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ORIGINAL PAPER

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Comparison of traditional and intrafascial iliac crest bone-graft harvesting in lumbar spinal surgery

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Abstract We studied 117 adult patients undergoing posterior lumbar spinal fusion and instrumentation using bone grafts from the iliac crest between February 1999 and January 2001. All patients had degenerative disease of the lumbar spine, and all were operated upon by the same surgeon. Patients were randomized to have the iliac bone graft harvested either through a separate incision (traditional approach) or utilizing the same midline incision as used for the spinal surgery (intrafascial approach). Total volume of harvested graft, blood loss, pain, complications, and patient satisfaction were evaluated with a minimum of 2-year follow-up. There were no infections. The average volume of harvested bone was 17.2 cc versus 14.7 cc; total blood loss was 168 cc versus 96 cc; total complication rate was 20% versus 8%, and overall satisfaction rate was 81% versus 96%, respectively. The intrafascial graft harvesting technique minimizes morbidity and increases patient satisfaction compared with the traditional bone harvesting technique.

Résumé Nous avons étudié 117 malades adultes traités par arthrodèse lombaire postérieure avec instrumentation et greffe iliaque entre février 1999 et janvier 2001. Tous les malades avaient une maladie dégénérative de la colonne vertébrale lombaire et tous ont été opérés par le même chirurgien. Les malades ont été randomisés pour avoir la greffe iliaque prélevée par une incision séparée (approche traditionnelle) ou par la même incision médiane habituellement utilisée pour la chirurgie vertébrale (approche intrafasciale). Le volume totale de greffe prélevée, la perte de sang, les douleur, les complications et la satisfaction des malades ont été évalué avec un minimum de suivi de deux années. Il n'y avait pas d'infection. Le volume moyen d'os prélevé était 17,2 cc contre 14,7 cc; la perte totale de sang était 168 cc contre 96 cc; le taux de complications était 20% contre 8% et le taux de la satisfaction était 81% contre 96% respectivement. La technique de prélèvement intrafasciale minimise la morbidité et augmente la satisfaction du malade comparée à la technique traditionnelle de prélèvement.

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Introduction

Bone graft is used in spinal surgery to achieve fusion [3–5, 9, 12, 14]. Fresh autogenous bone graft is considered the most successful material and provides more predictable results than allograft because of its osteoinductive and osteoconductive properties [5, 9, 12]. Autogenous bone graft has the advantage of histocompatibility, nonimmunogenicity, and absence of potential for disease transmission [3–5, 8, 11, 14].

The posterior iliac crest and the lateral wall of ilium is a bountiful source of corticocancellous bone in posterior spinal fusion surgery [4, 6, 13]. The most common complications are pain and sensory loss at the donor site, but other complications such as graft site fracture, cluneal nerve palsy, tissue herniation, and superior gluteal artery laceration have been recorded [2, 3, 6, 7, 9, 10, 14].

In the literature, different complication rates are given for various bone-graft harvesting techniques. One is known as the intrafascial or midline splitting technique and is considered to have a low complication rate [9]. The purpose of this study was to compare the amount of harvested bone graft, pain, blood loss, and donor-site complications in a homogenous group of patients undergoing posterior iliac crest bone-graft harvesting either with the traditional separated incision approach or with the intrafascial (same midline incision) technique [9].

Materials and methods

From February 1999 to January 2001, a randomized clinical study was conducted comparing two techniques of iliac crest bone-graft harvesting in 117 adult patients

undergoing low back surgery. All patients had the diagnosis of degenerative disease of the lumbar spine, and all had spinal decompression with posterior fusion using iliac bone graft and instrumentation. Patients were randomly allocated to the technique of bone-graft harvesting by using a random number generator . Patients were informed about the harvesting techniques and approved the procedure that they had and were grouped according to the harvesting technique with a similar body height and weight (height between 160–180 cm, weight between 60–90 kg) to avoid any variation according to the graft site volume. Group 1, for which the traditional posterior iliac crest bone-graft harvesting technique was used, consisted of 59 patients—27 men and 32 women; mean age 51. Group 2 consisted of 58 patients—24 men and 34 women; mean age 48, for whom the intrafascial posterior bone-graft harvesting technique was used. There was statistically no difference between two groups ($p>0.05$).

