

Methods. A standardized harvesting technique was used. At 3, 6, and 12 months after surgery, the patients completed a *proforma* questionnaire rating symptoms on a visual analog scale and underwent a postoperative examination by the surgeon. Finally, overall surgical outcome was assessed at 12 months.

Results. The major component of morbidity is donor site pain. Mean pain scores were 1.640 at 3 months, 1.812 at 6 months, and 1.207 at 12 months. The pain at 12 months was significantly less than at 3 and 6 months ($P = 0.005$), with a trend toward the highest scores at 6 months. A pain score of 0 was reported by 55% of the patients. Local sensory loss was found in 10% of the patients. Outcome assessment showed significant differences in morbidity for surgery performed at different spinal levels ($P = 0.001$), with lumbosacral surgery resulting in worse outcomes than either cervical ($P < 0.05$) or thoracolumbar ($P < 0.05$) surgery. Significantly higher visual analog scores were observed at 6 months in patients with poorer overall outcomes.

Conclusions. According to this study, it is reasonable to reassure patients that a good result from spinal surgery will not be compromised by severe symptoms or major morbidity secondary to posterior iliac crest bone graft donation. Before surgery, patients may be advised concerning the risks of donor site pain, which improves significantly by 12 months, local tenderness, and uncommonly localized sensory loss. [Key words: bone grafting, donor site pain, posterior iliac crest] **Spine 2001;26:1473–1476**

Bone graft is used in spinal surgery to achieve fusion. Autogenous bone is both osteoinductive and osteoconductive. In addition to its superiority over allografts,[3,7] autogenous bone graft has the advantage of histocompatibility, nonimmunogenicity, and absence of potential for disease transmission. The posterior iliac crest and lateral wall of the ilium is a bountiful source of corticocancellous bone for posterior spinal fusion surgery.

Harvesting of bone graft from the posterior iliac crest has long been recognized as a source of significant morbidity.[3] Previous retrospective case studies have indicated that minor complications are common, with rates ranging from 10% to 39%.[1,2,5,8,11,13] Severe and major complications such as graft site fracture,[6,12] superior gluteal artery injury,[9] peroneal and sciatic nerve palsy, and herniation of tissue through donor sites have been recorded.

Although a number of retrospective studies and case reviews investigating major complications exist, to the authors' knowledge, no prospective analysis of the natural history and complications of posterior iliac crest bone graft harvesting have been performed. This study used prospective analysis to document donor site morbidity, to record the incidence of major complications, and to collect information that could guide patients in considering the impact of autologous bone graft harvesting from the posterior iliac crest on their overall outcome.

Methods

The study group was a consecutive series of 106 patients in the practice of a single spinal surgeon. All patients undergoing posterior spinal fusion with autologous posterior iliac crest bone graft were considered. Patients were excluded if they had undergone Galveston-type fixation to the ilium, did not speak English, or had spinal cord injury that could confound neurologic examination and symptom appreciation.

The technique for harvesting was the same for all the patients. In every case, the bone graft was harvested in corticocancellous or cancellous strips for onlay bone grafting. No "structural" grafts were harvested. A separate oblique incision was made laterally to the posterior iliac crest. This oblique incision extended from the superolateral to the inferomedial position, paralleling the posterior iliac crest. The gluteus maximus origin was identified and elevated, displaying the outer wall of the ilium. The sciatic notch was carefully identified by palpation to allow avoidance of any exiting structures. Subsequently, strips of corticocancellous bone graft were harvested. Once the outer table of the ilium was broached with osteotomes, corticocancellous bone was harvested in strips using Capener gouges.

Care was taken throughout the procedure to ensure that the inner table was left intact. The bone defect was packed with a large sheet of Gelfoam, and bone wax was used sparingly for any significant bone bleeding. Anatomic reconstruction of the

From the Departments of *Orthopaedics and †Neurosurgery, Auckland Hospital, New Zealand.
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Table 1. Surgery by Level and Pathology

	Degenerative	Trauma	Neoplastic	Rheumatoid	
Cervical	1	9	1	9	20
Thoracic	0	1	1	0	2
Thoracolumbar	0	6	2	0	8
Lumbar	71	3	2	0	76
	72	19	6	9	106

gluteus maximus was achieved. The gluteus maximus origin was drawn over the donor site and attached to the fascia overlying the posterior iliac crest with large absorbable sutures. In all cases, both the harvest and wound closure were performed by a single experienced spinal surgeon, and not relegated to a junior member of the team.

