

Conservative treatment for humeral surgical neck non-unions

Federico Alfano¹

Abstract

Introduction: 2-part non-union of the surgical neck fractures of the humerus after conservative treatment may result from initial displacement, secondary disimpaction, interposition of soft tissue, synovia fluid at the site of fracture, aggressive rehabilitation, bad patient compliance, and many other intrinsic causes. A wide variety of treatments for this condition have been proposed. They include conservative treatment, ORIF (with or without bone grafting), hemiarthroplasty and reverse arthroplasty. Most reports emphasize possible treatment options and their results. Nonetheless, it is hard to address conservative treatment since it is a very disabling disease. The aim of the present study is to evaluate the results achieved with conservative treatment for surgical neck non-unions in elderly patients. Although we advocate for surgical treatment for 2-part non-union of the surgical neck fractures, the group of patients included in the study didn't accept our surgical indication or surgery was contraindicated because of increased operative or anesthetic risks.

Materials and Method: Retrospectively, 13 shoulders with a 2-year follow-up period were included in the study. 9 of the 13 patients were female. The mean age of the patients was 83.3 years (range 75–91 years). The dominant arm was affected in 4 patients. In the current study it was found that bone cavitation may occur early in the course of the disease, even in cases of hypertrophic non-union. It seems clear that 2-part surgical neck fractures can develop non-union in distinct manners. We found an association between hypertrophic non-union and gleno-humeral arthritis. In these cases, it looks like the limited range-of-motion in the gleno-humeral joint causes fracture instability and continuous movement between fragments, leading to hypertrophic non-unions. As stabilization of a fracture provides the essential mechanical component to allow calcification of the fibrous cartilage, on the contrary, early active mobilization exercises of a stiff joint leads to early mobilization of the fracture site before bone healing had occurred.

Results: All patients complained of pain and functional impairment within the first year (with a mean Constant Score of 13.1, 15.1, 17.2 at 3, 6 and 12 months respectively). After that period most patients complained mainly about poor active range of motion (with a mean Constant Score of 24.7 and 25.6 at 18 and 24 months respectively). The mean pain score improved from 8.4 at 6 months to 4.1 at the time of follow-up ($p < 0.05$). Mean active elevation didn't improve although home-based exercises or supervised strengthening was carried out. All patients had internal and external rotation lag signs. At the time of last follow-up, the average active shoulder range of motion was 73° of total elevation, 20° of external rotation; on internal rotation, the ipsilateral thumb could reach the ipsilateral buttock. The two patients with combined preexisting gleno-humeral arthritis and hypertrophic non-unions had worse outcome in terms of pain and range of motion.

Conclusions: Pain relief after 12 months was associated to three anatomical changes during the natural course of the disease. These are the development of a capsule-like formation of connective tissue in the non-union site, a varus cephalic displacement and bone cavitation process interruption (which was represented by the proximal humerus metaphyseal region and subcapital head sclerosis). In cases of preexisting gleno-humeral arthritis we advocate for reverse arthroplasty. If the hypertrophic non-unions had occurred we would advocate for surgical stability and earlier mobilization. In all other cases, we still prefer the surgical indication if the patient has an unacceptable pain. If surgery is not possible, we can still expect reduction of pain but any improvement in terms of range of motion after 12 months of conservative treatment.

Key words: Conservative treatment, humeral surgical neck non-unions, elderly patients.

Introduction

Proximal humeral fractures account for 4–5% of all fractures (1-3). While the majority of surgical neck fractures of the

humerus will be minimally displaced, expecting good functional outcomes with conservative treatment, (4, 5) in exceptional cases, complications such as non-union do occur (6-10). Neer reported the incidence as 13.7% in 117 three- and four-part fractures, all occurring at the surgical neck (5). The finding of non-unions occurring at the surgical neck was confirmed by others (7,11). Hanson et al. reported a delayed

union and non-union prevalence of 7% (95% CI, 3.6%-12.3%) in their series of 160 non-operative fractures (12). 2-part non-union of the surgical neck fractures of the humerus after conservative treatment may result from initial displacement, secondary disimpaction, interposition of soft tissue, synovia fluid at the site of fracture, aggressive rehabilitation, bad patient compliance, and many other intrinsic causes. A wide variety of treatments for non-union of the surgical neck fractures of the humerus have been proposed. They include conservative treatment, ORIF (with or

