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Harvesting Bone Graft from Anterior Iliac Crest and its Early Impact on Donor Site Morbidity

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Abstract

Objective: To evaluate the frequency of early donor site morbidity of bone graft harvest from anterior iliac crest in orthopaedic surgical procedures.

Methods: This Descriptive case series was conducted at Department of Orthopaedic Surgery, from April 2015 to March 2016. Total 135 patients were taken in to this study, underwent bone grafting taken from iliac crest bone. Complications that occur within 4th postoperative week were labelled as early morbidity which is pain, infection, hematoma, parasthesias, use of walking aid, and gait disturbance. The final outcome was assessed at the end of 4th week postoperatively by assessing early morbidities. Descriptive statistics were calculated and post stratification Chi-square test was applied and p value ≤ 0.05 taken as significant.

Result: Out of 135 patients 111 (82.2%) were male and 24 (17.8%) were female. On the basis of bone graft indication 34.1% patients with fracture nonunion, bone defects needs reconstruction with bone graft observed in 20.7%, joint arthrodesis in 22.2% patients and 23.0% with intraoseous lesions. Pain were noticed in 85.9% patients, hematoma in 5.2%, parasthesias in 38.5%, use of walking aids in 24.4%, infection in 10.4%, and gait disturbance were observed in 20.0% patients.

Conclusion: There is definite donor site morbidity while harvesting a bone graft from anterior iliac crest, but these complications can be addressed by better surgical technique, meticulous closure and cognizant of relevant anatomical land marks and possible anomalies of important structures that are in danger of being injured, however many are unavoidable.

Keywords: Bone graft; Iliac crest; Morbidity

Introduction

Use of auto-genous bone graft is commonly practiced in orthopaedic surgical procedure as in the treatment of fracture non-union, filling the defect after intraosseous lesions excision and for surgical arthodesis of joints [1]. The iliac crest is the commonest donor site for bone grafting as compare to other side because it is easily accessible, relatively large amount of graft can be taken safely [2].

Auto-genous iliac crest bone graft is considered as "Gold Standard" because of it is osteo-inductive, osteogenic, osteo-conductive along with non-immunogenic properties compared to other available bone graft substitutes [3].

Harvesting a bone graft from iliac crest may be associated with donor site complications and morbidity, wide range of complication rates from 9.4% to 49% have reported by various studies, with minor and major complication rates ranging from 6% to 39% and 0.7% to 25 % consequently [4]. Pain at donor site, hematoma and seroma formation, gait disturbance, sensory loss, and surgical site infection are commonly reported complications [5]. Pain is the commonest complication was reported by various studies. R Pollock et al in his study reported 91.3% patients suffered from pain, out of 25 only 1 (4%) patient developed hematoma, Parasthesias at the donor site was experienced by 34.8% and a walking support was used by 19.1% after harvesting bone graft from anterior iliac crest [5]. However at 4th week postoperatively it doesn't effects the quality of life and at third postoperative month the negative effect on clinical outcome disappears [6].

Study was conducted by Loeffler et al. [7], he categorized pain intensity in three groups on the basis of pain scoring based on VAS as mild (<3), moderate (3-7) and severe (>7) in patients undergoing for treatment of fracture non-union and he reported the mean pain score to be 3.9±2.8 at 2nd week. Whereas, Satar et al. [6] reported in his study an infection rate of 10.1%.

In several studies autogenous bone graft labelled as gold standard for many orthopaedic surgical procedure like reconstruction of bone defects and treatment of non-union but their associated complications in term of significant donor site morbidity specially pain and other complications are debatable.

Several alternatives in the form of bone graft substitutes have been introduced and used to avoid such complications but these alternative options of bone graft are quite expensive to be regularly used in developing countries, on the other hand local data is insufficient to measure the true burden of morbidity caused by anterior iliac crest bone graft harvesting (Figure 1).

