CASE REPORT

Iliac wing fracture following graft harvesting from the anterior iliac crest: Literature review based on a case report

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Summary  The morbidity of bone graft harvesting from the iliac crest has been widely discussed in the literature. For some authors, it is considered to be low and for others relatively high. We report on a case of a fracture of the iliac wing after graft harvesting from the anterior iliac crest despite good surgical technique. This complication is well known and most of these fractures heal uneventfully if treated conservatively. However, if anatomical and technical considerations are respected, the patient could be spared this inconvenience. Based on a literature review, we discuss the procedure’s potential complications and how to avoid them in an update.

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Introduction

Bone grafting is frequently used in traumatology as well as in orthopaedic and maxillofacial surgery. Autologous bone remains the gold standard for grafting [1–6]. Several locations can be used as the donor site, but the iliac crest is still the most frequent and preferred site. For some authors [1,7–10], bone graft harvesting from the iliac crest is a minor procedure with few complications. For others [11–13], on the contrary, this procedure can be potentially deleterious if anatomical and technical considerations are not respected. Based on a case report of a fracture of the iliac wing after graft harvesting from the anterior iliac crest, we review donor site morbidity and the harvesting and reconstruction techniques at the iliac crest.

Case report

We report the case of a 75-year-old female who presented with a painful nonunion after retrograde intramedullary nailing of her right humerus for a pathological fracture. She had known intraductal invasive carcinoma (pT1, pN1, M0, G2) of the left breast operated on 11 years before. The fixation of the humerus had been completed by palliative radiotherapy and hormonotherapy. Afterwards, no evidence of fracture consolidation could be found. No further
treatment had been proposed as the patient had not complained of pain at that time. After 2 years, however, she became symptomatic. Consequently, nail removal, refixation with a plate, and decortication and grafting of the humeral nonunion with corticocancellous bone harvested from the right anterior iliac crest were performed.

While the patient was rising from a chair on the second postoperative day, she felt a crack at the operative site on the iliac crest. This event was immediately followed by pain and inability to walk. The radiological exam showed a fracture of the iliac wing starting at the bone donor site even though its most anterior part was located at least 3 cm behind the anterior superior iliac spine (ASIS) (Fig. 1). Despite the displacement of the fragment, we decided to treat this fracture conservatively and observed no further complications. The radiological follow-ups at 3, 6 and 12 months (Fig. 2) showed malunion which had no clinical consequences.

**Discussion**

The morbidity of bone graft harvesting from the iliac crest is not insignificant. In the literature, complication rates vary from 0 to 48% [13–16]. Among minor complications, superficial infections, seromas, and local hematomas are often mentioned [9,17,18]. Among major complications, deep infections, retroperitoneal hemorrhages, abdominal hernias, ilium fractures, pelvic instability, as well as vascular and nervous lesions are reported [9,17–19]. The infection rate after bone graft harvesting from the iliac crest varies in the literature from 0 to 3% of cases [8,12]. Chronic pain at the iliac crest after bone graft harvesting is found in up to 30% [20].

Fracture of the iliac wing following graft harvesting from the anterior iliac crest is an extremely rare occurrence. To date, only very few cases have been reported in the literature [21–27]. In the present case, a fracture of the iliac wing occurred after a bicortical graft harvesting of the inner table of the ilium using a conventional open technique with no intraoperative complications. Nocini et al. [24] reviewed the literature focusing on fractures of the iliac crest and pelvic ring instability due to anterior and posterior bone graft harvesting. They found 24 fractures related to bone harvesting from the anterior region and 12 due to harvesting from the posterior region. Contrary to the posterior iliac crest fractures after bone harvesting, the anterior iliac crest fractures, even though painful, remained stable and healed spontaneously in most cases without further complications. Only 16.6% of cases required further surgical treatment. Ahlmann et al. [28] showed that the harvest of the posterior iliac crest bone graft was associated with a significantly lower risk of postoperative complications.

The technique for bone graft harvesting from the iliac crest should respect a number of biomechanical principles. Ebraheim et al. [29] studied the morphology of the anterior part of the iliac crest. They showed that the region around the iliac tubercle was suitable for bone graft harvesting. Hu et al. [30] demonstrated that harvesting a graft 3 cm behind the ASIS weakened the iliac crest less than harvesting 1.5 cm posterior to it. In a biomechanical study on cadaveric hemipelves, Varga et al. [31] proved that if corticocancellous bone graft removed from the posterior iliac

**Figure 1** Anteroposterior view of the right hip shows a fracture of the anterior iliac wing starting at the level of the donor site.