¹ Spanish Hospital of Buenos Aires

Address of Correspondence

Dr. Federico Alfano
Spanish Hospital of Buenos Aires
Email: drfedericoalfano@gmail.com



Figure 1: A: Anteroposterior radiograph of a 75 year-old woman, six months after a proximal humeral fracture, showing a nonunion of the neck-shaft fracture. This patient was treated with a sling for 6 weeks. In the X-ray, there is an absence of callus formation. There is severe head cavitation but fracture ends didn't look tapered and/or sclerotic yet. B: hypointensity on T1-weighted image, and hyperintensity on T2-weighted image T1-weighted at 6 months, which is differentiated from the low intensity in T2-weighted image at 24 months, showing capsule-like formation and fracture end sclerosis at this point. Images B and C show a varus cephalic displacement from 6 to 24 months. At last follow-up these images showed humeral head cavitation process interruption by metaphyseal region and subcapital head sclerosis.)

without bone grafting), hemiarthroplasty and reverse arthroplasty. Most reports emphasize possible treatment options and their results. Nonetheless, it is hard to address conservative treatment since it is a very disabling disease. The aim of the present study is to evaluate long-term outcomes achieved with conservative treatment for surgical neck non-unions in elderly patients.

Materials and methods

Study design and entry criteria

We retrospectively assessed the function of the upper extremity in a group of patients who were assigned to non-operative treatment of a humeral surgical neck non-union. Our primary objective was to obtain reference values for the Constant score, Visual Analog Scale for Pain (VAS Pain) and MRI changes until two years from the fracture event. All patients with a radiographically proven, closed non-union of the surgical neck fractures after 24 months were admitted to the study. For the purpose of this research, we defined non-union as occurring after 6 months from the

fracture. Although we advocate for surgical treatment for 2-part non-union of the surgical neck fractures, the group of patients included in the study didn't accept our surgical indication or surgery was contraindicated because of increased operative or anesthetic risks. All patients provided written informed consent for the publication of this study. Moreover, this study was approved by the Institutional Review Board of our Hospital. We excluded patients with prior shoulder surgery, patients with malignant tumors (irrespective of location), presenting to the hospital 10 days or more after injury, patients with open fractures or multiple trauma and preexisting upper extremity neurological disorder affecting the function of the upper limb, such as multiple sclerosis, paraplegia, thoracic outlet syndrome, reflex sympathetic dystrophy, and patients with generalized polyarthritis or rheumatoid arthritis. Also excluded were patients with a history of drug or alcohol abuse and those who were deemed unlikely to cooperate or attend all scheduled study visits.

Baseline documentation

On admission, patient demographics (ie, gender, age, working status, dexterity, concomitant diseases, and medication) and injury characteristics (ie, accident type, energy level of trauma, concomitant injuries, fracture classification) were recorded. (Table 1). Radiographs were obtained in anterior-posterior projection and axillary view

upon admission in the Division of Shoulder Surgery. Non-unions were classified according to AO and Neer fracture schemes by the physician on charge (FA). We documented the type and duration of immobilization and beginning of active assisted and unrestricted mobilization as well as the need for immediate or later surgical repair.

Follow-up

Patients were actively monitored and physically examined after 3, 6, 12, 18 and 24 months. Primary outcome measures comprised VAS, anterior elevation and raw Constant scores. Power was instrumentally measured with an Isometer – Muscle strength gauge (Innovative Design Orthopaedics / IDO) with the arm held in 90° abduction in one case only, because the rest of the cases never achieved 90° abduction. In those cases we graduated the Strength of Abduction as 0 pounds. Plain radiographs of the injured shoulder in 2 planes (with use of standard techniques for true anteroposterior and scapular Y views of