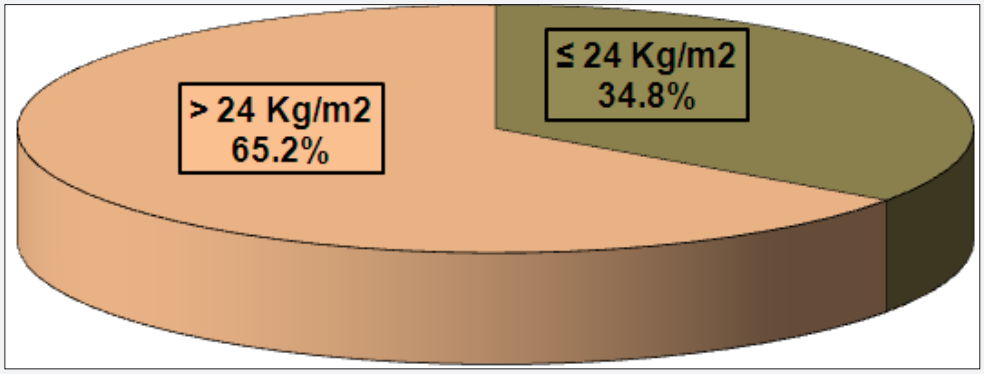

Figure 1: Percentage of Patients According to BMI Groups (n=135).

Therefore this study was design to measure the burden of patients facing early complications after harvesting bone graft from anterior iliac crest. If the burden found to be high then alternative methods could be developed to overcome the complications that will ultimately reduced the bed occupancy and cut down cost of treatment in our low resource country.

Material and Methods

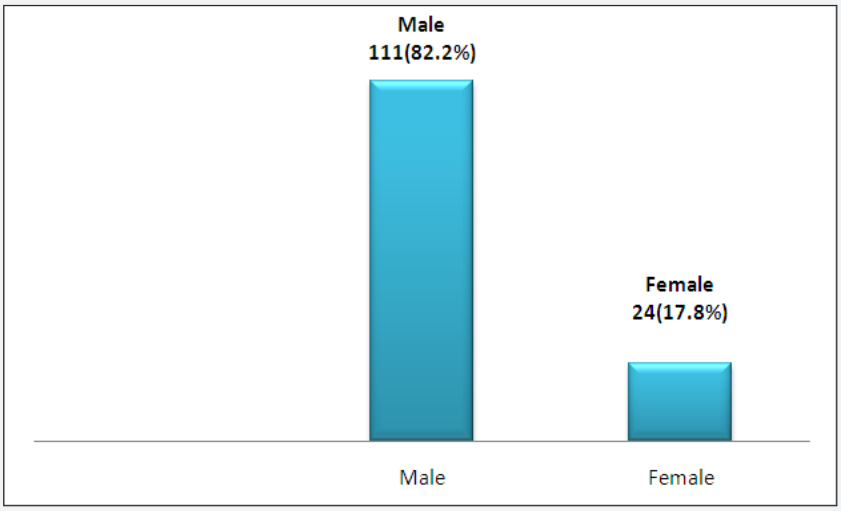

Figure 2 : Frequency of Patients According to Gender (n=135).

This descriptive case series was conducted at the Department of Orthopaedic Surgery, Dow University of Health Science, Civil Hospital Karachi, from April 2015 to March 2016. Patients were registered using a predesigned Performa. Approval from institutional ethical review committee was taken prior to commencement of the study. Formal informed written consent was obtained from patients registering in the study. Using a non-probability, consecutive sampling technique 135 patients were enrolled for the study (Figure 2).

Inclusion criterion

a. Patients aged 20 to 60 years

b. Patients undergoing bone grafting taken from iliac crest bone for fracture non-union, bone defects needs reconstruction with graft, joint arthrodesis and intraoseous lesions requires filling with bone graft after excision biopsy.

c. Irrespective of gender.

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Exclusion criteria

a. Presence of an abscess or discharging sinus at purposed surgical site

b. Patient with uncontrolled diabetics because of infection risk

c. Patient taking steroids or on chemotherapy as endangering bone union

d. Patient on anticoagulant therapy or with clotting disorders as increases the risk of hematoma formation.

After meeting the criteria, patients were included in the study undergone bone grafting. All patients were operated using a standard prescribed surgical technique by the surgeon (having greater than 2 years post fellowship experience) under general or spinal anaesthesia as per anaesthetic assessment or on the basis of procedure requirement. Patients have a follow up protocol daily in ward till discharged, at 2nd and 4th week post operatively. Complications that occur within 4th postoperative week were labelled as early morbidity which are;

Pain: Was assessed in verbal rating system (VRS).The Verbal Rating Scale (VRS) is an 10-point scale for patient self-reporting of pain [8]. Pain score more than 3 was taken as pain.

