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ORIGINAL ARTICLE

Iliac crest reconstruction to reduce donor-site morbidity: technical note

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Abstract The design of the study includes case series, technical note and review of the literature. Autogenous bone graft (autograft) harvest from the iliac crest remains the gold standard substrate for spinal fusion. Persistent donor-site pain is the most common cause of morbidity after autograft harvest, occurring in one-third of patients. Numerous techniques for reducing donor-site morbidity have been reported in the literature, including infusion of analgesics and post-harvest reconstruction of the iliac crest with ceramics, allograft or bone morphogenic protein. A case series of patients undergoing spinal fusion surgery is reported. All patients were treated with iliac crest reconstruction using Calcium Phosphate Cement and follow-up data of persistent donor-site pain was collected. Twelve patients underwent autograft harvest with iliac spine reconstruction using Calcium Phosphate Cement. 42% (5) had persistent donor-site pain (after 3 months). All pain scores were less than or equal to 2 out of 10 (mean 1.25). In conclusion, iliac spine reconstruction using Calcium Phosphate Cement following autogenous bone graft harvest is a relatively simple procedure which failed to decrease the incidence of donor-site morbidity in our patient population.

Keywords Autogenous bone harvesting · Iliac crest pain · Donor-site morbidity · Reconstruction · Tri-calcium phosphate

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Introduction

Autogenous bone graft (autograft) harvest is utilized by numerous surgical specialities including orthopedic, cranio-facial, dental and neurosurgery. Indications for graft harvest are vast and include surgery for post-traumatic injury, deformity correction, progressive degenerative disease and chronic pain. Despite advances in allogenous bone graft preparation (allograft) and biologic treatments, autograft is still considered the gold standard substrate for bone grafting for numerous reasons including ease of harvesting, inexpensiveness, immune-compatibility, reduced infection risk and reduced potential for disease transmission [1–4]. The most common site of procuring bone substrate is the iliac crest. Many severe and major complications due to this harvesting procedure have been reported in the literature [5–8]. However, the most common complication is pain at the iliac crest donor-site, the precise cause of which remains poorly understood. We document a series of 12 patients undergoing iliac spine reconstruction following autograft harvest for spinal fusion, describe our operative technique using a Calcium Phosphate Cement and present a review of the literature.

Case series

A retrospective review of 12 patients who underwent iliac spine reconstruction after autograft harvest for spinal fusion surgery was conducted (Table 1). The visual analogue scale (VAS) was used to determine pain scores at between 3 and 6 months of follow-up [9].

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Table 1 Case series of patients undergoing spinal fusion surgery with autograft harvest from the iliac crest

Case	Indication for surgery	Fusion levels	Number of levels fused	Follow-up period (months)	Pain score (out of 10)
1	Spondylolisthesis	L4/5	1	6	0
2	Spondylolisthesis	L4/5	1	5	1
3	Lower back pain	L3/4	1	5	1
4	Spondylolisthesis	L5/S1	1	4	0
5	Deformity post laminectomy	L3-L5	2	5	0
6	Spondylolisthesis	L5/S1	1	4	1
7	Rheumatoid instability	C1/2	1	4	0
8	Trauma	C5/6	1	3	0
9	Degenerative scoliosis	L3-S1	3	3	2
10	Spondylolisthesis	L5/S1	1	6	0
11	Deformity post laminectomy	L3-S1	3	5	0
12	Spondylolisthesis	L4/5	1	3	2

Operative technique

In each case, reconstruction of the iliac spine following bone graft harvest was undertaken by the senior author (RM). Iliac crest bone graft harvest for this study was performed using standard landmarks and techniques with a linear incision over the posterior superior iliac spine and dissection performed subperiosteally to expose the iliac crest. Using an osteotome, a window was made in the iliac crest and bone ronguers used to curette an adequate volume of medullary bone. Care was taken not to breach the medial wall of the iliac crest. For a single level lumbar fusion, the goal was to create a 10–15 cc defect in the crest.