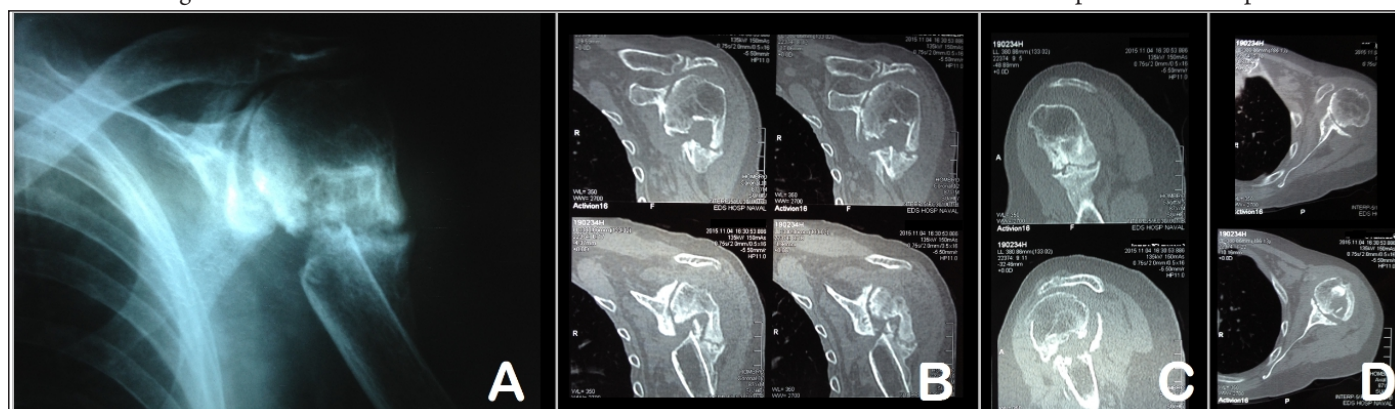


Figure 2: A: Anteroposterior radiograph of a 89 year-old woman with nonunion of proximal humerus taken 14 months after the fracture. The patient had a previous glenohumeral osteoarthritis. The AP radiograph shows a smooth and sclerotic line at the fracture ends with exuberant callus formation. There is some external callus formation present (white arrow). Initial treatment of the fracture included a sling and NSAIDs for pain relief. Surgery was contraindicated because of increased operative or anesthetic risks. B, C and D: CT scan images taken at 15 months after the fracture show respectively a coronal, sagittal and axial views of the hypertrophic callus formation at the fracture site and head bone cavitation).

the shoulder) were obtained to determine fracture healing (or non-healing) at 3, 6, 12, 18 and 24 months. Additional computed tomography (CT) and MRI scans were ordered at 3, 12 and 24 months as well.

Statistical analysis

Because of the observational character of this study, we did not pose a formal null hypothesis. We didn't have a target sample size or assumed a % drop-out rate. We planned to enroll all patients with non-union of the surgical neck fractures of the proximal humerus treated in our hospital (Spanish Hospital of Buenos Aires) from January 2012 to February 2017. All analyses were made according to the intent-to-treat principle; that is, all patients who were assigned to conservative management were included in the final evaluation, regardless of complications, pain or shoulder mobility.

The Constant Score outcome was considered significant if the patient had a difference of 15 points from the baseline score at 3 months. The VAS outcome was considered significant if the patient had a difference of 4 points from the baseline pain of a 10-point scale. The Fisher exact test was used to evaluate the Constant Score and VAS pain scale (clinical significance vs. non clinical significance). Statistical significance was defined as a p value of <0.05 .

Results

13 shoulders with a 2-year follow-up period were included in the study. 9 of the 13 patients were female. The mean age of the patients was 83.3 years (range 75–91 years, 95% CI, 77.8%–88.8%). Comorbidities, mostly cardiovascular and respiratory diseases, were present in 12 patients (92%, 95% CI 63.6–99.8%). (Table 1). The dominant arm was affected in 4 patients. The distribution of the nonunions, according to the AO and Neer classifications, is shown in Table 2. In the current study it was found radiographically that bone cavitation may occur early in the course of the disease, even in cases of hypertrophic non-union. Early complications included loss of reduction with fragment dislocation and axis deviation in all cases. In the first 6 months we found muscle weakness, neurologic sensations (mainly tingling or numbness of the

