CASE REPORT

Use of Strut Grafts in Bone Defects when Placing a Total Elbow: Two Case Reports

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Introduction. Bone defects that become visible during total elbow revision surgery or further to poor evolution of a supraintercondylar fracture can be addressed by means of an implant of bone-bank origin.
Case reports. We present two cases in which strut grafts were used when placing a total elbow prosthesis, one at the humeral and the other at the ulnar level.
Results. The clinical results for these grafts, one at 24 and the other at 26 months' follow-up, were fair and excellent respectively, according to the Mayo Elbow Performance Score.
Conclusions. The use of a bone-bank allograft is a useful way of treating the large bone defects that may appear when placing a total elbow prosthesis.

Key words: *total elbow prosthesis, bone defect, strut graft.*

Utilización de aloinjerto estructural en los defectos óseos durante la colocación de una prótesis total de codo: dos casos clínicos

Introducción. Los defectos óseos que aparecen en el momento de un recambio de una prótesis de codo, o tras la mala evolución de una fractura supraintercondílea, en el momento de colocar una prótesis de codo, pueden ser solucionados con un implante de hueso de banco.
Casos clínicos. Presentamos dos casos en los que se ha usado aloinjerto estructural en la colocación de una prótesis total de codo, uno en localización humeral y otro cubital.
Resultados. Los dos resultados clínicos obtenidos con 24 y 26 meses de seguimiento, utilizando la escala de *Mayo Elbow Performance Score*, han sido uno de regular y uno de excelente.
Conclusiones. La utilización de aloinjerto de banco es un recurso útil para el tratamiento de los grandes defectos óseos en la colocación de una prótesis total de codo.

Palabras clave: *prótesis total de codo, defecto óseo, aloinjerto estructural.*

Use of allografts as bone defect substitutes when placing a hip or knee total prosthesis is a common procedure, both as cancellous cavity fillers and as strut grafts, in the case of diaphyseal or metaphyseal defects. They have also been used when placing prostheses in other anatomical locations. Bone defects in the elbow can appear when exchanging an elbow prosthesis or following a poorly evolved supracondylar fracture and the placement of a primary elbow implant. The different prosthetic options for reconstructing these defects are as follows: a prosthesis (either custom-made or not) with no addition of extra bone; a prosthesis with morselized allograft[2], a prosthesis with cortical allograft[3] and a prostheses with strut grafting[4].

The purpose of this paper is to show our experience of the use of strut allografts in the bone defects encountered in the course of revising an elbow prosthesis and of the placement of a primary prosthesis in an old supracondylar fracture originally treated with osteosynthesis.

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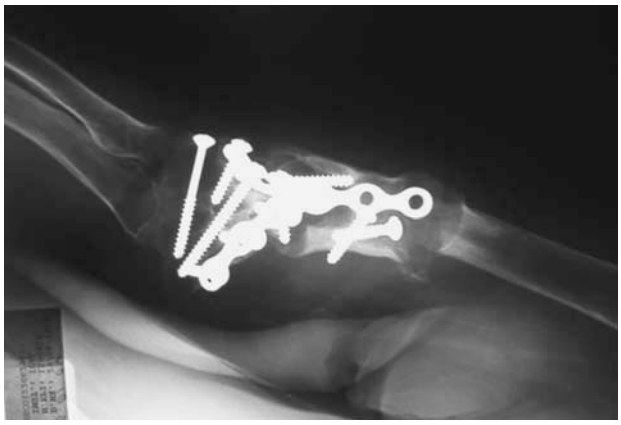

Figure 1. *Case 1:Pre-op x-ray showing a fracture through the proximal portion of the plate; pseudoarthrosis of the plate can also be seen, as well as global loosening of the osteosynthesis, with massive segmental bone resorption.*

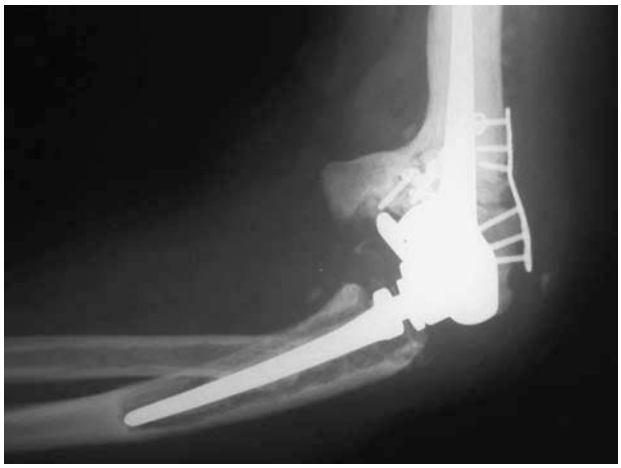

Figure 2. *Case 2: Pre-op x-ray showing significant osteolysis signs around the whole of the ulnar stem.*

Case 1

78-year-old patient who sustained a fortuitous fall and presented with a right humeral supracondylar fracture. Fracture osteosynthesis was performed with two one-third tubular plates. As a result of a breakage of hardware, a new fixation procedure was carried out with Sherman-type reconstruction plates. After this second surgery, the patient did not report back for her post-op controls and only did so 2 years later, when she already presented with a fracture through the proximal portion of the plate, as well as pseudoarthrosis of the fracture and global loosening of the osteosynthesis with massive segmental bone resorption (fig. 1). Complementary analytical tests ruled out an infectious etiology. Two years from the initial fracture, a decision was made to implant a Conrad-Morrey total elbow prosthesis. The approach used was described by Gschwend et al[5]. A resection was made of the diaphyseal segment, which showed massive resorption, replacing it by a humeral diaphyseal allograft. The epiphyseal portion was thus spared, together with its muscular (epitrochlear and epicondylar) attachments. Following the protocols used in our center, cultures and pathological analyses were made of the remainder of the distal humerus. Cultures were negative, which confirmed the etiology not to be infectious. According to the classification by Mansat et al[4], the defect assessed would correspond to a type II humeral defect. A cemented humeral component was used with a long stem and a long fin. This made it unnecessary to perform a supplementary osteosynthesis of the allograft.

