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Case Report

IS THERE A RATIONALE IN THE USE OF THE BONE STRUT ALLOGRAFT FOR MANAGEMENT AND INTERNAL FIXATION IN PERIPROSTHETIC HUMERAL FRACTURES? A CASE REPORT.

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ABSTRACT

The gradual increase in shoulder implants has resulted in a parallel increase in periprosthetic fractures of the humerus. Currently, there are no definite certainties about the best methods of treatment and there are no adequate devices to ensure optimal healing. Undoubtedly, the multitude of experience in treating femoral periprosthetic fractures can be a guide used to improve the approach to periprosthetic fractures of the humerus. The use of metallic fixation devices, in combination with bone grafts, could represent a favourable mixed mechanical and biological solution in the treatment of periprosthetic fractures of the humerus. This article presents a case of periprosthetic humeral fracture in a 77-year-old woman with reverse shoulder prosthesis.

1. Introduction

The gradual increase in shoulder implants in active elderly patients has resulted in a parallel increase in periprosthetic humeral fractures [1], whose incidence varies between 0.6% and 3% of all shoulder prostheses [2]. The use of cortical bone transplants allows orthopedic surgery to combine biological materials together with traditional metallic fixation devices [4-6]. The clinical case presented here is an example of treatment of periprosthetic humeral fractures with the use of this combination technique.

2. Case presentation

The A 77-year-old woman with a right, reverse shoulder prosthesis implanted two years ago, suffered a trauma on the right upper limb as a result of an accidental fall. The X–ray exam showed a multiple fragment fracture of the right humeral shaft at the apex of the prosthetic stem classified as Type B2 Worland (Figure 1). Surgical treatment was performed by lateral approach with the patient in the "beach chair". A 12-hole Synthes® reconstruction plate with monocortical-angular stable screws was used in the proximal site (due to the presence of the prosthetic stem) and bicortical screws in the distal site. In addition, two cortical bone grafts, derived from a homologous femoral shaft segment (taken from the bone bank), were placed to reinforce the synthesis by using two cerclage cables (performed with Synthes® technique) (Figure 2). The bone grafts were positioned at the top of the triangle corresponding to the circular transverse section of the humeral shaft, to ensure maximum biomechanical stability and limit, at the same time, the direct negative ischemic action of the cerclage on the humerus. The surgery lasted 210 minutes and allowed for an anatomical reconstruction of the humerus with mechanical stability sufficient for rehabilitation and fracture healing (Figure 3). Immediately after surgery, a stupor of the radial nerve was

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found, which was completely solved in about four months. After a month of immobilization, the patient cautiously began progressive movements of the shoulder. The following scores were used for clinical and radiological follow-up: The Short Form Health Survey (SF12) and the Constant Score. The radiographic controls after 3-months (Figure 4), and 1 year (Figure 5), showed very good healing of the fracture. The patient regained functionality of the right upper extremity; after one year, the scores of the right shoulder were essentially similar to those of the healthy contralateral limb (Figure 6). Furthermore, the quality of life improved together with the functional recovery of right upper limb (Figure 7).

Figure 1 - Multiple fragment fracture of the right humeral shaft at the apex of the prosthetic stem(Warland type B2)

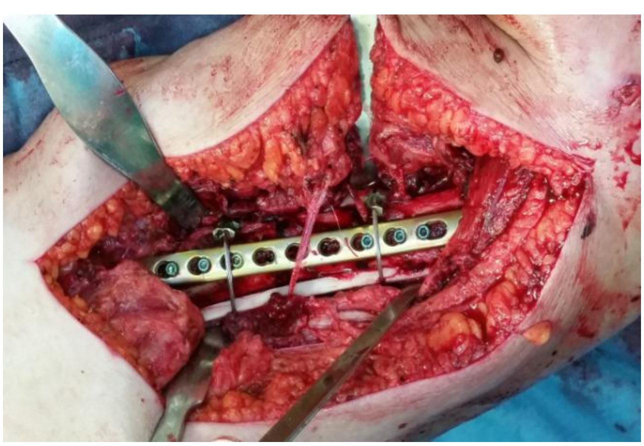

Figure 2 - Osteosynthesis of the humerus with plate and cortical bone allograft

Figure 3 - Radiographic control after surgery

Figure 4 - Radiographic control 3 months after surgery

Figure 5 - Radiographic control 1 year after surgery

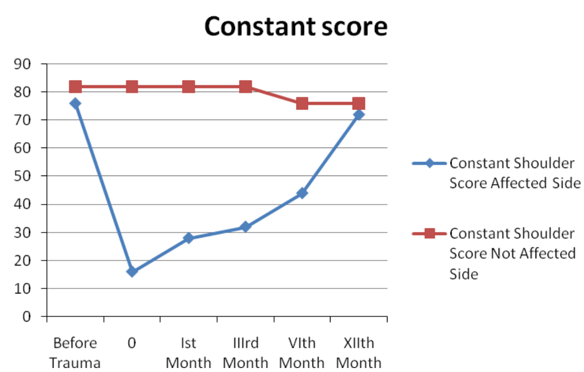

Figure 6 - Trend of Constant Score during 1 year of follow-up of affected side vs. non-affected side

