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**Original Research Article**

# Experience in a public hospital with the use of cortical bone grafts of olecranon for the treatment of bone gaps in the hand

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## ABSTRACT

**Background:** Bone grafting has been a popular approach for the reconstruction of hand bone abnormalities caused by trauma or tumor removal. Cortical bone grafts have mostly osteoinductive capabilities. Olecranon grafts are reported to be safe because of their low donor morbidity and appropriate quick mechanical stability.
**Methods:** This was a longitudinal descriptive study where 23 patients with hand fractures who were reconstructed with olecranon bone graft were evaluated. We included patients who were admitted to surgery at the "General Dr. Rubén Lenero" Hospital between January 2019 and November 2021. After surgery, a control radiograph of the graft insertion location and the donor area was taken postoperatively.
**Results:** A post-surgery control elbow X-ray did not show any fracture data in all patients. The olecranon graft widths of the 23 patients ranged from 5 mm to 12 mm, with an average width of 7.9 mm. The lengths of the olecranon grafts ranged from 5 mm to 47 mm, with an average length of 19.62 mm.
**Conclusions:** In this study, we found that cortical olecranon grafts have been a safe and viable reconstructive choice for our center for bone gap reconstruction in hand.

**Keywords:** Cortical bone graft, Hand fractures, Hand surgery, Olecranon bone graft, Reconstructive surgery

## INTRODUCTION

Bone grafting has been a popular approach for the reconstruction of hand bone abnormalities caused by trauma or tumor removal. Hand-high energy injuries may result in segmental bone loss; hence, numerous treatment strategies have been outlined.[1] As a result, large segmental bone deficiencies in the proximal or medial phalanges have been repaired with vascularized iliac crest graft, fingers, medial femoral condyle, or non-vascularized iliac crest graft.[2-7]

Nonetheless, in certain circumstances, a non-vascularized corticocancellous graft may be helpful. As previously stated, the olecranon graft is simple to get and can be entirely integrated into the injury.[1] Cortical bone are superior to cancellous bone thanks to a favorable and immediate structure that facilitates the application of osteosynthesis materials. Cortical bone grafts, on the other hand, take time to revascularize and incorporate due to their dense mineralization.[12]

Because of the donor's morbidity, cortical bone transplants are rarely employed. Throughout history, various donation locations have been used. In comparison to other grafts such as the iliac crest, tibia, fibula, rib, or skull, the use of olecranon grafts is relatively new. Even though cortical grafts have greater donor morbidity, olecranon grafts are reported to be safe grafts.[13] Because of its low donor morbidity and convenience of application in the restoration of minor bone lesions, the olecranon graft is a viable alternative for these surgeries.[8,9]

There have been few studies that have evaluated the use of olecranon bone graft as a treatment for the loss of phalanges.[1,10-12] The objective of this research was to showcase our experience in the use of olecranon grafts in our hospital center in patients that have a loss of phalanges or metacarpal bones.

## METHODS

This was a descriptive longitudinal and prospective study in which we included patients with bone gaps in the hand as a result of tumor or trauma resection who was admitted to surgery in "Dr. Ruben Leñero" General Hospital between January 2019 and November 2021.

### *Inclusion criteria*

Patients 18 years of age or older, with bone gaps in the metacarpals or phalanges as a result of tumor excision, trauma, injury by a fire weapon, or sharp objects, were included in the study. Written informed consent was obtained from all study participants. These patients were treated with an olecranon bone graft.

### *Exclusion criteria*

Patients were excluded if they had not received reconstruction with a bone graft or if the bone graft was derived from a region other than the olecranon.

The elimination criterion was the non-compliance with the treatment or the abandonment of the procedure. During the time of the study, 23 patients complied with the established inclusion criteria, we shall present those results in this work.

