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Harvesting olecranon bone graft in adults by using bone biopsy trephine

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ABSTRACT

Objectives: Bone grafts have been used for more than one hundred years in orthopedic surgery. Autografts are still the gold standard with respect to their osteoconductive, osteoinductive and osteogenetic peculiarities. Cancelleous grafts are the most commonly used autografts with their porous structure increasing the contact area. Although iliac crest is the preferred donor site, the femur, tibia, distal radius and olecranon are also employed when they are in a suitable location for the recipient site. The olecranon donor site can provide ample amounts of bone graft for reconstruction in the upper extremity. Here, the bone graft harvesting from the olecranon with the use of trephine as a safe and fast technique is presented. The bone graft harvested with trephine not only has the proper morphology to be used for phalanx and metacarpal reconstruction, but also can be utilized for wrist and forearm procedures.

Methods: 82 patients (21 female) had bone reconstruction with olecranon bone graft harvested with trephine between 2010 and 2015. The mean age was 34 (range: 20-62) years. The mean follow-up period was 26 (range: 6-48) months.

Results: None of the patients had pain or decrease in the range of motion in the early or late postoperative period. Only one patient (1.2%) had hematoma formation at the donor site and no other complications were observed in any patient. There was no difference in elbow extension strength between both elbows at the postoperative fifteenth day and at the end of the follow-up period.

Conclusion: Bone graft harvesting with trephine is technically easy and fast, and donor site morbidity is diminished compared other methods and donor sites. It can be performed under axillary anesthesia and provides adequate amounts of bone graft for upper extremity reconstructions.

Key words: *Olecranon, bone graft, bone biopsy, trephine*

Introduction

Bone grafts have been used for more than one hundred years in orthopedic, cranial and maxillofacial surgery for their contribution to bone healing and for its defect filling feature [1]. Autografts are still the gold standard with respect to their osteoconductive, osteoinductive and osteogenetic properties [2]. Cancelleous grafts are the most commonly used autografts with their porous structure increasing the contact area. Although iliac crest is the preferred donor site, the femur, tibia, distal radius and olecranon are also used when they are in a suitable location for the recipient site. The olecranon donor site can provide ample amounts of bone graft for reconstruction in the upper extrem-

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ity. Here, the bone graft harvesting from the olecranon with the use of trephine as a safe and fast technique is presented. The bone graft harvested with trephine not only has the proper morphology to be used for phalanx and metacarpal reconstruction, but also can be used for wrist and forearm procedures.

Patients and Methods

Eighty-two patients (21 female and 61 male) had bone reconstruction with an olecranon bone graft harvested with trephine between 2010 and 2015. The mean age was 34 (range: 20-62) years. The indications for reconstructions with bone graft harvested with trephine were: bone defect of forearm, both bone fractures (9 patients), bone defect of ulna diaphysis fracture (5 patients), bone defect of distal radius fracture (6 patients), bone defect of metacarpal fractures (6 patients), proximal phalanx fractures with bone defect (6 patients), middle phalanx fractures with bone defect (5 patients), bone defect of distal phalanx fractures (6 patients), scaphoid pseudoarthrosis (12 patients), metacarpal pseudoarthrosisin (3 patients), proximal phalanx pseudoarthrosis (2 patients), middle phalanx pseudoarthrosis (4 patients), distal phalanx pseudoarthrosis (3 patients), arthrodesis of metacarpophalangeal joint (3 patients), arthrodesis of proximal interphalangeal joint (2 patients), arthrodesis of distal interphalangeal joint (2 patients) and curettage of enchondroma (8 patients) (Table 1). The study protocol was approved by the authors' hospital's institutional review board. All the patients signed an informed consent form.

Table 1. The indications for reconstructions with bone graft harvested with trephine.

Bone defect Forearm both fracture	9
Ulna diaphysis fracture	5
Distal radius fracture	6
Metacarpal fracture	6
Proximal phalanx fracture	6
Middle phalanx fracture	5
Distal phalanx fracture	6
Pseudoathrosis Scaphoid	12
Metacarpal	3
Proximal phalanx	2
Middle phalanx	4
Distal phalanx	3
Arthrodesis Metacarpophalangeal joint	3
Proximal interphalangeal joint	2
Distal interphalangeal joint	2
Curettage Enchondroma	8

