Corticocancellous olecranon autograft for metacarpal defect reconstruction: a case report

Anna Babushkina · Scott Edwards

Published online: 5 September 2012
© American Association for Hand Surgery 2012

Abstract

Background High-energy injuries to the hand frequently lead to bone defects as well as soft tissue loss. Early bone grafting of defects is well established in the literature; however, few options are available for autologous corticocancellous grafts. Most frequently cited studies describe the iliac crest or the distal radius donor sites.

Methods In this case report, we describe a new technique of obtaining corticocancellous bone graft from the olecranon.

Results Complete union of the segmental defect was achieved with this technique.

Conclusions The olecranon donor site is outside the zone of injury and therefore safe to access, but within the upper extremity, thus avoiding the need for harvest from a distant site such as the iliac crest or the distal femur. Additional benefits of this site are the greater volume of graft that can be harvested compared to the distal radius as well as a more optimal ratio of cancellous to cortical graft available, compared to the iliac crest where the graft may be excessively cortical in nature.

Keywords Autograft · Bone defect · Metacarpal · Olecranon

Introduction

A significant number of high-energy injuries to the hand involve segmental bone loss and several authors have described techniques for their management. Grafting for bone

defects has evolved from a delayed process, described by several authors since 1987 [4–7, 17], to an immediate grafting procedure [10, 14–16, 18]. The majority of authors use iliac crest with or without a cortical component. Cancellous grafts lack the additional rigidity of corticocancellous grafts and would therefore be less desirable in an area subjected to early rehabilitation such as the hand. Others have described a distal radius corticocancellous graft option to be taken with a cutaneous flap [10]. We present an alternate corticocancellous graft option from the olecranon that is easily harvested without the need to drape out additional fields at distant sites, is likely to be located outside the zone of injury and was shown to fully incorporate within the defect.

Case Report

A 54-year-old male sustained a chainsaw injury to the left hand resulting in partial amputation of the hand with lacerations of all flexor tendons, the small finger extensors and digital nerves, arterial injury with thumb ischemia, soft tissue defects on the volar surface, and fractures of the proximal and distal phalanges of the thumb, and the ring and small finger metacarpals (Fig. 1). After debridement of the zone of injury, reestablishment of vascular supply to the thumb, and pin stabilization of the thumb, the fifth metacarpal was left with a 2 cm defect. The defect was initially spanned with an internal buttressing pin (Fig. 2). At a second-look operation, a two-stage tendon and nerve reconstruction was initiated and the fifth metacarpal defect was grafted with an en bloc corticocancellous autograft from the ipsilateral elbow. The fourth and fifth metacarpals were then internally fixed with plates under compression (Fig. 3). The postoperative course included several trips back to the

A. Babushkina (✉) · S. Edwards
Georgetown University Hospital,
3800 Reservoir Rd NW, 1-Main,
Washington, DC 20007, USA
e-mail: babushkina.ay@gmail.com

S. Edwards
e-mail: sge1@gunet.georgetown.edu

Fig. 1 Injury radiograph

operating room related to tendon reconstruction and soft tissue coverage. The procedures which followed included four soft tissue debridements in the hand and forearm secondary to infection of the silicone rods which required removal and a thigh flap for coverage of the ulnar side of the hand after the debridements. The patient's elbow was immobilized briefly for wound healing as described in the technique below; after which point, he was released to activity as tolerated with the elbow. The hand rehab protocol was of the Duran type with passive flexion only as the rods were not active. Bony union was achieved at 3 months and confirmed with X-ray and a CT scan (Fig. 4a, b). The proximal ulna showed evidence of filling the donor site defect without complications. Range of motion at the elbow returned to normal and was symmetric to

Fig. 2 Intraoperative fluoroscopic image after debridement with *k*-wire spanning fifth metacarpal defect

Fig. 3 Intraoperative image with fifth metacarpal defect filled with olecranon graft (a), followed by plate application (b)

the contralateral extremity (Fig. 5a, b). Unfortunately, due to the degree of the initial injury and the subsequent rod-related complications, the patient was only able to gain modest function in the form of pinch of his index against the thumb with the other fingers lacking active proximal interphalangeal joint or distal interphalangeal flexion.

Corticocancellous Graft Technique

A 3 cm longitudinal incision was made over the ulnar crest approximately 2 cm distal to the tip of the olecranon. With the soft tissues retracted, a sagittal saw was used to obtain a block of bone measuring slightly longer than the defect in the metacarpal and approximately the width of the metacarpal. The depth of the graft was made to approximate the diameter of the metacarpal. The graft was elevated from the donor site with the aid of a 0.25-in. osteotome. After irrigation, a small amount of bone wax (Bone Wax, Ethicon, Somerville, NJ, USA) was applied to the donor defect. The skin was closed primarily as there is no reasonable deep fascia to close over the defect. An above elbow splint was applied postoperatively to protect the graft site. The hand was initially splinted in the intrinsic plus position and motion was initiated on the first postoperative day. Active range of motion was allowed for the fingers in which tendons were intact and passive motion was utilized for the remaining digits. The elbow splint was maintained for 2 weeks following surgery; after which, range of motion was allowed and advanced as tolerated.