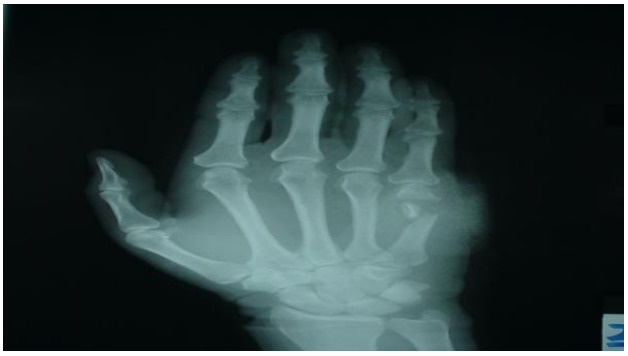

**Figure 1: Pre-surgical X-rayof the bone defect (Dr. Ricardo Pacheco López).**

X-rays were used in all of the operations to examine the bone gap in posterolateral, lateral, and oblique projections (Figure 1). A dorsal incision was made and planes are dissected till the fracture site was reached (Figure 2). A longitudinal incision of 4 to 5 cm was done on the posterior part of the forearm in its proximal portion in a flexed position to get the olecranon graft. (Figure 3). Planes were used to dissect it, and the graft was harvested with an osteotome (Figure 4) and, in some cases, a saw. The closure was carried out by planes from the donor area. When the graft was placed in the bone gap, osteosynthesis material was employed to secure the graft with Kirschner wire, cerclage, plates, and screws. (Figure 5). A control radiograph of the graft insertion location (Figure 6), as well as the donor area, was required postoperatively (Figure 7). Post-operative care was provided in an outpatient clinic, and he was then transferred to rehabilitation. We used Statistical Package for the Social Sciences (SPSS). Descriptive statistics included percentages, means, and SDs. The $\chi 2$ and Fisher's exact tests were used to compare categorical variables, paired Student's t tests were used to compare continuous variables and Mann-Whitney U test to compare medians. A level of significance was determined for a p value of less than 0.05.

