Spontaneous Posterior Iliac Crest Regeneration Enabling Second Bone Graft Harvest; A Case Report

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Abstract We present a case of a revision spinal fusion in which successful bone graft reharvesting was performed from the posterior iliac crest 4 years after initial intracortical harvesting. To date, only anterior iliac crest regeneration has been reported in orthopedic trauma patients. A 70-year-old man with a history of two prior instrumented lumbar fusion operations developed thoracolumbar kyphosis junctional to the lumbosacral fusion mass. His first operation was an instrumented posterolateral lumbar fusion L1 to L5, where bone graft was harvested from the right iliac crest using the intracortical harvesting technique. The second procedure was performed 18 months later and consisted of an extension of the fusion to the sacrum due to L5–S1 level derived symptoms. The bone graft for this procedure was taken with the same technique from the left iliac crest. The development of thoracolumbar junctional kyphosis necessitated the third operation, which consisted of a same-day anterior–posterior extension of the fusion to T10. Prior to this third procedure, a

spinal computer tomography was performed that documented regeneration of the cancellous bone in the right iliac crest. This permitted reharvesting of almost 40 ml of cancellous bone using the intracortical bone harvesting technique from the right iliac crest. Histological analysis showed mature bone. Cancellous bone regeneration and restoration of the local anatomy of the ilium are possible after intracortical bone harvesting. This regeneration can provide autologous bone graft to assist fusion in subsequent operations.

Keywords posterior iliac crest bone graft · intracortical technique · bone harvesting · reharvesting · complications

Introduction

Autogenous bone graft harvested from the iliac crest has proved superior to allografts [1] when used to augment spinal fusion procedures. It is the present gold standard for spinal arthrodesis. Nevertheless, morbidity of the graft donor site and graft availability in particular in patients with multiple prior spinal operations are significant shortcomings. Allografts or bone graft alternatives are a viable solution in the multi-operated spinal patient, but they lack the high osteogenic potential of autogenous cancellous bone.

In spinal surgery, cancellous bone graft is often harvested from the posterior iliac crest with the traditional outer-table technique, where the cortical outer table is also harvested and only the adjacent sacroiliac joint inner cortex is preserved. Alternatively, with the intracortical technique, the cortical bone envelope (both inner and outer tables) can be preserved. This technique, when applied to the anterior iliac crest, results in regeneration of the iliac cancellous bone and permits reharvesting within as little time as 24 months [2].

We present a patient in whom the initial bone graft harvesting procedure was performed with the intracortical

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technique enabling progressive regeneration of the cancellous bone of the iliac crest and thus reharvesting at his latest spinal operation. This technique has the advantage of providing the highest-quality bone graft for complex revision spinal procedures.

Case report

A 70-year-old man with a history of two instrumented lumbar fusion operations developed thoracolumbar kyphosis junctional to the lumbosacral fusion mass. His prior operations included an instrumented posterolateral lumbar fusion (L1 to L5) that addressed his lumbar spinal stenosis associated with a scoliotic curve. For this procedure, bone graft was harvested from the right iliac crest using the intracortical harvesting technique. Eighteen months later, this fusion was extended to the sacrum due to L5–S1 level derived symptoms, and bone graft was taken with the same technique from the left iliac crest. At this point, computer tomography (CT) of the lumbar spine demonstrated the right iliac crest cancellous defect (Fig. 1).

At the third operation, the patient underwent a same-day anterior–posterior extension of the fusion from L1 to T10 with simultaneous posterior decompression and instrumentation. The senior author (PFO) performed all three operations. A preoperative computer tomography depicted regeneration of the cancellous bone in both right and left posterior iliac crest, 4 and 2.5 years, respectively, after the graft harvesting procedures (Fig. 2). However, some abnormalities were observed such as sclerotic fissures extending from the outer iliac crest cortical osteotomy site

Fig. 1. Image from a CT myelogram, performed 18 months after right posterior iliac crest bone graft harvesting and prior to the second operation, depicting partial regeneration of the cancellous bone (white arrow)

Fig. 2. Image from a CT myelogram demonstrating that the iliac cancellous bone is almost completely regenerated on both the right (white arrow) and left (black arrow) sides, 4 and 2.5 years, respectively, after initial harvesting

to the regenerated cancellous bone and small radiolucencies. The use of a drawing software (AutoCAD LT® 2005; Auto Desk, Inc., San Rafael, CA, USA) enabled the calculation of the extent of the defect in square millimeters in all consecutive images, which was multiplied by 3 mm (the section thickness) to produce a rough estimate of the defect in cubic millimeters. The residual defect 4 years after bone harvesting with the open-door technique was estimated at 1 ml.