Discussion

The importance of early grafting and rigid internal fixation for the purpose of early motion is well documented [1, 4–6,

Fig. 4 Xray (a) and CAT scan (b) at 3 months

9, 18]. The distal radius techniques come with recommendations of prolonged immobilization, as long as 4–6 weeks, as well as the potential of being within or close to the zone of injury. With the presented technique, the extremity is already draped within the operative field, unlike the iliac crest and medial femoral condyle techniques, and the donor site is likely to be a significant distance away from the zone of injury. Additionally, unlike the iliac crest, no cutaneous nerves are in danger of injury during harvest. An extensive search of the literature produced only one article in the craniofacial literature with similar grafting technique by Nadal et al. [12]. These authors made a transverse 2 cm incision distal to the tip of the olecranon and removed a relatively small trapezoid shaped corticocancellous graft with attached periosteum to fill an alveolar defect in a series of patients with cleft palates. We recommend a longitudinal incision to allow for extending the length of the graft. Cancellous olecranon graft was shown to assist healing in phalangeal defects [11, 13]. The presented technique is the

first in which the cortical component of the proximal ulna is used to provide structural support. This allows for a load-sharing function of the plate, rather than load bearing as in the cancellous-only graft option. Together, the stronger construct of corticocancellous graft and the metacarpal plate fixation can then be expected to withstand a more rigorous early motion protocol and continue to withstand these forces despite an anticipated prolonged healing time.

Iliac crest has been a reliable source for many years and was described as an option for metacarpal defects as early as 1962 described by Henneing et al. [8]. While it is unclear whether the presented technique will be as utilitarian with larger-sized defects, the authors suspect that defects of several centimeters may be repaired. Bruno et al. [3] reported that the volume of cancellous graft obtainable from the iliac crest is twice that in the olecranon and the distal radius, and therefore extensive defects may still be better served with that option. In fact, Bruner used a block of iliac crest bone graft to reconstruct several metacarpal fractures [2].

Fig. 5 a Radiograph of ipsilateral elbow immediately after graft harvest. b Final radiograph of the donor elbow with evidence of healing in the defect

However, the ratio of cancellous bone to cortical bone is much larger with the olecranon graft and may be more appropriate for small bones such as metacarpals. Regardless, the presented technique remains a good option for the patient with a limited metacarpal defect in need of structural support in whom the surgeon prefers to avoid donor site morbidity or the need to prepare a separate site for access to bone graft. A defect of 2.5 cm has been successfully treated with the corticocancellous graft described here. The authors suspect that a longer graft may be taken; however, without a biomechanical study, it would be difficult to pinpoint the limit beyond which greater precautions must be taken to protect the ulna from fracture.

References

1. Akmaz I, Kiral A, Pehlivan O, et al. Late reconstruction of neglected metacarpal shaft defects due to gunshot wound. *J Hand Surg Eur Vol.* 2004;29B(6):585–9.
2. Bruner J. Use of single iliac-bone graft to replace multiple metacarpal loss in dorsal injuries of the hand. *J Bone Joint Surg Am.* 1957;39:43–52.
3. Bruno RJ, Cohen MS, Berzins A, et al. Bone graft harvesting from the distal radius, olecranon, and iliac crest: a quantitative analysis. *J Hand Surg.* 2001;26A:135–41.
4. Calkins MS, Burkhalter W, Reyes F. Traumatic segmental bone defects in the upper extremity. *J Bone Joint Surg.* 1987;69(A):19–27.
5. Freeland AE, Jabaley ME. Stabilization of fractures in the hand and wrist with traumatic soft tissue and bone loss. *Hand Clin.* 1988;4:425–36.
6. Gonzalez MH, McKay W, Hall Jr RF. Low-velocity gunshot wounds of the metacarpal: treatment by early stable fixation and bone grafting. *J of Hand Surg.* 1993;18A:267–70.
7. Gonzalez MH, Hall M, Hall Jr RF. Low-velocity gunshot wounds of the proximal phalanx: treatment by early stable fixation. *J of Hand Surg.* 1998;23A:150–5.
8. Henneing L, Essafi Z, Martini M. Repair of loss of metacarpal substance with the aid of iliac grafts. *Tunis Med.* 1962;50:245–9.
9. Jupiter JB, Goldfarb CA, Nagy L, et al. Posttraumatic reconstruction in the hand. *Instr Course Lect.* 2007;56:91–9.
10. Merlino G, Borsetti M, Boltri M. Reverse radial artery bone flap reconstruction of segmental metacarpal losses. *J Hand Surg Eur Vol.* 2007;32:98–101.
11. Mersa B, Ozelik IB, Kabakas F, et al. Olecranon bone graft: revisited. *Tech Hand Surg.* 2010;14:196–9.
12. Nadal E, Sabas M, Dogliotti P, et al. Secondary alveolar bone grafting: our experience with olecranon bone graft. *J Craniofac Surg.* 2010;21:371–4.
13. Ozelik IB, Kabakas F, Mersa B, et al. Treatment of nonunions of the distal phalanx with olecranon bone graft. *J Hand Surg Eur Vol.* 2009;34E(5):638–42.
14. Rinaldi E. Autografts in the treatment of osseous defects in the forearm and hand. *J Hand Surg.* 1987;12:282–6.
15. Saint-Cyr M, Gupta A. Primary internal fixation and bone grafting for open fractures of the hand. *Hand Clin.* 2006;22:317–27.
16. Saint-Cyr M, Miranda D, Gonzalez R, et al. Immediate corticocancellous bone autografting in segmental bone defects of the hand. *J Hand Surg Br Eur Vol.* 2006;31B:168–77.
17. Sammer DM, Bishop AT, Shin AY. Vascularized medial femoral condyle graft for thumb metacarpal reconstruction: case report. *J Hand Surg.* 2009;34A:715–8.
18. Stahl S, Lerner A, Kaufman T. Immediate autografting of bone in open fractures with bone loss of the hand: a preliminary report. *Scan J Plast Reconstr Hand Surg.* 1999;33:117–22.

No external funding was used in the preparation of this project