Techniques

The traditional posterior harvesting procedure was performed in a standardized fashion. An oblique skin incision was made over and slightly lateral to the posterior iliac spine and parallel to the route of the superior cluneal nerves. Thoracolumbar fascia was dissected as far as the posterior iliac crest. To harvest by intrafascial technique, the same incision that had been made for the low back surgery was used, and the superficial fascial extension of the latissimus dorsi with its horizontal fibers were retracted superiorly (Fig. 1). The fascia, with vertically oriented fibers enveloping the erector spinae muscles that attached to the midline spinous processes, was dissected up to the iliac crest [9].

In both techniques, the harvested grafts were in the form of cancellous bone chips and strips. The outer table technique was used at both harvesting procedures; iliac crests were exposed subperiosteally, the outer cortical table was removed with the use of osteotomes, and the cancellous strips of bone were taken from the outer cortical table of the crest with gouges and curettes [1, 11, 12]. All bone-graft strips were then converted to chips with the use of rongeurs. The grafts were placed in a 50-cc plastic syringe and covered with marrow blood. Their volume was measured with the use of the volumetric part of the syringe [1]. All donor-site incisions were closed over hemovac drains, which were left in place for 3 days postoperatively. The amount of blood loss, including the intraoperative blood loss and drain output at the donor site over 3 days, was measured. Postoperative management for the donor site consisted of the administration of prophylactic antibiotics for 24 h.

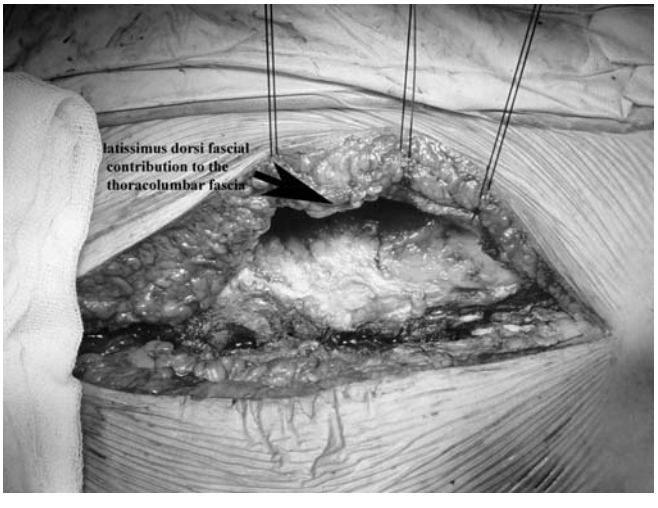

Fig. 1 In the intrafascial harvesting technique, the same incision was used for spinal surgery and for bone harvesting. The superficial fascial extension of the latissimus dorsi muscle with its horizontal fibers was retracted superiorly.

The volume of bone graft harvested, estimated blood loss, and minor and major complications were recorded (Table 1). Minor complications were defined as self-limited events that did not require an additional surgical procedure. Major complications resulted in extended patient hospitalization or required additional surgical procedure. Residual pain and sensory loss were also considered major complications [1]. Questions regarding all complications were routinely asked, and the answers were recorded in the clinic chart of every patient.

A detailed functional outcome questionnaire pertaining to the level and duration of postoperative and residual pain, sensory disturbances, functional limitations, cosmetic appearance, and overall satisfaction with the result of the bone-graft procedure was presented to all patients [1]. There were also questions concerning the locations of both temporary and residual sensory disturbances. Functional disturbances were evaluated with questions pertaining to gait, difficulty with climbing stairs, and rising from a seated position. Patients were interviewed at a mean of 33 months (minimum 24 months) by telephone or at their latest follow-up clinic visit by a surgeon (BK) not involved in the patient care.