At the time of the third operation, the right posterior superior iliac crest was approached subcutaneously through the main spinal midline approach. The thoracolumbar fascia was incised over the posterior superior iliac spine (PSIS). The previous harvest site was found healed. With the use of an osteotome, a 1×1-cm cortical window

Fig. 3. A drawing demonstrating the intracortical harvesting technique

was performed on the PSIS and cancellous bone was harvested with a curette as far as was possible, without perforating the cortices (Fig. 3). Approximately 40 cm³ of bone graft was harvested, which was augmented with 10 cm³ of allograft (Grafton® DBM Crunch; Osteotech, Eatontown, NJ, USA). A sample of this regenerated cancellous bone (from the center of the iliac crest) was sent for histologic examination and showed mature bone (normal trabeculae with a highly cellular component). The cavity was packed with gelfoam and the fascia was sutured with continuous absorbable sutures. The patient had no bone graft harvesting-related complications and reported no chronic pain at the iliac crest sites after each operation.

Discussion

Repeated spinal operations due to pseudarthrosis or degeneration of spinal levels junctional to previous fusion deplete the cancellous bone graft available from the posterior iliac crest. Bone graft is usually harvested with traditional outer-table technique, which in our experience provides no clear advantage over the intracortical bone harvesting technique that preserves the iliac crest cortical envelope.

In this case, the right iliac crest cancellous bone regenerated 4 years after an initial intracortical harvesting procedure, enabling subsequent reharvesting. Regeneration and reharvest of the iliac crest cancellous bone after intracortical harvesting was first demonstrated in a canine model [3]. Subsequently, four orthopedic trauma patients were reported that underwent anterior iliac crest reharvesting [2]. The initial bone graft harvest in these patients was performed with the intracortical technique, and the interval from reharvesting was 24 months, which appeared ample time to allow regeneration [2].

The amount of regeneration of the iliac crest can be estimated with computer tomography. Large voids should cause concern that adequate bone graft will not be available [2, 3]. In this patient, the availability of serial preoperative CT scans enabled the monitoring of the regeneration, which on the right side was almost complete in the final CT scan. The lack of immediate CT scan after the first right iliac crest harvesting prevented us from estimating the amount of the regeneration at the 18th postoperative month. On the left iliac crest side, the bone was completely regenerated 30 months after harvesting, as seen in the second CT scan (Fig. 2). The sclerotic or cystic areas seen in the tomogram did not significantly limit the harvest of a sufficient quantity of regenerated cancellous bone.

Intuitively, the intracortical technique should result in less postoperative blood loss and chronic donor site pain than the traditional outer-table technique. With the outer-

table technique, blood loss can be severe in case of superior gluteal artery injury [4, 5], whereas chronic pain has been related to several factors such as muscular or periosteal stripping of the abductors from the ilium [6], injury of the cluneal nerves [7], fractures secondary to the use of osteotomes [8], pelvic instability, and sacroiliac joint arthritis from violation of the SI joint surface [9, 10]. Mirovsky et al. [11] compared the outer table with the intracortical technique and showed no difference in the severity of postoperative pain or blood loss; however, their study was possibly underpowered [12]. They also found that the intracortical technique provided significantly less bone [11]; but, in our experience with this patient, the bone graft harvest was considered substantial in all operations.

Although this is a single-patient case report, it is an indication that with the intracortical technique the iliac crest cancellous bone may regenerate and therefore be available for reharvesting in a subsequent spinal surgery. This makes this technique attractive, even given the current availability of potent synthetic grafts such as the bone morphogenetic proteins.

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