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Bone Graft Harvesting Site Morbidity in Donor Area (Anterior Iliac Crest): A Retrospective Study

Bhaskar Borgohain[1], Tashi G Khonglah[1]

Learning Point of the Article:

Anterior iliac crest for bone graft harvesting with an open technique appears to be a safe procedure with low long-term donor site morbidity from the patients' perspective, when performed/ supervised by an experienced surgical team in a tertiary-care teaching hospital.

Abstract

Introduction: In orthopedic practice, autologous bone grafts are routinely employed to aid fracture healing in non-unions. The anterior iliac crest (AIC) is readily accessible, and a standard harvesting site in adults, yielding a generous quantity of bone grafts. Although autologous bone graft remains the gold standard, harvesting graft from the AIC may potentially risk donor site morbidity that is highlighted, especially in the western literature. Our objective in this study was to explore the quantum of donor site morbidity after harvesting AIC bone graft for various reconstructive orthopedic surgeries.

Materials and Methods: A total of 44 patients of autologous AIC bone graft procedure for various reconstructive orthopedic surgeries (with an average follow-up of 3 years) were evaluated retrospectively on a 9-point retrospective questionnaire response to understand the extent of morbidity.

Results: Early post-operative pain at the donor site was reported by 19 patients, but the highest level of pain was only 3/10 in Visual Analog Scale (VAS). There was no post-operative wound complication at the donor site (both as per file records/discharge paper and/or patient recollection). Only two patients experienced pain that lasted beyond 1 week. After stitch removal, the average pain in VAS reported was as low as 0.8, and none complained of any residual pain at the final follow-up. Only two patients experienced persistent paresthesia at the donor site.

Conclusion: In our hands, AIC for bone graft harvesting was a safe and effective procedure with low donor site morbidity. This low morbidity appears to be due to multiple factors (1) low volume of work compared to high volume/high turnover centers (2) bone graft harvesting done by surgeons not below the rank of senior resident (3) awareness in the surgical team about potential graft site morbidity (4) adjunct local anesthetic infiltration/post-operative regional block and pre-emptive analgesia.

Keywords: Anterior iliac crest graft, bone graft, donor area, morbidity, paresthesia, complications, orthopedics.

Level of Study: Level IV, Retrospective study.

Introduction

The problem of fracture site non-unions in some fractures is universal despite advances in our understanding of fracture biology, biomechanics, and surgical techniques. Autologous bone grafts are commonly used to promote fracture union during difficult and redo osteosynthesis. The anterior iliac crest (AIC) is the preferred harvest site due to the simplicity in harvesting (most surgeries are performed in supine position) and the quantity and quality of bone graft obtainable. Being autogenous, it is non-immunogenic, tends to incorporate well to host bone

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Author's Photo Gallery

Dr. Bhaskar Borgohain

Dr. Tashi G Khonglah

[1]Department of Orthopaedics and Trauma, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong, Meghalaya, India.

Address of Correspondence:
Dr. Bhaskar Borgohain,
Department of Orthopaedics and Trauma, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong - 793018, Meghalaya, India.
E-mail: bhaskarprofessor@gmail.com

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(when compared to artificial bone grafts), being inherently both osteoconductive and osteoinductive [1].

The morbidity associated with harvesting iliac bone graft (IBG) in adults is well documented [2,3]. The potential complications of bone graft harvesting are bleeding, hematoma, pelvic fractures, nerve damage (sensory loss) and infection [4]. Severe and prolonged pain at the iliac crest after graft harvesting is reported [2,3,4]. To circumvent these issues, bone graft substitutes are now available. However, their lack of osteoinductivity, additional cost and risk of infection (being synthetic foreign materials) are currently the major concerns [5,6].

