

## Fresh Frozen Osteochondral Allografts Reconstruction of the Proximal Humerus, after Severe Gunshot injury: A Case Report

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### Abstract

Fractures secondary to firearms normally result in comminuted fractures, which require an individual approach in order, these represent a true challenge for the specialists. Actual treatment is unsatisfactory due to the higher risk to develop wound healing complications, and small fragments are difficult to attach, and surgical debridement should be performed to prevent wound infection. Osteochondral graft provides a more promising alternative in the bone and joint healing process in these cases. The objective of this paper is to report the outcome of a comminuted bone fracture in which an osteochondral graft was used to repair the humeral injury. This is a case report article in which fresh frozen massive osteochondral allografts were used to rebuild the proximal right humerus comminuted fracture originated by multiple gunshots. Surgical debridement and a cemented spacer were required in this procedure prior to the osteochondral graft implantation, the surgery was postponed for four weeks due to a specific graft size request. Accurate graft's size was essential for this patient because of his extended and complicated bone and cartilage involvement. The patient has recovered important range movement, with a slow pace, but promising outcome, just after six months posterior to the injury, no chronic or recidivant pain was referred by the patient after the graft's implantation.

**Keywords:** Osteochondral; Gunshot injury; Proximal Humerus

### Introduction

Firearm injuries have become more common nowadays. When a high-velocity bullet impacts the bone, its structure suffers comminution and massive soft tissue damage. Orthopaedic surgeons face a difficult time reconstructing this type of injuries. Most of the times it is possible to carry out a regular osteosynthesis bonding the fragments and fixing them together. Unfortunately sometimes the result of the event leads to multiple small fragments that are impossible to attach. The situation worsens if the joint's surface is chattered.

Orthopaedic oncology has developed new limb sparing procedures, in which it has been studied the biological consolidation process between an allografts and the bone. Large bone defects can form a media where host cells can live and aid to this interaction to achieve a better fusion. Over the last decade orthopaedic surgeons have used the allografts use in a more diverse fashion. Finally it has been established the mechanism in which allografts accelerate the healing process by stimulating stem cells and growth factors.

A severe proximal humerus comminuted fracture originated from an assault weapon represents an important challenge for the orthopaedic traumatologist. The difficulty of this pathology not only depends on the bone injury itself, which produces small bone fragments, it

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is also important because soft tissue injury plays a role. There is also an increased risk of developing wound infection, because these are contaminated and the bone fracture is exposed.

### Case Report

A 28 year-old male multiple gunshot victim, arrives to the emergency department unconscious and hemodynamically unstable and receives standar resuscitation maneuvers. After the patient was stable, he was taken to the operating room. Portable X-rays revealed a right humeral comminuted fracture (Figure-1).



**Figure 1:** Severe proximal third comminuted fracture of right humerus.

Surgical debridement was performed, bone pieces were retrieved and a cemented spacer was left to maintain the humeral space (Figure-2). A fresh frozen osteochondral proximal humerus with rotator cuff insertion at the bone bank was requested.



**Figure 2:** A bone cemented spacer applied on the right shoulder.

Four weeks later the humeral graft was delivered and the patient was taken to the operating room. A deltopectoral approach was performed, and the cemented spacer was removed. The patient's rotator cuff was localized and repaired with sutures. A second team worked on the allograft and an intramedullary nail was attached. Pencil sharpner technic was realized to achieve a more stable osteotomy, and the humerus was adapted to match the graft.

The graft was placed and secured after a proper retroversion was realized. Anchor sutures were applied to connect the host's rotator cuff with the graft's cuff, and this last was sutured to the humeral head. Two large bone fragments were dissected, one of them involved the deltoid's muscle insertion, and the other pectoralis's muscle insertion. They were both attached to the allograft with a surgical wire. Soft tissue were closed in a regular fashion.



**Figure 3:** Fresh frozen osteochondral allograft, the bone graft with a locked nail.

After the soft tissue was closed and the infection risk ruled out. Radiographs were taken immediately after the surgical procedure, and two years later (Figure-3). They were compared and revealed that the osteotomy site was completely healed with the articular cartilage viability. The humeral head is higher due a weaknes of the rotator cuff. And the patients has a regular life style. The patient was sent to rehabilitation, with improved range of motion.



**Figure 4:** Two years later; showing bone graft integrated and articular cartilage preserved

## Results

Six months after the injury, the patient was able to reach; complete internal rotation, a 60 degrees anterior flexion, 30 degrees adduction, 15 degrees external rotation, 30 degrees abduction. The patient continues his therapy program with a slow pace, but promising evolution.

## Discussion

Firearm injuries are one of the most challenging situations for the Orthopaedist. Ater the patient is stabilized, the next important step is to obtain anteroposterior and lateral radiographs not only at the site of the wound, but also above and below in order to exclude

joint involvement. Some authors recommend arthrography to identify projectile penetration (Wood, 2012). Computerized tomography (CT) should be used if articular involvement is suspected.

These injuries destroy the natural skin defensive barrier and they also are contaminated because of the non-sterile projectile. Wound irrigation with local debridement, tetanus prophylaxis and a single long-lasting intramuscular cephalosporin are proven to be effective in the prevention of an infectious process. Wound infections depend on the type of the fracture. Type I fractures may be as low as 0% - 2%, type II fractures fluctuate between 2% - 7%, type III may vary between 10% - 50% (Wood, 2012).

Bone healing consists of a complex process that depends on the recruitment of various cell, which include fibroblasts, chondroblasts, osteoblasts, osteoclasts, and macrophages, along with growth factors and transcription factors. If bone fragments are large enough and there is no vascular damage, the healing process begins with the inflammation, repair, and remodeling. Normally firearm fractures require surgical repair, the most recommended procedure is to stabilize the fracture with external fixation, until wound healing is completed, which is approximately a two-week period. After the wound is healed a locked intramedullary nailing.

Specifically proximal humeral fractures involving rotator cuff injury are difficult to repair because of the complexity of the articulation itself. Comminuted fractures as seen on case one, require full replacement of the humeral proximal third. Unfortunately for this patient only the superior portion of his rotator cuff was repaired with stitches and needed the use of a graft in order to achieve the maximum recovery in conjunction with the proximal humerus graft. Patient's recovery was the over expectations. Actually he is fully independent after two years of the event, even though he experienced multiple comminuted fractures that involved the articular surface.

Orthopaedists should make use of algorithms if they lack experience, still every patient should be evaluated individually, and special situations must be considered in order to identify the additional risk factors such as vascular or neuronal damage, or articular involvement. They must confront the possibility of a non-complete recovery of the limb function or even an amputation.

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