

Autogenous Iliac Crest Bone Graft

Complications and Functional Assessment

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Functional outcomes and complications experienced by adult patients who underwent iliac crest bone grafting were evaluated to assess the effect of bone grafts on patient function. In addition to retrospective chart reviews, patients completed the Sickness Impact Profile and a detailed questionnaire on pain. One hundred ninety-two patients met study inclusion criteria. Major complications were recorded in four (2.4%) patients in whom infections developed requiring readmission. Thirty-seven (21.8%) patients had minor complications. One hundred nineteen of 170 patients were available for followup; of these 119 patients, 87 (73.1%) returned completed questionnaires. Thirty-three of 87 (37.9%) patients reported pain 6 months postoperatively. The incidence of pain decreased with time, with 16 of 87 (18.7%) patients continuing to report pain more than 2 years postoperatively. Proportionately more spine patients reported pain at all time points. The mean Sickness Impact Profile score for patients completing questionnaires was nine, suggesting most patients were functioning well 2 years postoperatively. The morbidity of iliac crest grafting remains substantial. Pain symptoms in this study sample seemed to last longer in more patients than earlier series have indi-

cated. Minimizing muscle dissection around donor sites and the advent of bone graft substitutes may help alleviate these problems.

Approximately 200,000 autologous bone grafts are harvested annually in the United States, most commonly from the posterior iliac crest.¹¹ Serious complications rarely are associated with bone grafts, but have a profound effect on outcome when they do occur. Proximity of the bone graft site to vascular and neurologic structures accounts for many of the most serious complications of bone graft surgery. Reported major complications include pseudoaneurysm of the pelvic vasculature,² arteriovenous fistula,^{2,8} massive blood loss,^{2,14} pelvic instability presenting as low back pain,⁶ avulsion of the anterior superior iliac spine,^{5,13,18,19} ureteral injury,⁸ hernia,^{3,10,16,21} and neuropathy.^{9,22}

Retrospective series assessing bone grafting procedures have confirmed that catastrophic complications occur rarely. Considerable disparities have been reported in the overall incidence of complications, and the distinction between major and minor complications has been arbitrary, often poorly defined, and widely variable between series. Minor complications reported have consisted of cutaneous nerve damage, persistent discomfort, and local wound complications including superficial infections, seromas and

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hematomas, and poor cosmesis at the bone graft incision site.

Most authors concur that complications are common and that they may have lasting adverse effects.^{1,4,12,14,15,21,24} For example, Canady et al¹ reported a 4% minor complication rate and no major complications in a series of 50 patients with iliac crest donor sites. Cockin's⁴ series of 118 iliac crest bone grafts included a minor complication rate of 6% and a major complication rate of 3.4%. Using more inclusive complication criteria, Younger and Chapman²⁴ reported a major complication rate of 8.6% and a minor complication rate of 20.6% in their series of 243 autogenous grafts, including 215 grafts from the iliac crest. In contrast to these well documented series, most reviews of iliac crest bone grafts have been limited by either small numbers of patients or short term followup. Even among the most complete series, little has been reported about the impact and duration of these complications on patient function.

To better assess the effect of bone graft harvest on patient function, a retrospective analysis of iliac crest bone grafting with long term followup was initiated at the authors' institution. This study was designed to assess the functional outcome of patients who have undergone bone graft procedures as a function of time after surgery and to document accurately the complication rates associated with this common procedure.

MATERIALS AND METHODS

The medical records of all patients who underwent iliac crest bone grafting as part of their primary orthopaedic procedure at the University of Michigan Medical Center from 1988 to 1991 were reviewed retrospectively. Patients were at least 18 years of age at the time of their operation. Patients in whom multiple iliac crest bone grafts were harvested were excluded from the analysis.

Operative notes, discharge summaries, and clinic notes were evaluated by two reviewers. Age, gender, location of harvest, operative indication, operative time, estimated blood loss, medical history, all complications related to the iliac

crest, and any reference to discomfort at the iliac crest or the appropriate cutaneous nerves of the harvest region were recorded. The approach to the iliac crest graft site, either through the same incision used to expose the primary surgery site, or through separate incisions, also was recorded.