Hematoma: Presence of any two of the following:

i. Elevation and discoloration of the wound edges

ii. Pain (VRS>3) at the donor site on movement

iii. Leakage of blood through skin sutures.

Parasthesias: Sensation of pins and needles at the donor site was taken as parasthesia.

Use of walking aid: Use of stick, crutches, frame, wheelchair post surgery.

Infections: Patient had at least one of the following:

i. Purulent drainage from the superficial incision

ii. Pain or tenderness

iii. Localized swelling

iv. Redness or heat

Gait disturbance: Swings while walking was taken as Gait disturbance.

All the patients were assessed for early morbidities during follow up periods and final outcome was assessed at the end of 4th week postoperatively.

All the data were entered and analyzed using statistical package SPSS version 21. Categorical data like gender, site of iliac crest, indication for bone grafting, early morbidities were presented in frequency and percentages and numerical variables like age, weight, height, and BMI were presented in mean±SD. Effect modifiers like age, gender, site of iliac crest, indication for bone grafting, and BMI were dealt through stratification. Post stratification chi square test was applied and p value ≤0.05 was taken as significant (Table 1).

Table 1: Frequency Distribution of Pain, Hematoma, Parastesias, Use of Walking Aids, Infection and Gait Disturbance (n=135).

Early Donor Site Morbidity (n=135)		Frequency	%
Pain	Yes	116	85.90%
	No	19	14.10%
Hematoma	Yes	7	5.20%
	No	128	94.80%
Parasthesias	Yes	52	38.50%
	No	83	61.50%
Use of Walking Aids	Yes	33	24.40%
	No	102	75.60%
Infection	Yes	14	10.40%
	No	121	89.60%
Gait Disturbance	Yes	27	20.00%
	No	108	80.00%

Results

Total 135 patients of either gender with age between 20-60 years, undergone bone grafting taken from iliac crest bone were evaluated to determine the frequency of early donor site morbidity.

Out of 135 patients 111(82.2%) male and 24 (17.8%) were female. Mean age was 48.53±9.64 years and it was stratified in two groups, 50 patients included in ≤45 years age group and 85 patients in >45 years age group.

The mean weight was 73.21±7.67Kg and mean height was 167.56±6.62cm with mean body mass index was 26.09±2.59 Kg/m^2. The BMI was stratified in two groups. The BMI of 47 patients was ≤24Kg/m^2 and BMI of 88 patients was >24Kg/m^2.

Among total study subjects, left site of iliac crest was grafted in 52.6% patients and right site was grafted in 47.4% patients. As far as indications of bone grafting are concerned, it was noticed that fracture nonunion observed in 34.1% patients, bone defects needs reconstruction with bone graft in 20.7% patients, joint arthrodesis in 22.2% and intraoseous lesions documented in 23.0% patients.

The final outcome i.e. early donor site morbidity was evaluated. The results showed that pain was observed in 85.9% patients, hematoma in 5.2%, parasthesias in 38.5%, use of walking aid 24.4%, infection noticed in 10.4% of patients, and finally gait disturbance was documented in 20.0% patients. Stratification with respect to gender, age, site of iliac crest, indication of bone graft, and BMI was done to observe effect of these modifiers on outcome i.e. early donor site morbidity.

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The results showed that significant association of pain was found with site of iliac graft (p=0.000), indication of bone graft (p=0.034), and with BMI (p=0.023) in addition to that there is statistical significant association also found among parasthesias with gender (p=0.028) and infection with site of iliac crest (p=0.040). No significant association was observed among rests of the modifiers as p>0.05.

Discussion

Use of bone graft in orthopaedic surgical procedures to provides structural support, promotes healing and filling the defect/voids. When an autograph is used for such orthopaedic surgical procedures, the iliac crest is the prefer site for harvesting the graft as its approach is easy and provides large quantity of cortico-cancellous graftbecause and in addition to that it possesses osteogenic, osteoconductive and osteoinductive properties [9,10].