A visual analog scale (VAS) for pain was used. The patients were asked to grade the severity of postoperative pain at the donor site on a scale of 1–10. At the end of the follow-up time, patients were also asked whether they were satisfied or dissatisfied with the overall result of the bone-graft procedure and cosmetic appearance.

Statistical analysis

Statistical analysis was performed with the Mann–Whitney U test with the use of unpaired t test, the Pearson chi-square test, and the Fisher exact test. Any p value smaller than 0.05 was considered significant.

Results

The average amount of bone harvested was 17.2 cm^3 in group 1 and 14.7 cm^3 in group 2 ($p<0.001$). Mean intraoperative blood loss was 82 ml for group 1 and 46 ml

Table 1 Comparison of two harvesting procedures

	Traditional posterior bone-graft harvesting	Intrafascial posterior bone-graft harvesting
Number of patients	59	58
Mean volume of graft harvested (ml)	17.2 cc (range 10–28, SD 4.62)	14.7 cc (range 8–21, SD 3.45)
Mean total blood loss (ml)	168 cc (range 110–234, SD 40.5)	96 cc (range 56–180, SD 25.74)
Total complication rate (%)	20.3	8.6
Visual analog score (VAS)	2	0.25
Overall satisfaction rate (%)	81.3	96.5

for group 2 ($p<0.0001$). Mean total blood loss that comprised intraoperative and postoperative values were 168 ml and 96 ml for group 1 and 2, respectively ($p<0.0001$) (Table 1). There were no infections at the donor site in either group.

The total complication rate for the two harvesting procedures was 12/59 (20.3%) for group 1 and 5/58 (8.6%) for group 2. The rates of both minor and major complications were significantly higher in group 1 ($p<0.05$) (Table 2).

Twelve minor complications occurred, including seroma formation in three patients. Six patients complained of temporary sensory loss, and three patients suffered from pain over the donor site lasting more than 1 month. All of these complications resolved by 6 months. There were five major complications. One patient had a sacroiliac joint penetration at surgery that caused pain but did not interfere with daily activity. Three patients still had pain over the donor site at the 12th month follow-up and one patient complained of residual numbness over the donor site lasting more than 8 months. There were no reoperations (Table 2).

Postoperative VAS pain score at the donor site ranged from 6 to 0 with a mean of 2 in group 1 and ranged from 4 to 0 with a mean of 0.25 in group 2 ($p<0.0001$). Patients who underwent the traditional grafting procedure had more severe postoperative pain and also complained of pain for a longer period than did those who underwent the intrafascial grafting procedure. In group 1, 48 patients (81.3%) and in group 2, 56 patients (96.5%) rated their overall satisfaction as satisfactory ($p<0.05$).

Table 2 Comparison of complication rates of two harvesting procedures

	Traditional posterior bone-graft harvesting (n=59)	Intrafascial posterior bone-graft harvesting (n=58)
Minor complications total	8	4
Serous hematoma	2	1
Temporary sensory loss	4	2
Pain over the donor site lasting more than 1 month	2	1
Major complications total	4	1
Sacroiliac penetration	0	1
Pain over donor site lasting more than 1 year	3	0
Residual numbness over donor site	1	0

Discussion

The average volume of bone graft harvested from traditional posterior iliac bone graft harvesting technique has been reported as 30 cm^3 [3, 4, 12]. In this study, a relatively smaller amount of corticocancellous and cancellous bone graft was harvested, averaging 17.2 cm^3 and 14.7 cm^3 from group 1 and group 2, respectively ($p<0.001$). Our results were less than reported values. In the literature, some evidence suggests that the larger the graft harvested, the higher rate of complications [8]. Mean total blood loss for traditional posterior iliac crest bone-graft harvesting technique has been reported to be in the range of 160–180 ml [3, 12, 14]. In this study, the results were 168 ml for group 1 and 96 ml for group 2. The average blood loss in group 1 was in the expected ranges, as documented in the literature, but the mean value of group 2 was statistically lower ($p<0.0001$).