An injectable form of Calcium Phosphate Cement (Jectos, KASIOS Biomaterials, France) was prepared during the graft harvest by the scrub staff. This bone graft substitute was chosen due to its relatively rapid setting time and isothermic temperature with setting. The graft was injected into the void until complete filling of the cavity was achieved (Fig. 1). The wound site was closed in standard fashion.

Results

Twelve patients underwent spinal fusion using autograft from the posterior superior iliac crest. The indications for surgery were degenerative spondylolisthesis 50% (6), progressive deformity post-laminectomy 17% (2), degenerative disease 5% (1), trauma 5% (1) and pain 5% (1). Single level fusion occurred in 75% (9) of cases whilst the majority 83% (10) were lumbar or lumbrosacral fusions. Patients were followed-up for a mean of 4.1 months (range 3–6). Persistent pain was reported in 42% (5) patients and mean pain scores were 0.6 out of 10 (range 0–2).

Discussion

Donor-site pain following iliac bone graft harvest causes significant morbidity and has been extensively studied in the literature. Early postoperative donor-site pain causes reduced ambulation leading to longer hospital stay, longer time until resuming work and recreational activities and overall health care costs [10, 11]. The degree of donor-site pain in the early postoperative period has been reported to range from 4.8 out of 10 postoperative day 1 to 3.5 on postoperative day 5 using the VAS [12]. Chronic donor-site pain, persisting longer than 3 months, is a major cause of morbidity following autograft harvest. Numerous, uncontrolled, retrospective studies have reported their incidence of persistent donor-site pain and it has now been widely accepted to be common, occurring in one-third of patients undergoing autogenous harvest from the iliac crest [5, 6, 8, 10, 11, 13–19]. Some studies have shown that the incidence of donor-site pain is significantly increased in lumbar or lumbrosacral spinal surgery compared with cervical or thoracic surgery [7, 8, 15, 17]. One group has suggested that this is due to the inability of the patient to differentiate donor-site from primary surgery site pain [15]. Other authors have suggested this phenomenon is due to biomechanical implications of destabilizing the pelvis in patients receiving lumbrosacral fusions [7, 8].

Numerous techniques to reduce donor-site pain have been reported. Studies have suggested a reduction in donor-site pain by using different operative techniques [20–23], reconstructing the iliac crest using various materials such as coralline hydroxyapatite [24], or calcium phosphate [25] or inserting resorbable mesh [26], or bioactive ceramic spacers [27]. Many recent studies have also suggested superior short and long-term outcomes from post-operative analgesic infusion to the donor-site [18, 28–31]. A recent Cochrane Review protocol has been established to analyze this data collectively [32]. An obvious technique to preclude donor-site pain is to not use autograft at all and many alternatives are under investigation for this purpose. A number of studies in anterior cervical fusion have shown allograft to be equally efficacious to autograft and without any associated donor-site morbidity [4, 14, 19, 33]. However, recent systematic reviews have failed to reinforce these findings due to inconsistencies between the measured outcomes of the studies, both radiological and clinical [2, 3].