There is well documented morbidity associated with bone graft harvesting from iliac crest in adult [11,12]. Infection, bleeding, nerve damage, pelvic fractures, hematoma and sensory loss are potential complications [13].

Number of studies reported prolonged and severe pain at the iliac crest site after graft harvesting [11]. In this aspect, several alternatives to iliac crest autografts, including allograft, demineralised bone matrix, bone marrow aspirate, and synthetic substitutes such as tri calcium phosphate, calcium hydroxyapatite, and bioactive fibers have been used [14-17]. These alternatives do not match the effectiveness of the patient's own bone and also synthetic materials are costly to use [18,19].

A systematic review of literature reported 1249 (20 %) complications in 6449 adults requiring iliac crest bone grafts [10]. The rates of minor complications in the adult population were found between 6 and 39 %, while major complications were between 0.7 and 25 % [13,20].

One of common complication associated with iliac bone grafting is nerve injury [1,21]. Usually sensory nerves are at risk of injury, so the characteristic symptoms include pain, paraesthesiae, numbness along with the distribution of affected nerve. Direct transection or excessive traction may results injury to the nerves which lying adjacent to the ilium bone. So the lateral femoral cutaneous nerve is found at risk of injury while harvesting graft from iliac crest bone [1,22].

A study was conducted on 205 cadaveric specimens and reported that 9.9% of nerves had an aberrant course and were vulnerable to injury following anterior iliac crest graft harvesting [23]. Bierne et al. documented a 1.3% incidence of LFCN injury in 137 patients. The low incidence led them to recommend the use of a 'bikini-line' incision (placing the skin incision 1cm behind the anterior superior iliac spine) [24]. Other preventive measures include limiting the amount of soft tissue dissection and minimising stretching of the surrounding tissues. The mean surgical scar length of 4.8cm in our study is intermediate to that reported in other series using anterior iliac crest grafting. Cohen et al. reported a mean scar length of 4.0cm, Swan et al. 6.0cm and Laurie et al. 7.0cm [25]. The reported incidence of lateral femoral cutaneous nerve injury is between 1.7% and 31% following harvesting graft fro iliac crest [23,26]. As it is originating from the posterior roots of L2-3, so its damage can result in burning, tingling, numbness and/or pain over the anterolateral aspect of the thigh.

The reported incidence of donor site complications after iliac crest bone grafting ranges from 2% to 39%, with the most common and frequent complaint is pain at the donor site [27]. Other complications include neurovascular injury, avulsion fractures of the anterior superior iliac spine, haematoma, infection, herniation of abdominal contents, gait disturbance, cosmetic deformity, instability of the sacroiliac joint, urethral injury and tumour transplantation [1,11].

Early mobilization is often interferes by most common complication is pain at donor site following surgery, the documented incidence of pain ranged from 2.8% to 17% [28]. The precise cause of donor-site pain is unclear but it is believed to be result from nerve injury or destabilization of the muscular origin at the time of graft harvesting [1,29]. 1% to 10% of patients reported hematoma formation following harvesting graft from iliac crest bone [1,30].

Consideration of surgical technique can minimize the donor site morbidity by meticulous closure and use of local anaesthetic agents [1,31]. Small size vertical or oblique skin incisions within a 6cm distance from the posterior superior iliac spine to avoid the cluneal nerves injury, [1,32] and similarly a skin incision made parallel and just above or below the iliac crest, beginning at least 3cm posterior to the anterior superior iliac spine can avoid injury to the lateral femoral cutaneous nerve [1,33] subperiosteal dissection with careful haemostasis and a unicortical cancellous graft harvest technique can also reduces risk of donor site morbidity [1,34].

Study Limitations

The sample size was small and the study was confined to a single centre and study targeted only local subjects, so it is not clear whether our findings could be generalized nationally and internationally. Regarding association with age, it could not found any case below 20 years due to the age limits in our study age group, so large data with lower age limits is needed to find exact findings in different age groups.

Conclusion

There is definite donor site morbidity while harvesting a bone graft from anterior iliac crest, but these complications can be addressed by better surgical technique, meticulous closure, however many are unavoidable. Most of the complications encountered during bone graft harvasting from the iliac crest can be prevented by using a safe and minimally invasive technique

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