Drawbacks of autogenous bone-graft harvesting include increased surgical morbidity from the additional surgery, increased blood loss, time required for surgery, additional cost, and donor-site pain [2, 3, 6–8, 10, 12–14]. In the literature, high complication rates of 14–25% were reported after bone-graft harvesting from the posterior iliac crest [2, 3, 6, 7, 10, 12–14]. Documented donor-site complications include hematoma, false aneurysm formation, nerve and arterial injuries, gait disturbances, fracture of iliac wing, sacroiliac instability, pain, and growth disturbance in children [3, 12, 14]. The major and minor complication rates during traditional posterior iliac crest bone-graft harvesting procedure is 2.8–10% and 5.6–39% [3, 12, 14]. Our results were 6.77%, 1.72%, and 13.5%, 6.89% for major and minor complications in group 1 and in group 2, respectively. The results were in expected ranges.

The total complication rates for group 1 and group 2 were 20.3% and 8.6%. Our complication rates for group 1 were similar to the literature, but statistically less complication rates were seen in group 2 for which the intrafascial bone-grafting technique was used ($p<0.05$). The intrafascial bone-graft harvesting procedure appears to be a safer procedure than the traditional one. Reported rates of donor-site infection have ranged from 0% to 3% [1, 11].

Hematoma formation has been reported in 1–10% of patients following harvesting of posterior iliac crest bone grafts, and it has been associated with an increased risk for infection [3, 12, 14]. In this study, there were only two seroma (3.38%) seen in group 1 and one (1.72%) in group 2 as a minor complication, and neither required treatment. Those rates were within accepted ranges, as reported in the literature. The number of patients with temporary sensory loss due to contusion of cluneal nerves (considered as a minor complication) was 4 (6.77%) for group1 and 2 (3.44%) for group 2, respectively. One patient (1.69%) in group 1 had residual numbness over the donor site lasting more than 8 months, but no permanent sensory loss was seen in either group at the end of the follow-up. In our series, three patients, 2 (3.38%) in group 1 and one (1.72%) in group 2, had temporary pain lasting more than 1 month (considered a minor complication), and three patients (5.08%) from group 1 had residual pain lasting more than 1 year (considered a major complication). Only one patient in group 2 had sacroiliac joint penetration at the time of the surgery, but this major complication only caused minor pain that did not interfere with daily activity or require additional surgery.

The rates of satisfaction after harvest of iliac crest bone graft have been reported at a range between 83% and 88% when a traditional posterior bone-grafting technique was used [3, 12, 14]. In this study, the overall satisfaction rates were 81.3% and 96.5% for traditional and intrafascial techniques, respectively. Patients in group 2 were significantly more satisfied ($p<0.05$). The VAS score at the donor site after surgery was 2.0 in group 1, a value that is statistically higher than the score of 0.25 for group 2 ($p<0.0001$). This may be related with fact that the intrafascial approach was less traumatic to soft tissues, and also, there was no need for a second skin incision.

In conclusion, posterior iliac crest bone-graft harvesting with intrafascial technique compared to the traditional technique significantly reduced the incidence of postoperative serous hematoma and disabling pain and increased patient satisfaction. Significantly, the intrafascial approach is simple, anatomic, decreases trauma to soft tissues, and reduces the risk of postoperative complications. Another advantage is that there is no requirement for a second skin incision; having only one incision wound for two procedures increases patient satisfaction with respect to cosmetic appearance. Moreover, with the intrafascial approach, the cluneal nerves located in the subcutaneous tissue are less likely to be damaged. Although the harvested graft volume is smaller than with traditional technique, due to its lower complication rate, intrafascial graft harvesting could be preferred to traditional iliac-crest harvesting for low back surgery.

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