Complications were defined as major if additional hospitalization related to the graft site was required for intravenous antibiotics, debridement, or other hospital care related to the graft site. Minor complications included self limited wound problems such as stitch abscesses requiring oral antibiotics (or no treatment), and any recording of wound drainage at discharge or followup. Complaints of pain or numbness related to the iliac crest were classified as minor if the pain was controlled adequately with nonnarcotic medications. Complaints of pain were divided into those recorded less than 3 months after surgery and those longer than 3 months postoperatively. Cosmetic complaints were recorded if any form of scar revision was requested or if plastic surgery consultation was sought. Complications of the primary operative site included incisional pain of the primary operation, residual low back pain or radicular symptoms, or deep infection of the primary operative site.

All available patients were asked to complete a postoperative pain questionnaire and a standardized assessment instrument (the Sickness Impact Profile²⁵) to assess overall current health status and level of function. The status of wound infection, pain, paresthesia, and gait disturbances related to the iliac crest donor site were determined at intervals of 6 months, 12 months, and 24 months postoperatively, and the most current followup visit past 24 months.

RESULTS

One hundred ninety-two patients met study inclusion criteria. Twenty-two (11.4%) of these patients subsequently required an additional iliac crest bone graft and were excluded from the analysis. Of the remaining 170 patients in this study, 110 were men and 60 were women. The average age at surgery was 41 years (range, 18–87 years). One hundred thirty-six (80%) patients underwent spinal operations as their primary procedure. In the spinal surgery group the graft was har-

vested through the same incision in 90 patients and the posterior iliac crest was used as the bone graft donor site for all but one spine operation. Of the remaining 34 bone grafts that were not part of a spinal operation, nine were used at acute fracture sites, 21 were used as a part of treatment for fracture nonunion, and four were used in association with joint fusions. Twenty-one of these 34 patients had grafts obtained by an anterior approach, and 13 from a posterior approach.

Major complications were recorded in four (2.4%) patients. An iliac crest abscess developed in one patient, requiring readmission 3 weeks postoperatively for intravenous antibiotics and subsequent debridement. Three patients with superficial infections required hospitalization. One of these superficial infections cleared without operative intervention, with treatment consisting of only 3 days of intravenous antibiotics. Two patients with superficial infections required operative debridement of their wounds with evacuation of hematomas superficial to the fascial layer.

Thirty-seven (21.8%) patients had minor complications. Twenty-eight (16.5%) of these consisted of complaints of pain about the iliac crest that were noted in the followup clinic notes. Of these, 10 had pain 3 months or later after their surgery. Six (3.5%) minor superficial wound problems (stitch abscess, minor drainage) were observed. Two (1.2%) patients had keloids form over the separate incision required for the bone graft used for scoliosis surgery. One patient reported numbness 3 months after bone graft harvest through a separate incision.

Questionnaires were sent to 119 of 170 patients; three patients were deceased and 48 patients had no available address or phone number. Of the available 119 patients, 87 (73.1%) returned completed questionnaires. The questionnaire respondents seemed to be representative of the entire study sample. Forty-nine men and 38 women responded. Among these patients, the mean age at the time of surgery was 41 years (range, 18–75 years) with a mean followup of 56 months (range, 31–89 months). Seventy-one (81.6%) of

these patients underwent spine operations as their primary procedure. The graft was harvested through the same incision in 52 patients in this group. Of the remaining 16 bone grafts, five were used at acute fracture sites, eight were used as a part of treatment for fracture nonunion, and three were used in association with joint fusions.

The mean Sickness Impact Profile score for patients completing questionnaires was nine of 100, with lower scores indicating better function. The Sickness Impact Profile score ranged from 0 to 39.5. The physical dimension score was eight (range, 0–34.7), and the psychosocial dimension score was 8.2 (range, 0–59.3), suggesting that most patients were functioning well 2 or more years after surgery.