Materials and Methods

We conducted a retrospective study involving all patients of AIC bone graft harvesting (as part of their orthopedic surgical treatment) between April 2010 and December 2015. All procedures were performed in compliance with institutional guidelines and with due approval by the appropriate institutional committee(s) vide Reference no. P87/19/87 vide letter no. NEIGR/IEC/M8/F9/19. We did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The aim was to assess donor site morbidities after harvesting of AIC bone graft in the department of orthopedics of a regional tertiary care teaching institute of India. The patients were identified from the operative records of the department of Orthopedics. All patients received pre-emptive intravenous paracetamol and adjunct local anesthetic infiltration/post-operative continuous regional block, and standard the World Health Organization (WHO) step ladder pattern of analgesia protocol after surgery was used as per pre-existing departmental pain control protocol. Only adults and adolescents (15 years and above) who have had bone graft obtained from the AIC were included in the study. These patients were then invited to answer a predefined questionnaire. The study was based on the retrospective 9-point retrospective questionnaire response as proposed by Pollock et al. [7]. The questionnaire was duly validated by a panel of experts with face validity and content validity, with an acceptable content validity index limit (0.8). The Visual Analog Scale (VAS) score records of the immediate post-operative period were included as well. All Patients were assessed retrospectively for complications (bone graft site morbidity at AIC) using the self-administered questionnaire which consisted of nine questions about (1) Pain at donor site and its effect on functions, (2) complications due to donor site surgery and (3) satisfaction with scar appearance, (4) a global outcome question at the end to understand the overall satisfaction/complications with bone graft harvesting.

Demographic characteristics, harvest site confirmation, surgical indication for bone grafting, and any complications after surgery were also recorded. The participants were specifically asked about their post-operative pain, sensory disturbances like paresthesia, functional limitations, and cosmetic appearance of their scar, etc., in respect to the graft harvesting site.

Results

A total of 44 adults and adolescents (15 years or above) underwent AIC bone graft harvesting in this 5-year period. Retrospective questionnaire feedback from all 44 patients was obtained over a period of 4 weeks. There were 28 males and 16 females, the mean age at surgery 35.7 years (range 15–64 years). Out of 44 patients, 32 patients underwent operation for non-union of the lower limb fractures, while 22 patients for the upper limb non-unions. The average follow-up period was 3 years. The results were summarized in a table and figures for clarity in Table 1 and Fig. 1, respectively.

Early post-operative pain at the donor site was reported by 19 out of 44 patients (43.2%), and of these, only two (4.5%) patients experienced pain that lasted for more than a week. A VAS was used to measure the intensity of pain. After stitch removal, the average pain in VAS retrospectively was below 2. One patient had a minor wound complication without any sequalae. None complained of any residual pain at the final follow-up.

Only two patients (Both were females) reported a VAS score above 3 until stitch removal. Patients who were operated on their lower extremities did require some form of walking aid

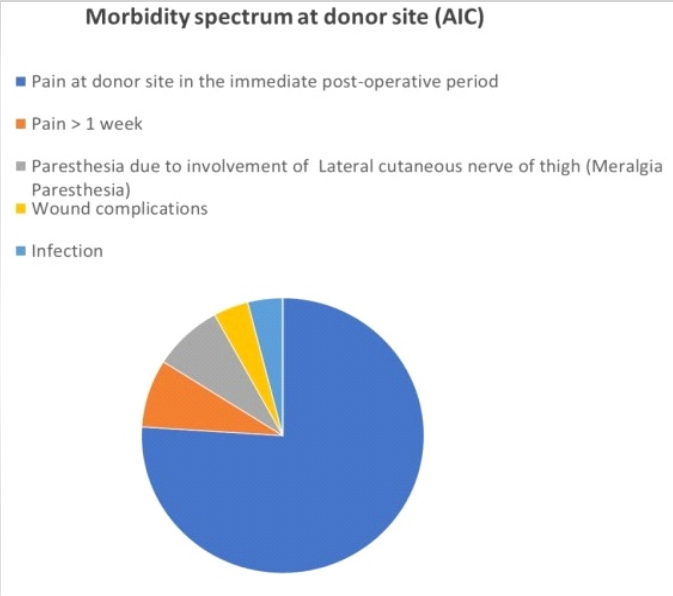

Figure 1: Distribution of Donor-site Morbidity.