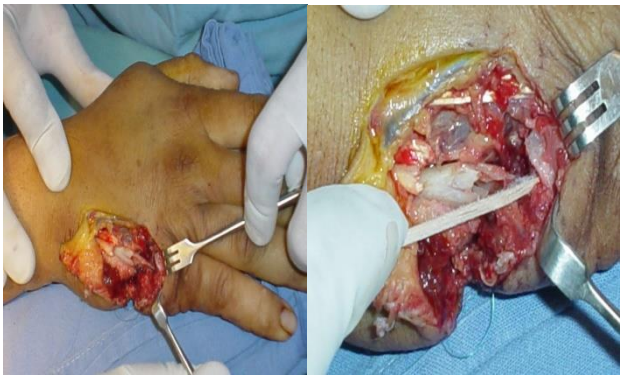

**Figure 2: Comminuted fracture approach with bone gap.**

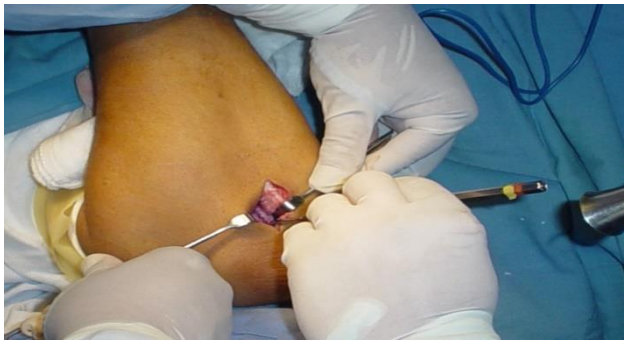

**Figure 3: Procurement of olecranon graft.**

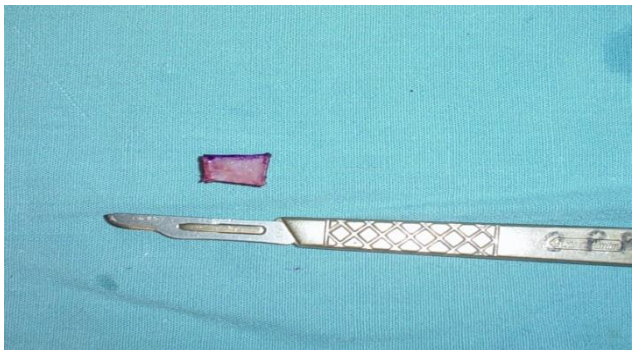

**Figure 4: Olecranon graft.**

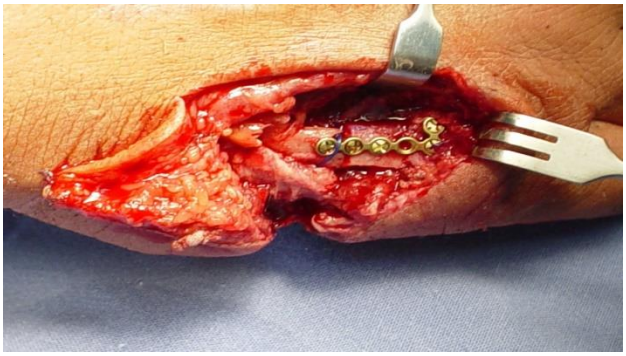

**Figure 5: Graft implantation and osteosynthesis material placement.**

**Figure 6: Post-operative control X-ray.**


**Figure 7: A post-operative control X-ray of the donor location.**

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## RESULTS

This study included 23 patients, 7 of whom were women and 16 of whom were men. The average age of the patients who underwent olecranon grafting surgery was 37 years. Secondary or tumor reconstruction (22.7 percent), fire weapon (50 percent), laceration with a saw or grinder (13.6 percent), and trauma were the mechanisms of harm for these patients (13.6 percent). The bone gap reconstructed with olecranon bone graft was located in the metacarpals in 9 patients (39%), the proximal phalanx in 9 patients (39%), the middle phalanx in 3 patients (13%), the metacarpal/proximal phalanx in 1 patient (4.3%), and the proximal phalanx/middle phalanx in 1 patient (4.3%) (Table 1).

**Table 1: Patients' general features.**

| Variables/characteristics | n=23 |
|---|---|
| **Age, years** | 37.65±12.18 |
| **Sex, no. (%)** | |
| Women | 7 (30.4) |
| Men | 16 (69.6) |
| **Smoking, n (%)** | 9 (39.1) |
| **Diabetes mellitus, n (%)** | 2 (8.7) |
| **Diagnosis, n (%)** | |
| Tumor | 3 (13) |
| Fracture | 20 (87) |
| **Etiology, n (%)** | |
| Tumor | 5 (22.7) |
| Firearm | 11 (50) |
| Cutting | 3 (13.6) |
| Trauma | 3 (13.6) |
| **Location, n (%)** | |
| Metacarpal | 9 (39.1) |
| Proximal phalanx | 9 (39.1) |
| Middle phalanx | 3 (13) |
| Metacarpal/proximal phalanx | 1 (4.3) |
| Proximal phalanx/middle phalanx | 1 (4.3) |
| **Affected finger, n (%)** | |
| 1 | 4 (18.2) |
| 2 | 3 (13.6) |
| 3 | 4 (18.2) |
| 4 | 6 (27.3) |
| 5 | 5 (22.7) |
| **Left, no. (%)** | 11 (47.8) |
| **Right, n (%)** | 12 (52.2) |

Seven of the 23 procedures were performed in the ambulatory operating room utilizing regional blocking, while the remainder were performed in the main operating room under general anesthetic. All patients were asked to provide a post-surgery control elbow X-ray that did not include any fracture data. The olecranon graft widths of the 23 patients ranged from 5 mm to 12 mm, with an average width of 7.9 mm. The lengths of the olecranon grafts ranged from 5 mm to 47 mm, with an average length of 19.62 mm (Figure 8). The control X-ray revealed no elbow fractures. Seven of the patients had hypersensitivity and/or stiffness as reported post-surgery sequelae. The previously described issues were seen more frequently in metacarpal bone gaps (p=0.05), but no further complications associated with bone loss etiology were seen (Table 2).

**Table 2: Complications that occurred throughout the postoperative period.**

| Variables/characteristics | Without complications n=16 | Complications n=7 | P value |
|---|---|---|---|
| **Age, years** | 35.44±12.24 | 42.71±11.23 | 0.19 |
| **Sex, no. (%)** | | | |
| Women | 5 (31.3) | 2 (28.6) | 0.99 |
| Men | 11 (68.8) | 5 (71.4) | |
| **Smoking, n (%)** | 7 (43.8) | 2 (28.6) | 0.65 |
| **Diabetes Mellitus, n (%)** | 1 (6.3) | 1 (14.3) | 0.52 |
| **Diagnosis, n (%)** | | | |
| Tumor | 3 (18.8) | 0 (0) | 0.52 |
| Fracture | 13 (81.3) | 7 (100) | |
| **Etiology, n (%)** | | | |
| Tumor | 4 (26.7) | 1 (14.3) | 0.93 |
| Firearm | 7 (46.7) | 4 (57.1) | |
| Cut | 2 (13.3) | 1 (14.3) | |
| Trauma | 2 (13.3) | 1 (14.3) | |
| **Location, n (%)** | | | |
| Metacarpal | 5 (31.3) | 4 (57.1) | 0.05 |
| Proximal phalanx | 9 (56.3) | 0 (0) | |
| Middle phalanx | 2 (12.5) | 1 (14.3) | |
| Metacarpal/proximal phalanx | 0 (0) | 1 (14.3) | |
| Proximal phalanx/middle phalanx | 0 (0) | 1 (14.3) | |
| **Affected finger, n (%)** | | | |
| 1 | 3 (20) | 1 (14.3) | 0.70 |
| 2 | 1 (6.7) | 2 (28.6) | |
| 3 | 3 (20) | 1 (14.3) | |
| 4 | 4 (26.7) | 2 (28.6) | |
| 5 | 4 (26.7) | 1 (14.3) | |
| **Left, no. (%)** | 8 (50) | 3 (42.9) | 0.99 |
| **Right, n (%)** | 8 (50) | 4 (57.1) | |
| **Graft, n (%)** | | | |
| Ulna | 6 (37.5) | 2 (28.6) | 0.99 |
| Olecranon | 10 (62.5) | 5 (71.4) | |
| **RX length defect size, mm** | 21.53±11.01 | 15.25±3.20 | 0.05 |
| **RX width defect size, mm** | 7.93±1.75 | 7.52±2 | 0.63 |
| **Length graft size, mm** | 24.31±9.19 | 17.48±3.88 | 0.02 |
| **Width graft size, mm** | 8 (7-9.75) | 8 (5-10) | 0.94 |

