

# One-Bone Forearm Reconstruction

## A Salvage Solution for the Forearm with Massive Bone Loss

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**Background:** Salvaging the forearm is a major challenge in cases of massive bone loss from injuries in which the extremity is severely mangled or following bone resection secondary to pathological tissue excision. The purpose of this study was to evaluate the role of one-bone forearm (OBF) reconstruction as a salvage option in these difficult situations.

**Methods:** A total of 38 patients with forearm segmental bone loss (acute and chronic) treated between 1995 and 2014 were included (range of follow-up, 2 to 20 years). Sixteen of the patients, 8 with avulsion amputations and 8 with severely mangled extremities, were managed in the emergency department because they required immediate replantation and revascularization, respectively. In the chronic setting, bone loss was due to infection with nonunion in 16 patients, tumor of the radius in 2 patients, and pseudarthrosis of the forearm in 4 patients. The surgical technique included conversion to OBF by achieving union between the distal part of the radius and the proximal part of the ulna in the majority of cases, with distal radioulnar joint (DRUJ) fusion in 4 cases, and ulna to carpals in 5 cases. Direct bone contact was achieved in 16 patients, a free vascularized fibular graft was used to bridge the bone gap in 10 patients, and 12 patients required iliac crest bone-grafting.

**Results:** The mean patient age was 35.5 years (range, 6 to 87 years); there were 23 male and 15 female patients. Among those who underwent OBF for acute injuries, the mean time to union was 7.3 months; 14 patients had complete union, and 2 patients had infection with nonunion requiring secondary procedures. As assessed using the criteria of Chen, 10 patients had a grade-I functional outcome, 3 patients had a grade-II outcome, and 3 patients had a grade-III outcome. In the elective group of 22 patients, the average time to union was 7.1 months. Nonunion was reported for 2 patients. On the basis of the Peterson scoring system, the outcome was excellent for 12 patients, good for 6 patients, fair for 2 patients, and poor for 2 patients.

**Conclusions:** OBF reconstruction is a viable surgical treatment alternative. It is a demanding reconstruction but functions better and is cosmetically more appealing than a forearm amputation.

**Level of Evidence:** Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.

The forearm is unique in its anatomy, with the radius and ulna and associated articulations including the humeroulnar joint, the proximal and distal radioulnar joints, the radiocarpal joint, and the interosseous membrane. The relative length of both the radius and ulna is important for proper functioning of the forearm<sup>1,2</sup>. A fracture of 1 or both bones of the forearm may be an intra-articular fracture, with anatomical reduction required to restore normal function. Standard skeletal fixation methods may not be possible in replantation and revascularization scenarios for a mangled

upper extremity or an avulsion amputation. In addition to the problems of soft-tissue and bone loss, ischemic time related to vascular injury is also very important<sup>3-7</sup>. Despite the latest advances in microsurgical techniques, salvage in cases of these major injuries is a challenge, and, to our knowledge, there are no standard techniques described for reconstruction with major bone loss in the forearm<sup>8</sup>. We also are not aware of any scoring system that has been described for mutilating injuries of the upper limb with vascular injuries that can be used to predict salvage and functional outcome<sup>9,10</sup>.

**Disclosure:** The authors report support for manuscript preparation from the Ganga Orthopaedic Research Education Foundation (GOREF), Coimbatore, India during the conduct of this study. The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (<http://links.lww.com/JBJS/F329>).