(axillary crutches, frame walkers) for a period of at least 6 weeks due to restrictions on full weight bearing and not due to pain from the graft donor site. There were no post-operative wound complications at the donor site. Apart from paresthesia at the donor site reported by two patients (4.5%), no post-operative wound complications were reported from the AIC donor site. All patients were satisfied with the scar, and none had any identifiable functional limitations related to the harvest site.

Discussion

We tried to understand the extent of donor site morbidity in patients (a rather homogeneous group of adults and adolescents above 15 years of age; all having limb bone non-unions after fractures) after AIC bone graft harvesting. Although AIC is both popular and preferred as a source of autogenous bone graft donor site and is generally considered safe, nevertheless, morbidity and complications are not unreal. The reported incidence of such complications after iliac crest bone graft harvesting ranges from 2% to 39%; pain at the donor site being the most frequent among them [1,8]. Other known complications include fractures, neurovascular injury, urethral injury, infections, herniation of abdominal contents, pelvic instability, cosmetic defects, hematomas, and tumor transplantation [9]. Fortunately, major complications are uncommon (tend to resolve with appropriate management), and minor complications may continue for months to years [2].

Pollock et al., reported donor site pain (experienced by 62% of their patients) as the commonest complication lasting <6 weeks [7]. The reported incidence of temporary pain varied [10] from 2.8% to 17%. Chronic pain after graft harvesting was reported [11] in 29% of their patients. Several hypotheses exist to explain the origin of such post-harvest pain; the precise cause, however, remains unclear. It could be due to nerve injury or disruption of the musculature during graft harvesting [12]. Goulet et al., reported pain in 37.9% of their patients at 6-month follow-up, with persistent pain in 18.3% of them even at 2 years [2]. In our study too, 19 (43.2%) patients reported early post-operative pain at the donor site following surgery, but only two patients had pain lasting more than a week. It may be mentioned that the previous studies apply to bone graft taken from the posterior iliac crest for spine surgeries, where the gluteal muscles are released from the iliac crest. Nerve injury is not uncommon complication during iliac crest graft harvesting [4]. Several sensory nerves are known to be inherently at risk. The lateral cutaneous nerve of the thigh is vulnerable during harvesting the AIC [13]. The superior cluneal nerves are at risk during harvesting of the posterior iliac crest [14]. If injured, the typical neurogenic symptoms include pain, tingling, numbness, and paresthesia along the distribution of the injured nerve. All patients were clinically examined for checking sensation along the lateral cutaneous nerve of the thigh – only two patients in our study had chronic altered sensation at the donor site. Knowledge about anatomy of the lateral cutaneous nerve of the thigh and its common variations seems to be important to avoid injuries.

Table 1: Summary table of donor site morbidity after IBG harvesting from AIC

***n*=44**

Morbidity	No.
Pain at donor site in the immediate post-operative period	19
Pain >1 week	2
Paresthesia due to involvement of Lateral cutaneous nerve of thigh (Meralgia Parasthesica)	2
Wound complications	1
Infection	0
Bad scar at donor site	0
Fracture of ilium/pelvis	0
Visceral injury	0