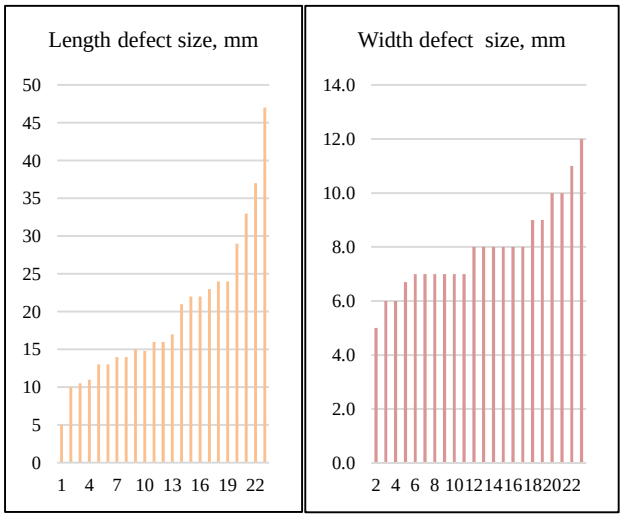


**Figure 8: Achieved graft dimensions.**

## DISCUSSION

Bone graft remains the material most commonly used to replace deficient bone.[15] The need for bone autografts to be used in the restoration of bone gaps caused by related trauma or tumor removal emphasizes the importance of bone autografts. Its use is limited due to the related morbidity. Obtaining grafts from a safe site with easy and constant access, on the other hand, enables for growing usage of this treatment to treat various types of injuries.[13]

This study demonstrates the safety and ease of obtaining and applying olecranon grafts. These can only be done with an axillary block, avoiding orotracheal intubation and the hazards of general anesthesia. There were no important structures such as nerves or arteries in the olecranon's perimeter during the graft's procurement, no vital structures such as nerves or arteries in the periphery of the olecranon. Another benefit is that the donor will scar effectively, locating the lesion in a less visually

prominent place. In this investigation, seven patients reported discomfort and rigidity following bone graft insertion; however, these symptoms could be related to an injury mechanism. Furthermore, no complications from acquiring the olecranon graft were recorded in the post-operative process. In the donor area, there was only one report of hypersensitivity in four patients. As part of the procedure, every patient was sent to rehabilitation to continue their physical and occupational therapy. In fractures with hand bone loss, an olecranon graft proved an adequate alternative for gaps ranging from 5 mm to 47 mm. All of the patients had a stable graft fixation using various osteosynthesis materials such as 3D plates, linear plates, or nails. Regardless of the mechanism of damage, all patients had appropriate skin coverage, even if the bone loss was accompanied by skin and soft tissue loss. Local flaps were used in some situations to provide skin coverage before transplant insertion. There were no graft losses reported by any of the patients.

There were recognized limitations with our descriptive longitudinal and prospective study design that may have affected our findings and conclusions. The outcome assessments and X-rays of the graft donor sites were obtained at differing time points. Different surgeons performed this procedure, which may have introduced bias. Also, we used various osteosynthesis materials for graft fixation. Therefore, in order to compare each one, we need to increase the sample size.

## CONCLUSION

Cortical olecranon grafts have been a safe and viable reconstructive choice for our center for bone gap reconstruction. With the osteosynthesis procedures used, these grafts enable secure fixation. Its use is safe for bone gaps ranging from 5 mm to 47 mm in length and 5 mm to 12 mm in width, as no fractures were reported following graft procurement. Minor problems have been described, which may be related to the same trauma mechanism. Each problem, however, was sent to rehabilitation to continue their treatment. This study enables additional research on the patient's follow-up, utilizing proven measuring devices to assess their functional stage post-surgery.

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