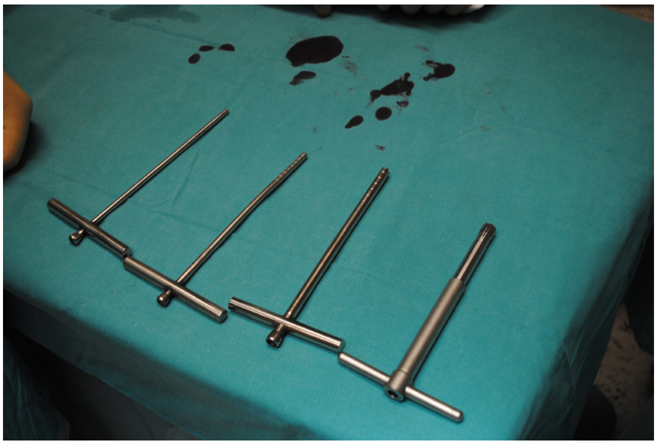

Figure 1. Trephines with different diameters.

Figure 2. The 1 cm incision 0.5 cm superior to the olecranon tip.

Figure 3. Insertion of a trephine to the olecranon by rotation.

Surgical Technique

The operations were performed under axillary or general anesthesia. After the patients were in the supine position with the shoulder and elbow in 90 degrees of

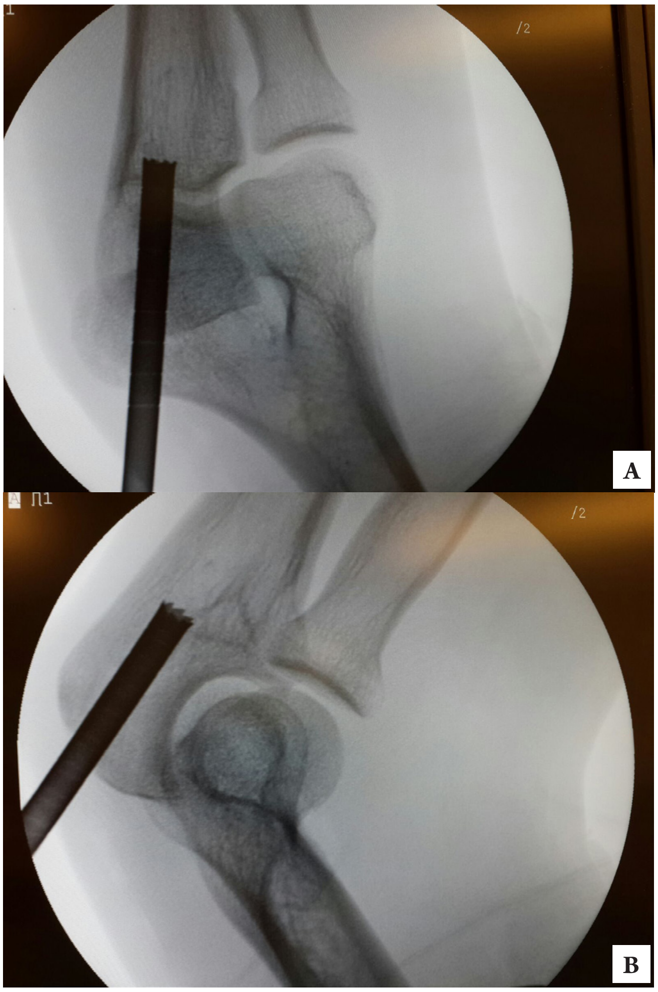

Figure 4. (A-B) Fluoroscopy control including anteroposterior and lateral views is necessary to protect the ulnohumeral joint and decide the length of bone graft.

flexion, a 1 cm skin incision was made. According to the needs of the recipient site, trephines with diameters of 4,5,7,8 and 10 mm were chosen (Figure 1). The entry site for bone harvest was determined to be 1 cm superior to the olecranon tip with the help of fluoroscopy. After the 1 cm longitudinal split incision was made to the triceps tendon, the periosteum was dissected off the bone (Figure 2). The trephine was inserted into the bone by a rotational movement parallel to the long axis of the olecranon controlled by fluoroscopy (Figure 3). The procedure was controlled by fluoroscopy so as to not disturb the ulnohumeral joint. The trephine was inserted into the olecranon until the desired length for the amount of bone to be harvested was determined. This was again controlled by fluoroscopy (Figures 4a and 4b). After the desired length was reached, the trefin was driven back by rotation at the same direction. The bone graft within the trefin was pushed out gently by a pusher rod (Figure 5). After obtaining about 1-2 cc bone graft according to the diameter of the selected trephine, bone wax was applied and periosteal and tricep repair was performed by absorbable sutures. Skin repair was performed without placement of a drain. The mean operation time for harvesting was 15 (range: 13-17) minutes. No splinting was performed to the donor site and the patient was allowed to use his or her elbow.