The most frequent complaint reported by patients in the questionnaire in the first 6 months after surgery was pain, present in 33 of 87 (37.9%) patients. The reported frequency declined to 16 of 87 (18.3%) patients at 2 or more years postoperatively. Of the 16 patients who reported continued pain at the bone graft donor site, 15 had a spinal operation for their primary orthopaedic procedure, and nine of these procedures were performed through the same incision. The most frequent words patients used to describe their pain were tender, sharp, penetrating, and numb. Some patients reported that it was difficult to differentiate back pain from pain at the bone graft site. Proportionately more patients who had spine surgery reported pain at each time point, with 30 of 71 (42.3%) of these patients reporting pain at 6 months. In contrast, only three of 16 (18.7%) patients who had surgery not involving the spine reported pain at 6 months. At 2 or more years after surgery, the trend continued with 15 of 71 (21.1%) patients who had spine surgery reporting pain compared with only one of 16 (6.2%) patients who had surgery not involving the spine. Seven of the 16 patients who reported they had persistent donor site pain stated that they took a prescription analgesic regularly for their back pain and donor site pain. Only

one patient of the 16 who did not undergo a spine procedure reported persistent pain at the donor site at greater than 2 years followup. This patient had an iliac crest bone graft harvested as part of treatment for an acute fracture and continued to use codeine for control of donor site pain.

Another complication reported by patients was difficulty ambulating because of bone graft donor site pain. Eleven (12.6%) patients reported difficulty ambulating in the first 6 months postoperatively. Of these 11 patients, five still reported difficulty 2 or more years after surgery. In the first 6 months, patients who had spine surgery represented eight of the 11 patients in this group reporting ambulation difficulties, and four of the five patients 2 or more years after their surgery.

DISCUSSION

Autogenous iliac crest bone grafts are well recognized as the gold standard against which alternative methods must be measured. Complications associated with the harvest of iliac crest bone grafts have been accepted largely as costs associated with the higher success rates bone grafts confer on primary orthopaedic procedures. Bone graft procedures clearly have been associated with discomfort and may be associated with other less common but more serious consequences. As results with bone graft substitutes approach the success rates achieved with autogenous grafts, appreciation of the risks and costs associated with iliac crest bone grafts will become increasingly important. This study was designed to assess the functional outcome of patients who have undergone bone graft procedures as a function of time after the surgery, and to report the complication rates in a sample of patients at the authors' institution.

Pain is the most frequently cited complication of harvesting iliac crest bone grafts. Laurie et al¹⁵ reported that all of their patients had moderate pain that lasted for ap-

proximately 6 weeks and that 10% of their patients experienced moderate pain with exercise 2 years or more postoperatively. DePalma et al⁷ reported discomfort lasting for more than 1 year in 36% of their patients in whom an anterior iliac crest bone graft had been harvested. Younger and Chapman²⁴ reported only a 2.5% incidence of complaints of donor site pain greater than 6 months postoperatively. In their series, in which pain was noted to be present only when documented in patients' progress notes, continued pain was considered a major complication.

In this current series, 28 (16.5%) patients reported pain at the iliac crest donor site during the first 3 months after surgery when information was obtained by chart abstraction alone. Questionnaires specifically directed at the description of postoperative pain led to a reported incidence of pain that was higher than the incidence of pain observed by retrospective review of the medical records alone. At the time of followup 2 or more years after surgery, 33 of 87 (37.9%) patients reported that at 6 months after surgery they still had pain. The reported frequency of pain declined to 16 of 87 (18.3%) patients at 2 or more years postoperatively, an incidence considerably higher than reported in the previous literature cited above.^{7,15,24} The authors' findings concur with previous observations in the literature that the incidence of pain after iliac crest bone harvest decreases with time. Using a detailed evaluation of pain and a standard outcome measure, this study shows that many patients continue to have some level of discomfort associated with this surgery long after the operative procedure, but that this level of discomfort does not detract greatly from their psychosocial or physical functioning in most cases.