IBG: Iliac bone graft, AIC: Anterior iliac crest

None had infection, vascular injury, hematoma, extensive bruising, scar numbness, fracture, or chronic pain in our study. The reported rate of minor complications (resolve without any intervention) is between 10% and 40%. Minor complications reported are superficial infection, hematoma, and temporary paresthesia [1,2,4,10,11,12]. Major complications can be neurologic injury, vascular injury, deep infection, large hematoma, bowel herniation, fracture or pelvic instability with impaired gait [15]. We did not do a radiological evaluation to confirm absence of any fractures in our study. In a systematic review, Sulistyani et al. [16] reported lower complication after fibular bone graft harvesting and reports high complication rate after IBG, irrespective of the size of bone graft harvested or the age of the donor (without major co-morbidities) for all non-vascularized bone graft harvesting. However, Brandenburg et al. [17] in their study reported that the graft volume and length of scar do have a significant effect on the extent of donor site morbidity (including neurogenic pain) in vascularized IBG harvesting donor site. Schott et al. [18] reported (single-center study with small sample size) lower than anticipated morbidity in pediatric patients of IBG, except donor site pain lasting up to 30 days after harvesting. Lopez et al. [19], Bernstein et al. [20] and Missiuna et al. [21] even suggested avoiding open techniques and consider minimally invasive techniques (e.g. bone grinder and trephine technique, transcrestal technique,

etc.) of graft harvesting to reduce the extent of post-operative pain, need for walker support and length of hospital stay.

The limitations of our study are its small sample size and lack of a control arm for comparison. However, the participation of all 44 patients represented 100% of patients from this institute who underwent bone grafting during this specific period adds to the strength of the study. Being a single-center study, external validity may be limited; but it provides a snapshot on graft site morbidity. Absence of a control group reduces the value of this study; however, currently, there is a lack of any published work in this area from this region. Future work should consider registered clinical trials to compare various techniques (open and minimally invasive techniques of bone graft harvesting). Validated questionnaire adapted from Pollock et al. [7] is not a subjective evaluation but can be considered analogous to a patient-reported outcome measurement tool and quality of life previously used for the same study objectives in patients undergoing spinal fusions. Questionnaire has the ability to measure quality of life, such as WHOQOL-BREF – a 26-item self-report measure for adults to assess self-perceived quality of life [22]. Another drawback is the retrospective nature of our study with possibility of bias concerning the patients' ability to clearly recall the past level of pain and minor complications during their post-operative pain, that too after an average follow-up of 3 years, and thus limits the ability to establish a clear causal relationship. However, each participant was clinically examined as a part of the evaluation for a comprehensive assessment of possible residual complications of graft harvesting to fill up the gap in information. Observer and interviewer bias was minimized by standardizing the process of collecting participant's response and cross-checking by a panel. Being a retrospective study, it was not possible to correlates the quantity of bone graft harvested with donor site morbidity. While interpreting the findings of our study, the limitations of a retrospective design, single-center study and a small sample size, possibility of selection bias – all may be taken into consideration.

Conclusion

With a short-lived post-operative pain and low frequency of complications after harvesting of AIC bone grafts for various orthopedic procedures, we found that the AIC remains a safe site for bone graft harvesting in adolescents and adult patients. There was no significant long-term morbidity associated with well-performed open AIC graft harvesting, when performed/supervised by trained surgeons in the setting of elective surgeries in a teaching hospital. Inadvertent injury to the lateral cutaneous nerve of thigh during this procedure appears to be the primary concern that may add to long term morbidity. In our hands (single-center study with small sample size), AIC for bone graft harvesting with an open technique was a safe and effective procedure with low donor site morbidity. This low morbidity appears to be due to multiple factors (1) low volume of work compared to high volume/high turnover centers (2) bone graft harvesting done by surgeon not below the rank of senior resident (3) awareness in the surgical team about graft site morbidity (4) adjunct local anesthetic infiltration/post-operative continuous regional block, and application of standard WHO step ladder pattern of analgesia protocol after surgery. While interpreting the findings of our study, the limitations of a retrospective design, single-center study, and a small sample size, the possibility of selection bias – all may be taken into consideration.

Clinical Message

In this single-center, retrospective, patient-reported study, open AIC graft harvesting was found to be a safe procedure, with low donor site morbidity when performed in a tertiary care set up. Familiarity of the procedure by an experienced tertiary-care team, team awareness about potential donor-site morbidity and good perioperative analgesia may have contributed to low donor site morbidity.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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