**Figure 2** Anteroposterior view of the right hip (at 12 months) shows malunion of the anterior iliac wing.
crest exceeded 3 cm in length, the risk of iatrogenic stress fracture increased substantially.

Considering these biomechanical aspects, some authors [14–16,32–34] proposed grafting or reconstruction of the iliac crest donor sites. Bojescul et al. [33] reported a prospective randomized study of coraline hydroxyapatite used as backfill for iliac crest donor sites. This bone substitute acts as a biological osteoconductive matrix, aids in iliac crest healing after bone graft harvesting and seems to reduce postoperative pain at the bone graft site. Ito et al. [15] investigated the long-term clinical results of a bioactive ceramic spacer (apatite wollastonite containing glass ceramic [AWGC]) for reconstructing the bone graft donor site at the iliac crest. AWGC iliac spacer appears to be useful in the reconstruction of harvested iliac crest because new bone formation occurs, reducing the defect size and allowing repeated harvesting of bone at this site after complete incorporation if need be. Huemer et al. [14] presented a technique of reconstructing the bone gap after iliac crest harvest by covering the defect with a plate. This results in less postoperative pain and shorter rehabilitation as well as improved musculoskeletal balance and a reduced risk of abdominal wall herniation. Halsnøy et al. [16] used a custom-made titanium plate to reconstruct the iliac donor site following harvest of a composite vascularized free flap with the deep circumflex iliac artery. Harris et al. [34] recommended iliac crest reconstruction after tricortical graft harvesting with the resected rib from the surgical approach to the thoracic spine when performing reconstructive spine surgery. Recently, Gil-Albarova and Gil-Albarova [35] developed a simple method to reconstruct the bone defect after iliac crest tricortical bone graft harvest. Their technique consists in repairing the bone defect by means of a transversal fence of appropriate thin tricortical chips obtained from the posterior lateral wall of the bone defect itself.

In order to reduce the morbidity of bone graft harvesting from the iliac crest, some authors have developed minimally invasive techniques. Brawley et al. [36] reported a technique using small acetabular reamers to obtain the iliac crest bone graft. In their study, none of the patients experienced morbidity from the graft harvest site. Finkemeier et al. [37] proposed a technique of harvesting intramedullary bone with the reamer irrigator aspirator (RIA). Primarily used for the acute treatment of femur and tibia fractures in polytrauma patients with chest injury or with two or more long bone fractures, this technique has replaced iliac crest bone grafting as the autologous graft of choice for nonstructural defects and nonunions in their community trauma practice. Sandor et al. [38] presented a method using a minimally invasive trephine. This technique appears to be safe and results in minimal morbidity. They also compared their technique with the conventional technique and showed that the trephining of cancellous bone from the anterior iliac crest results in significantly less morbidity than traditional open methods [39]. Burstein et al. [40] compared the morbidity of traditional iliac bone graft harvesting techniques to minimally invasive techniques, showing that they were statistically superior in terms of total time for pain medication, operative time and mean incision length. Eufinger et al. [41] studied iliac crest donor site morbidity following open and closed methods of bone harvest for alveolar cleft osteoplasty. They reported that the short-term morbidity (postoperative pain, appearance of the mature scar) at the donor site in the traditional open osteotomy group was slightly greater than the closed harvesting group. The long-term morbidity, on the contrary, was negligible in both groups.

Following our experience and the review of the literature, we currently still perform autologous bone graft harvesting from the iliac crest. Depending on the position of the patient for the main surgical intervention, we harvest bone from either the anterior or posterior crest. We routinely locate the most forward point of our osteotomy at least 3 cm to the ASIS. We also try to preserve the outer table intact whenever possible. When a tricortical bone graft is needed or the length of the crest osteotomy exceeds 3 cm, we always reconstruct the iliac crest at the donor site. We routinely use a one-third tubular plate with one screw anterior and one screw posterior to the osseous defect. Furthermore, we use an absorbable hemostatic gelatin sponge (Spongostan®, Ferrosan, Denmark), which is introduced into the bone defect to decrease the bleeding of the bone. We no longer use suction drainage. Since we adapted our bone graft harvesting technique to these standards, we have not seen any major complication.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References

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