In the current series a greater number of patients who had spine surgery reported pain when compared with patients having other surgical procedures. Patients who have spine surgery may represent a subset of a population at greater risk for development of post-

operative pain regardless of operative site or donor site. Summers and Eisenstein²¹ reported a 25% rate of chronic donor site pain in patients who had lumbar spine fusion in which bicortical and tricortical grafts were taken. In contrast, Canady et al¹ assessed 50 consecutive patients and found no patients reporting any long term pain or disability related to iliac crest donor sites used for maxillofacial procedures. The wide variations in reported complication rates may be related to the number of patients undergoing spine fusion in each study when compared with the volume of bone graft harvested, or perhaps other factors not yet defined.

Difficulty ambulating because of donor site pain was a concern among the patients in this study. Eleven of the 87 patients completing the questionnaire at 2 or more years after surgery reported difficulty ambulating 6 months after the bone graft had been harvested, and five of these patients continued to have difficulty ambulating more than 2 years after surgery. Keller and Triplett¹² reported a 10% rate of difficulty ambulating 3 months postoperatively in patients with grafts obtained from the lateral cortex of the iliac crest. These rates are comparable with those found in the current study.

Many of the complications in this series occurred in patients who underwent posterior spine fusions in which a posterior iliac crest graft was harvested through the same longitudinal incision used to expose the spine. This finding is consistent with the series of Younger and Chapman,²⁴ in which the highest complication rates also were found in posterior iliac crest grafts harvested through the same incision.

The major complication rate associated with iliac crest bone grafting procedures in the current study may be overstated; in each of the three infections that occurred in association with a single incision in the series, the iliac crest site clearly was observed to be isolated from the site of infection at the time of the debridement procedure. Nevertheless, the authors included these three infections as

major complications of the bone graft surgery because the role of bone graft harvest could not be excluded as contributory to the complication. Of the major complications in this series, only one case is clearly attributable to the iliac crest harvest. In this case, the graft was retrieved through a separate incision. An ensuing iliac crest abscess led to rehospitalization 3 weeks after surgery. The minor complications in the current series consisted of six infections, which were classified as minor because all resolved with no intervention other than dressing changes, oral antibiotics, or both.

The low response rate to questionnaires is a limitation in this study. Although 73.1% of the patients who could be contacted did respond to questionnaires, the overall response rate for all the patients included in the study was only 51.2%. Generally, a response rate of 65% or more in a questionnaire survey is considered good, a response rate of 50% is minimally adequate, and below 50% the likelihood of response bias becomes increasingly likely.²⁰ Although the patients responding to the questionnaire seemed to be similar demographically to those not responding, these patients may have had higher complication rates and thus have been more likely to respond than patients with few or no complaints. Thirty-one of the 40 patients with major or minor complications by chart abstraction were available for contact. Twenty-four (77.4%) of these patients responded to the questionnaires. Without a higher response rate, bias cannot be excluded as one possible explanation for the study findings. Nonetheless, the results of the questionnaire raise important issues relating to the harvest of iliac crest bone grafts.

The wide variations in complication rates associated with bone grafting procedures and the emergence of substitute materials as potential alternatives to iliac crest bone grafting point to the need for a better understanding of the risks associated with iliac crest bone grafts in an orthopaedic practice. The limitations in the current study include the

small numbers of patients who did not have spine surgery and the low response rate to questionnaires. Additionally, the retrospective approach used in this study has not allowed the authors to correlate the mass of bone graft harvested, the incidence of post-operative pain, and patient outcome after bone graft surgery. A prospective approach, enlisting patients with orthopaedic problems before the operative procedure, currently is underway at the authors' institution to better ensure a higher postoperative response rate and reduce the likelihood of introducing response bias.

Although bone graft complications encountered in this series occurred less frequently than the complications reported in other recent series, the morbidity of iliac crest bone grafting in the orthopaedic population remains substantial. Methods of bone graft surgery that minimize dissection around the donor site, and the advent of bone graft substitutes, may alleviate these problems in the near future.

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