At 3, 6, and 12 months after surgery, the patients completed a *proforma* questionnaire and underwent a postoperative examination. They were asked to report donor site pain, neurologic symptoms such as paraesthesia or dysesthesia, and any other symptoms they had experienced. The patients scored their pain on a visual analog scale (VAS) with choices ranging from 0 (no pain at all) to 10 (maximal pain imaginable). Data pertaining to patient characteristics, pathology, level of fusion, new *versus* revision surgery, and side of graft harvesting were recorded. All the patients were examined for scar characteristics including length and width of scar, any scar tenderness, and any palpable soft tissue or bone defect. The patients were examined for the presence of a Tinel's sign over the cluneal nerves both at the scar and distal to it. Finally, any residual sensory loss was mapped. At the final review, the surgeon also assessed the overall surgical outcome.

■ Results

The study achieved 96% data completion, with 97 patients (92%) assessed at 12 months. Women made up 68% of the patients (n = 72), and men accounted for 32% (n = 34). The mean age was 47.4 years (range, 15–82 years). Only 15 cases (14.2%) involved revision surgery. According to a Mann-Whitney rank sum test, there were no significant differences in the outcomes for donor site morbidity between the primary and revision groups. A surgeon preference for right-side harvesting was identified, with 73 harvests (68.9%) occurring on the right-side and 33 (31.1%) on the left-side. The side used for harvesting did not influence patient outcomes. Most of the fusions (71.7%; n = 76) were performed on the lumbosacral spine. Another 20 fusions (18.9%) were performed on the cervical spine, and a minority (9.4%; n = 10) were performed on the thoracolumbar spine.

Analysis of the surgical indications showed that 67.9% (n = 72) of the surgeries were performed for degenerative disease, 17.9% (n = 19) for traumatic spinal column injury, 8.5% (n = 9) for rheumatoid cervical disease, and 5.7% (n = 6) for neoplastic or infective processes (Table 1). Importantly, no procedures were performed for spinal deformity, representing the adult bias of this study.

Only two major complications requiring reoperation occurred. In one patient, a deep infection developed in an instrumented lumbosacral fusion, which presented with an abscess at the posterior iliac crest site. A sinogram confirmed that the inner table of the ilium had been perforated, allowing for drainage of the deep infection. The other complication was a significant soft tissue defect caused by a detached gluteus maximus origin that required a gluteus maximus reattachment.

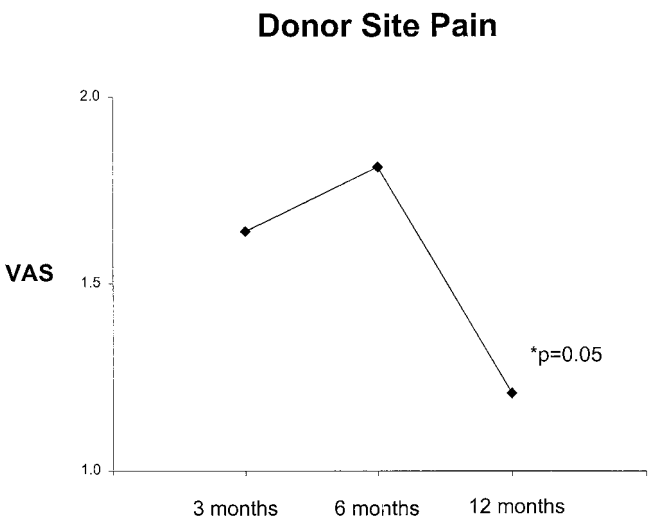

Figure 1. Mean visual analogue pain score (range 0–10) at 3, 6, and 12 months after surgery. A statistically significant reduction in pain is noted by the 12–month postoperative stage.

The minor complication rate or morbidity was 35%, corresponding to other published reviews.[2,5] The most frequently reported morbidity was donor site pain. The mean VAS was 1.640 at 3 months, 1.812 at 6 months, and 1.207 at 12 months. According to Friedman repeated measures analysis of variance (ANOVA) on ranks, pain at 12 months was significantly less than at 3 and 6 months ($P = 0.005$), with a trend toward the highest scores at 6 months (Figure 1). At 12 months, only 12% of the patients reported a pain score greater than 3, and 55% of the patients had no pain at all. Pathologic subgroup analysis showed a significantly higher VAS in the degenerative population at 12 months ($P = 0.029$, Kruskal-Wallis one-way ANOVA on ranks). Lumbar spinal surgery was associated with a consistently higher VAS than that for other levels, with the VAS reaching significance at 6 months ($P = 0.016$). The VAS was unaffected by gender, age, donor side, or primary *versus* revision surgery.

In the patients with unilateral leg pain before lumbar surgery for degenerative disorders in the lumbar spine, analysis was performed for pain at the donor site in relation to the side of preoperative leg pain. This analysis showed that harvesting from the same side or the side opposite the presenting pain had no effect on donor site pain.

Other reported morbidity included scar numbness in 13 patients (not correlating with any sensory loss), a scar that was painful if knocked in 6 patients, and an "itchy" scar in 4 patients. Local sensory loss was found in 10% of the patients, the predominant distribution being a tri-

angle with its base along the incision. This was consistent with minor cluneal sensory nerve loss. Examination showed palpable soft tissue defects in 26% of the patients at 3 months, 28% at 6 months, and 35% at 12 months. Correlation analysis (Pearson product-moment correlation) showed a strong correlation between local tenderness and palpable defect at 12 months ($P = 0.002$). The patients with a palpable defect were more likely to have expanded or hypertrophic scars ($P = 0.014$).