ipsilateral hand and forearm) and severe pain. The mean pain score improved significantly from 8.4 at 6 months to 4.1 at 12 months ($p < 0.05$). This clinical and statistical significance remained until final follow-up at 2 years. (Table 3) All patients complained of pain and functional impairment within the first year (with a mean Constant Score of 13.1, 15.1, 17.2 at 3, 6 and 12 months respectively). After that period most patients complained mainly about poor active range of motion (with a mean Constant Score of 24.7 and 25.6 at 18 and 24 months respectively) (Table 4). Of note, these differences were mainly influenced by pain relief. Indeed, mean active elevation didn't improve even after home-based exercises or supervised strengthening was carried out. All patients had internal and external rotation lag signs. At the time of last follow-up, the average active shoulder range of motion was 73° of total elevation, 20° of external rotation; on internal rotation, the ipsilateral thumb could reach the ipsilateral buttock. The two patients with combined preexisting glenohumeral arthritis and hypertrophic non-unions had worse outcome in terms of pain and range of motion. Pain relief after 12 months was associated to three anatomical changes during the natural course of the disease. These are the development of a capsule-like formation of connective tissue in the non-union site, a varus cephalic displacement and bone cavitation process interruption (which is represented by the proximal humerus metaphyseal region and subcapital head sclerosis). (Figure 1. A: Anteroposterior radiograph of a 75 year-old woman, six months after a proximal humeral fracture, showing a nonunion of the neck-shaft fracture. This patient was treated with a sling for 6 weeks. In the X-ray, there is an absence of callus formation. There is severe head cavitation but fracture ends didn't look tapered and/or sclerotic yet. B: hypointensity on T1-weighted image, and hyperintensity on T2-weighted image T1-weighted at 6 months, which is differentiated from the low intensity in T2-weighted image at 24 months, showing capsule-like formation and fracture end sclerosis at this point. Images B and C show a varus cephalic displacement from 6 to 24 months. At last follow-up these images showed humeral head cavitation process

interruption by metaphyseal region and subcapital head sclerosis.) At the time of the final radiographic follow-up, of the three patients with 3-part greater tuberosity fractures only one had healed in an anatomic position (<5 mm of displacement) and two had malunion (>5 mm of displacement). In addition, Constant Score and VAS pain outcomes of the two-part surgical neck nonunions without tuberosity involvement were not significantly different from the malunions that involved the tuberosities. It seems clear that 2-part surgical neck fractures can develop non-union in distinct manners. We found an association between hypertrophic non-union and previous gleno-humeral arthritis. In these cases, it looks like the limited range-of-motion in the gleno-humeral joint causes fracture instability and continuous movement between fragments, leading to hypertrophic non-unions (Figure 2: A: Anteroposterior radiograph of a 89 year-old woman with nonunion of proximal humerus taken 14 months after the fracture. The patient had a previous glenohumeral osteoarthritis. The AP radiograph shows a smooth and sclerotic line at the fracture ends with exuberant callus formation. There is some external callus formation present (white arrow). Initial treatment of the fracture included a sling and NSAIDs for pain relief. Surgery was contraindicated because of increased operative or anesthetic risks. B, C and D: CT scan images taken at 15 months after the fracture show respectively a coronal, sagittal and axial views of the hypertrophic callus formation at the fracture site and head bone cavitation). As stabilization of a non-union provides the essential mechanical component to allow calcification of the fibrous cartilage within the non-union, on the contrary, early active mobilization exercises of a stiff joint leads to early mobilization of the fracture site before bone healing had occurred.

Discussion

Since this disease typically results in substantial pain and functional impairment (13, 14), it is widely accepted that painful proximal humerus non-union fractures need to be surgically treated (15–25). This group of patients included subjects who actively refused the surgical indication or surgery

was contraindicated because of increased operative or anesthetic risks. The present investigation represents a detailed study on outcomes after nonoperative treatment for non-union of the surgical neck fractures of the humerus. Because mortality and nonattendance are very common in an elderly population who present with several comorbidities, we understand that this is a valuable study since it is very hard to be absolutely precise in the long-term outcome of this disease. In this series of thirteen proximal humeral nonunions treated with

conservative treatment, there was a significant reduction of pain after one year of follow-up but a limited function of the extremity secondary to absence of improvement in shoulder motion.

Conclusion

Our results show that there are significant functional problems associated with nonunion of the surgical neck fractures of the humerus. It is unlikely that shoulder motion will be regained after conservative treatment. Although we can expect little

functional improvement, pain decreases after one year. After this time, in a low demand elderly population, this disease becomes not only tolerable but also a painless disability.

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