Results

The mean follow-up period was 26.8 (range: 6-48) months. Patients were permitted to use their elbow joint and no casting was performed for the elbow. At the postoperative second day, the VAS score was 8.2 and at the postoperative fifteenth day, the VAS score was 2.3. Only one patient (1.2%) had hematoma formation at the donor site and no other complications were observed in any patient. Simple drainage was performed under local anesthesia for the patient with a hematoma and no recurrence was noted. None of the patients had limitations in range of motion in the early or late postoperative period. There was no difference in elbow extension strength between both elbows at the postoperative fifteenth day and at the end of the follow-up period.

Discussion

Cancellous bone grafts are employed in a wide variety of patient groups ranging from bone defects to pseudoarthrosis and bone tumors to arthrodesis, though they are weaker compared to cortical bone grafts. Traditional iliac bone is selected as the donor site for its ease of harvest and provision of ample amounts

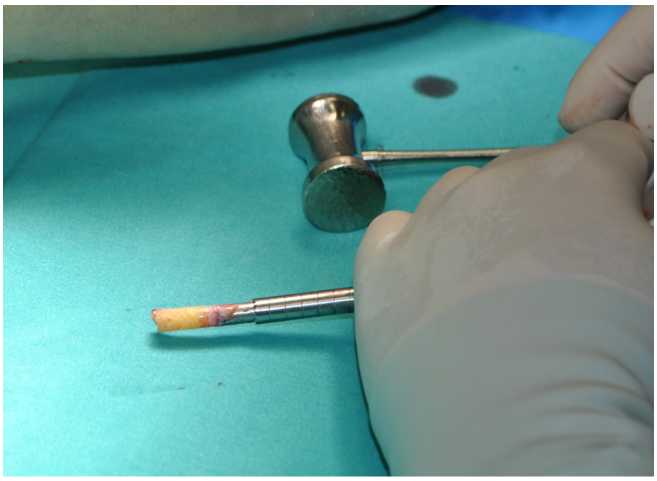

Figure 5. The pusher rod drives the harvested graft out of the trephine.

of bone graft. Sufficient amounts of cortical, cortico-cancellous, and cancellous bone grafts can be harvested from the anterior or posterior iliac bone through traditional techniques or the reamer, trephine, acetabular reamer or reamer-aspirator techniques.

Lesser amounts of bone graft are needed for upper extremity reconstructions, such as phalanx, metacarpal and carpal reconstructions. For this reason, the distal radius, lateral epicondyle and ulna are used as donor sites more frequently because of their low morbidity. Younger et al. found 8.6% major and 20.6% minor complications after bone graft harvesting from the iliac bone [1]. Again, Palmer et al. found 20% persistent pain, 16.6% walking difficulty, 6.6% dressing difficulty, 6% scar problems, 3% sensory disturbances and 53.3% major complications [3]. In their prospective study, Kim et al. reported that in the first year controls, 16.5% of patients had pain, 29.1% had sensory loss and 15.1% had gait disturbances and stated that these disturbances persisted despite the pain resolving over time [4]. Although chronic pain is the most frequent morbidity, nerve and vascular injury, seroma formation, fracture, hernia, walking difficulties, cosmetic problems, sacroiliac instability and urethral injury can be seen. The complication rates differed from study to study. What did not differ were the complications requiring interventions and increased hospital stays.

The complication rate for distal radius donor site is 1.7% which is frequently chosen as a donor site in upper extremity reconstructions [2,5,6]. These complications can be summarized as pain, De Quervain's tenosynovitis, fracture, infection and injury to the superficial radial nerve. Lateral epicondyle is another rarely used donor site. Charles et al. used lateral epicondyle as a donor site in elbow reconstructions [7]. In this study, the complication rate was 1.2%, specifically being hematoma formation in the donor site. This was treated with simple drainage under local anesthesia and no recurrence was observed in the follow-up period.

Chim et al. stated that in scaphoid fractures, olecranon grafts are appropriate alternatives to radius grafts as a result of proximity to surgical site and low morbidity [8]. Cosac et al. used an olecranon bone graft for rhinoplasty because of its low morbidity [9]. Ozcelik et al. used an olecranon bone graft successfully in pseudoarthrosis of the distal phalanx [10].