Final scar characteristics also were assessed best at 12 months, at which time 32% of the scars having an expanded or hypertrophic nature, as compared with 18% at 3 months. At the 12-month examination, 30% of the patients reported that their scar remained tender to palpation. Overall outcome assessment varied significantly for different spinal levels ($P = 0.001$), with lumbosacral outcome worse than either cervical ($P < 0.05$) or thoracolumbar ($P < 0.05$) outcome. There also was a significantly higher VAS at 6 months in the patients with poorer overall outcomes, as assessed by Kruskal-Wallis one-way ANOVA on ranks).

■ Discussion

As the results indicate, the major component of morbidity is donor site pain. The mean pain scores at each interval was relatively low. However, the pain was more significant in lumbar spinal surgery and in the degenerative population, as previously reported.[5] This may reflect the fact that patients who underwent surgery in close proximity to the donor site had difficulty isolating the origin of pain. It also was clear that there a higher pain score was associated with a poor outcome from their surgery.[10]

Only 12% of the patients had a pain score greater than 3, and 55% reported a score of 0. It was noted that patients often reported a score of 0.5 or 1 as a response to their own comment that "it is not painful but uncomfortable if I knock the area."

In all the groups, the pain scores tended to be higher at 6 months. It is tempting to suggest that these higher scores are associated with increased activity at this time, and that the significant decrease in pain at 12 months reflects ongoing rehabilitation. Increased muscular activity at 12 months may account for greater detection of palpable defects, which in turn is associated with more local tenderness.

The soft tissue defect at the site of wound closure became more detectable with time, and was associated with scar expansion. It is unclear whether the soft tissue defect reflects subcutaneous fat atrophy or gluteus maximus origin detachment. The relation between scar expansion and soft tissue defect suggests that these features may relate more to soft tissue healing characteristics than to surgical technique.

The symptom of scar numbness and the 10% incidence of cluneal nerve sensory alteration or loss may relate to the scar direction at the time of bone graft harvest. A recent prospective study[4] comparing a superolateral to inferomedial scar with a superomedial to inferolateral scar suggests less numbness, tenderness, and pain with the latter scar orientation. It may be that the superomedial to inferolateral wound orientation spares the cluneal nerves rather than the incision used in this study, wherein there is potential to divide the superficial nerves.

The finding that increased donor site pain is not associated with ipsilateral preoperative leg pain is interesting. Some have advocated graft harvest from the side opposite the leg pain to avoid operation in a "sensitized" leg. This study found no evidence that harvesting from the side of unilateral leg pain increased postoperative pain at the donor site. However, this must be interpreted with care because the side for graft harvest was not randomized in relation to the presence or absence of unilateral leg pain, but the graft frequently was harvested from the side requested by the patient.

This prospective study focused on outcomes during the initial year after autologous bone graft donation. Although longer follow-up evaluation would be desirable, reduced data completion may introduce selection bias. The literature review did not demonstrate evidence of increased pain or late onset of symptoms, although it is well recognized that a proportion of patients may have chronic pain.[10]

This prospective analysis confirmed that in experienced hands, the major complication rate for posterior iliac crest bone graft donation for spinal surgery is low. Conversely, the procedure is associated with donor site morbidity in 35% of patients. Before surgery, patients may be advised concerning potential donor site pain, which may be expected to improve significantly by 12 months, and other local symptoms such as local tenderness and uncommonly localized sensory loss. Clearly, these symptoms are troublesome for patients, and newer advances in biologic fusion techniques are to be welcomed if they supersede the need for bone graft harvesting. According to the findings from this study, it is reasonable to reassure patients that a good result from spinal surgery will not likely be compromised by severe symptoms or major morbidity secondary to posterior iliac crest bone graft donation.

■ Key Points

- A prospective analysis of donor site morbidity was performed, eliciting the natural history and complications of posterior iliac crest bone grafting harvesting.
- The major complication rate is low (1.9%) for posterior iliac crest bone graft donation for spinal surgery. However, the procedure is associated with donor site morbidity in 35% of patients.
- The major component of morbidity is donor site pain, which is more significant in lumbar spinal surgery and in the degenerative population.
- Pain scores tended to be higher at 6 months, followed by a significant decrease in pain at 12 months, at which time only 12% of patients had a pain score greater than 3, and 55% reported a score of 0.

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Address correspondence

Peter A. Robertson, MD, FRACS
Department of Orthopaedic Surgery
Auckland Hospital
Private Bag 92024
Auckland
New Zealand
E-mail: p.a.robertson@xtra.co.nz