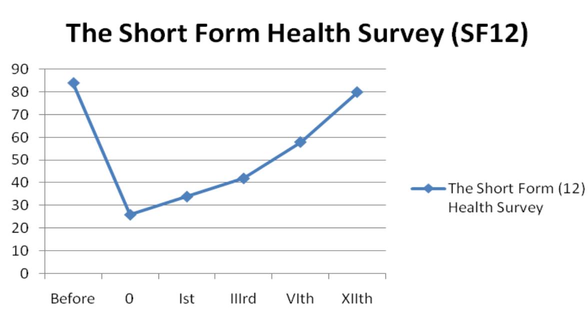

Figure 7 - Trend of The Short Form (12) Health Survey during 12 months of follow-up.

3. Discussion and conclusions

Periprosthetic humeral fractures account for approximately 11% of all complications related to total shoulder arthroplasties [3]. The fractures can be classified according to fracture anatomy and implant stability the same way the Vancouver classification grades the periprosthetic proximal femoral fractures. This grading system, described in 1999 by Worland, defines the fractures as type A, type B (subclassified in type B1, B2, B3) and type C. Depending on the fracture, the treatment options include conservative (non-surgical) and surgical approaches. Type B2 fractures have typically been referred to as the more complex, or difficult to treat, and non-surgical measures have no real role in the management of these injuries [1]. Complications from surgical intervention in these humeral fractures are predominantly related to radial nerve injuries (6–25% reported) and non-union (up to 13%) [4]. In the presence of proper prosthetic implant stability, type 2 fractures are generally treated with a plate associated with metal cerclage cables. It is possible to associate cortical bone grafts with metallic fixation devices. What advantages does this technique offer? The cortical bone graft plays an important biological and mechanical role: it enhances fixation stability of the wires and screws, especially in cases of periprosthetic bone fragility, resulting in a more stable synthesis that protects against early mobilization; it increases periprosthetic bone stock; it allows a relative osteoconductivity of the graft and the absence of contact of the periosteum with the metal cerclage-cable system, both of which aid in fracture healing; it avoids medial cortical bone break when the wires are tightened; it guarantees an immediate mechanical support by ensuring greater bone strength near the stem tip and reducing the mechanical stress by distributing greater elasticity along the bone surface. It's equally true that the use of cortical bone grafts lengthens the time of the operation, increases costs and risk of infection [4 - 6]. The use of a biological strut graft is widely described in the periprosthetic fractures of the femur[5]. On the contrary, there are few studies in the literature analyzing its usefulness in the periprosthetic fractures of the humerus. The study of Kumar et al[7] has proposed the use of bone graft for type B1 fractures with uncertain results regarding its usefulness [8]. Sanchez-Sotello have described the validity of the treatment of periprosthetic fractures of the elbow with a bone graft [9]. In Trompeter[1] and Martinez studies [6], confirmations have been found concerning the use of a bone graft as a viable method for the treatment of periprosthetic fractures of the humerus. In the clinical case analyzed, at one year after surgery, the validity of the technique is widely documented both by the excellent bone healing and the Constant Shoulder Score results, which show a progressive improvement of the shoulder features up to levels comparable to those of the contralateral healthy upper limb. At the same time, the Short Form Health Survey (SF12) has documented a net increase in quality of life related to health[10]. The scope of the osteosynthesis of a fracture is to create a morphological reconstruction and a sufficient mechanical stability to allow early mobilization without altering the healing processes[1,5,6]. With regard to periprosthetic fractures, the problems are greater because the presence of the prosthesis affects the use of traditional fixation devices[1,5,6,9]. Therefore, metal cerclage are frequently used together with traditional plates with screws to obtain a greater stability due to the forced use of monocortical screws in correspondence of the area occupied by the prosthesis[1,6].

While the use of metal cerclage in direct contact with the cortical bone in periprosthetic femoral fractures is now an established practice and without complications thanks to the femoral bone quality, for the humerus, the situation is quite different due to reduced cortical thickness; in the humerus, this intervention involves a higher incidence of bone reabsorption at the area of bone-cable contact[1,6]. However, the use of a biological graft placed between the cerclage and the bone is useful for biological healing and for increasing the biomechanical stability of the synthesis[1,4-7]. The use of multiple plates, on the other hand, would be disadvantageous as it would create an excessive "metallic commitment" hindering bone healing. In conclusion, in the clinical case analyzed, the association between a metal fixation device and an allograft bone is a useful and beneficial technique for optimum biological fracture healing and optimal recovery of upper limb function levels.

4. Declaration

All authors disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential conflicts of interest include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding.
This type of study does not require any statement relating to studies on humans and animals. All patients gave their informed consent prior to being included in the study. All procedures involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments.

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