Fujita and Bernstein employed the trephine technique in an iliac bone graft harvest and discovered lesser donor site morbidity [11,12]. Iliac bone harvesting with trephine was also used successfully in comminuted fractures of forearm [13]. Yesiloglu et al. utilized

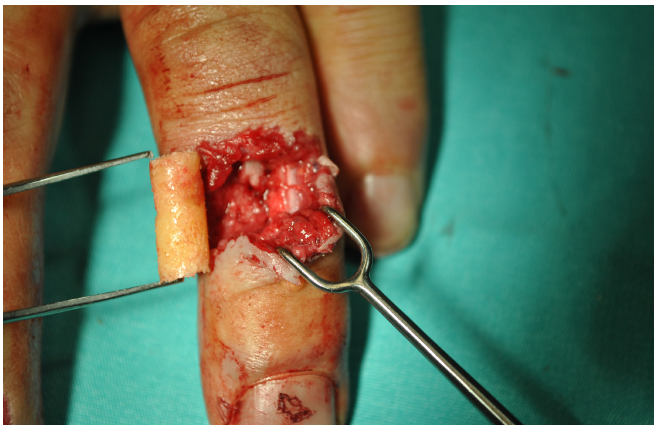

Figure 6. The cylindered compressed bone graft with its perfect shape for phalanx and metacarpal reconstructions.

Figure 7. K-wire can be applied through the graft.

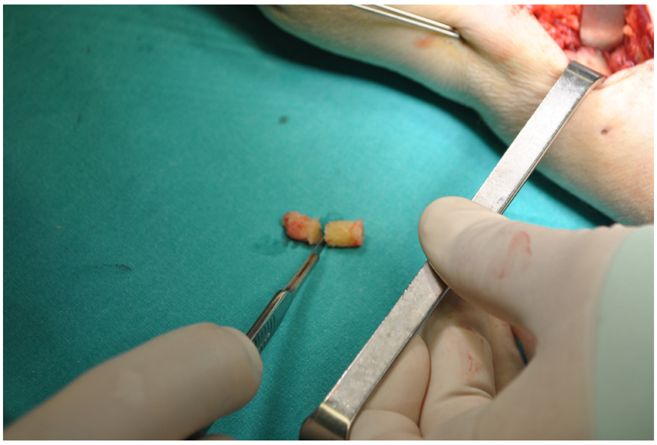

Figure 8. Shaping the bone graft with a scalpel is possible without fragmentation.

trephine for olecranon bone graft harvesting and in reconstruction of the orbital floor, once more highlighting the low morbidity of the trephine technique [14].

An olecranon bone graft donor site may not provide adequate bone graft in osteoporotic, elderly patients. Moreover, it increases the risk of fracture. Few fractures of the olecranon after bone graft harvesting have been documented. However, two were reported by Walker and Meals in 63- and 65-years-old patients [15]. Another case was with a 43-year-old nasal reconstruction patient [16]. The olecranon donor site is also not recommended in children based on possible injury to the growth plate.

The use of trephine in an olecranon bone graft harvest has numerous advantages:

1. It can be performed under axillary anesthesia for upper extremity reconstructions without need for general anesthesia.
2. The incision is on the tip of the olecranon and far from the pressure-bearing area compared to normal olecranon bone graft harvesting incision.
3. The bone graft can be taken from the same extremity without needing preparation of another body part.
4. The donor site is far from the neurovascular structures and major complications are unexpected.
5. There is no need to splint the donor site and patients can use the elbow joint with relatively less pain.
6. The scar is less obvious compared to a radius donor scar and shorter compared to defined olecranon bone graft harvesting techniques.
7. The procedure saves time and is faster compared to other techniques for olecranon bone graft harvesting.
8. The cylindered shape of the harvested bone graft has the perfect morphology for phalanx and metacarpal reconstruction.
9. The tubular cancellous bone is compressed by the longitudinal and rotational force of the trephine and is bestowed with a unique compact nature that permits both K-wire application without fragmentation and use in weight-bearing cortical bone defects (Figures 6,7).
10. The bone graft can be shaped with a scalpel if needed (Figure 8).
11. The diameter and length of the bone graft can be adjusted by changing the diameter of the trephine and by inserting it in the desired length according to the needs of the recipient site.

Bone graft harvesting with a trephine is technically easy and fast, and donor site morbidity is reduced compared to other methods and donor sites. It can be performed under axillary anesthesia and provides adequate amounts of bone graft for upper extremity reconstructions.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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