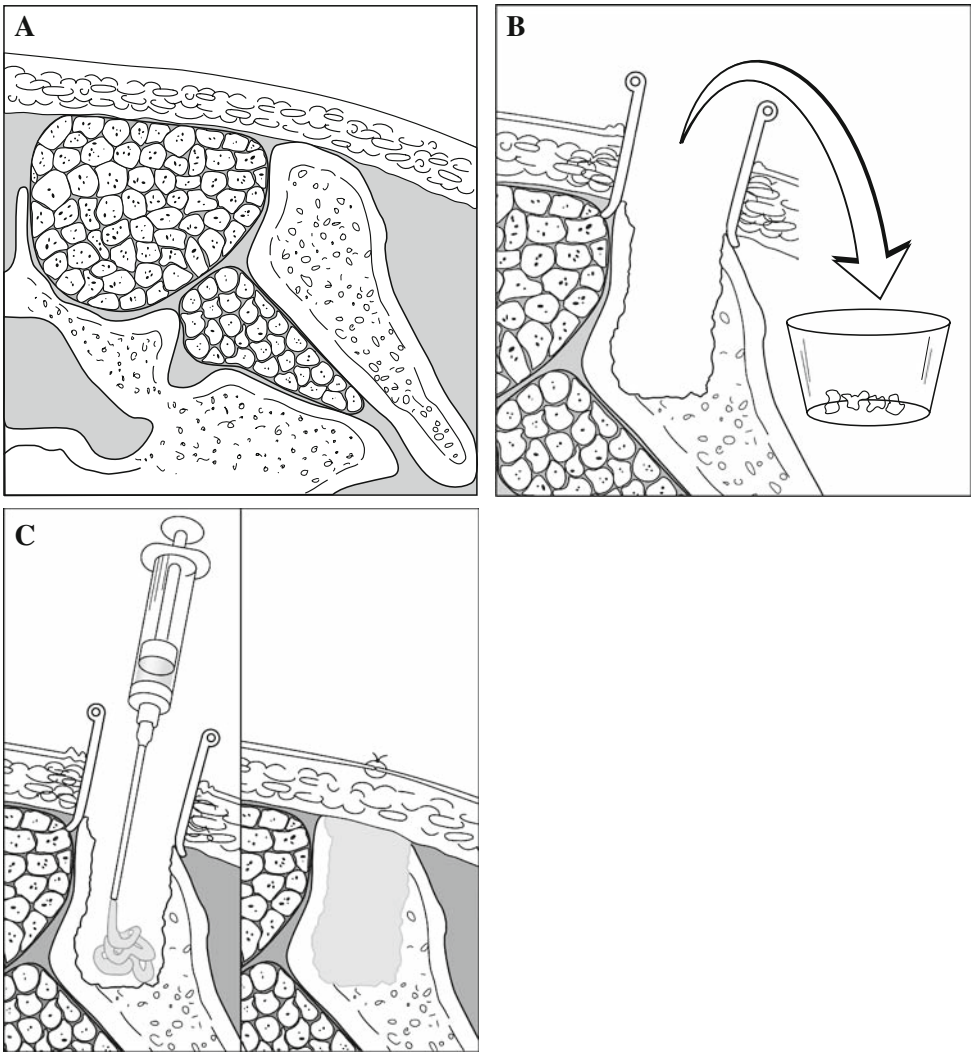

Fig. 1 **a** Posterior iliac crest and relationship to sacrum and surrounding muscles. **b** Medullary bone harvest from the iliac crest. **c** Insertion of Calcium Phosphate Cement to completely fill iliac bone defect with overlying closure of periosteal flap and wound

The other major option to potentially obviate the need for autograft is the use of biologics such as recombinant human bone morphogenic protein (rhBMP-2). There is a growing body of evidence that has shown rhBMP-2 to be efficacious in terms of fusion rates based on radiographic outcomes [3, 34–36]. However, long-term follow-up will be needed to determine the clinical significance of these results. The cost-effectiveness of rhBMP-2 is also a contentious issue in the literature and may limit the routine use of rhBMP-2 in spinal fusions until either its price can be reduced or more high-quality studies can be performed showing a distinct advantage [3, 37].

Conclusion

Donor-site pain is a common problem following autograft harvest from the iliac spine. While autograft remains the gold standard substrate for bone grafting in spinal fusion surgery every effort should be made to reduce the morbidity associated with the procedure. Iliac spine reconstruction using Calcium Phosphate Cement is a relatively simple procedure. In our series, iliac spine reconstruction did not reduce the incidence of persistent donor-site pain. However, the severity of persistent pain was found to be quite mild using the VAS.

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