Postoperatively, the elbow was immobilized for 3 days at 90°, which was followed by active mobilization; then passive extension by gravity was applied, followed by active flexion. The limb was placed in a swing for 3 weeks. Active extension was allowed after 6 weeks.

Case 2

38-year old patient who, as a result of a left humeral supracondylar fracture, presented with poor osteointegration with 45° antecurvatum and 40° varus. The patient presented with decreased and painful elbow mobility. Eight months from the initial fracture a decision was made to implant a GSB III prosthesis together with a supracondylar osteotomy using, as in the previous case, the stem of the prosthetic humeral component as an intramedullary fixation device. The components of the device became disassembled after 2 months, which led to two additional procedures. During follow-up, the patient suffered significant osteolysis around the whole of the ulnar stem as well as disabling elbow pain (fig. 2). The prosthesis was revised for a Conrad-Morrey implant that should prevent the construct from disassembling.

The defect in the ulnar area covered the whole extension of the ulnar stem and, according to the classification by Mansat et al[4], would correspond to a type II proximal ulnar defect. The same pre-op and post-op was followed as in the previous case to rule out infectious pathology. A bone-bank proximal ulnar fragment was given shape and prepared for insertion of the prosthetic ulnar stem. The prosthesis was introduced into the allograft. The ulnar stem was cemented onto the allograft and, subsequently, to the distal fragment of the patient's ulna. Unlike the first case, the allograft was fixated to the rest of the ulnar shaft with a small-fragment plate, since the length of the ulnar stem did not guarantee enough stability; the triceps was reattached with transosseous stitches. The post-op period was identical to that in the previous case.

Table 1. Results of the two cases according to the *Mayo Elbow Performance Score* (post-op/total)

Case	Follow-up	Pain	Stability	Mobility	Function	Total	Complications	Revision
1	24 months	45/45	10/10	15/20	0/25	70	No	No
2	26 months	45/45	5/10	15/20	25/25	90	No Failed healing Loosening	No

Result as a function of the total score: > 90 points, excellent; 75-89 points, good; 60-74 points, fair; < 60 points, poor.

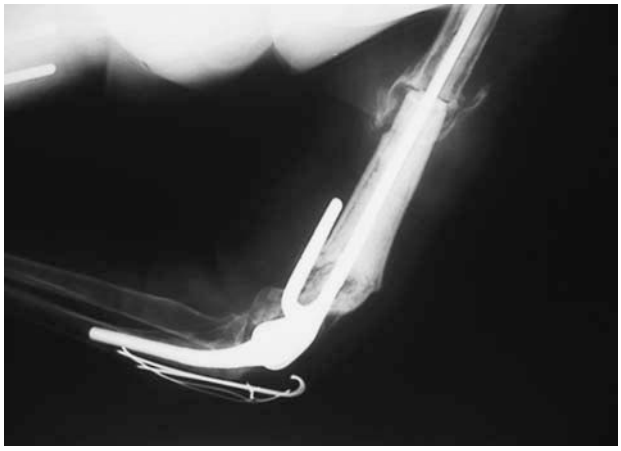

Figure 3. *Case 1: View of the strut humeral allograft ay 24 months' follow-up.*

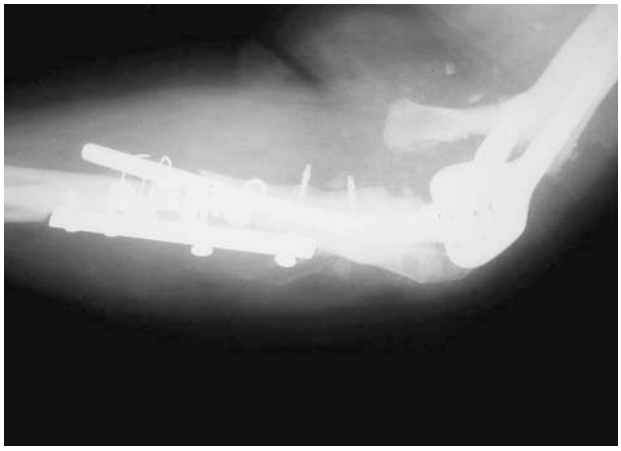

Figure 4. *Case 2:Failed incorporation of the ulnar allograft and loosening of the ulnar stem, at 26 months' follow-up.*

RESULTS

The clinical results for both patients, at 24 and 26 months' follow up, have been classified as fair and excellent respectively, according to the *Mayo Elbow Performance Score* (table 1).

The result of the first case was fair because the patient lost some elbow mobility, which means that although she does not experience pain she cannot use her elbow for her everyday activities (fig. 3).

Although the result of the second case is excellent, the allograft has not become radiologically incorporated and there signs of loosening of the distal portion of the stem at the distal ulna (fig. 4).

DISCUSSION

Bone defects in the elbow region may appear at the time of revising a prosthesis or when implanting a primary prosthesis following a supracondylar fracture. In revision cases, the osteolysis that caused the revision may leave behind it a significant bone defect, which is what happened in our case, made worse by the scraping of the cavity that had to be performed to remove the cement.

If we place a prosthesis in an old supra or intercondylar fracture, the bone defect could be caused, as in our case, by a poor evolution of the latter with bone resorption in the area, brought about by the loosening of the osteosynthesis. So when there is a large bone defect that cannot be addressed by just increasing the amount of cement used, or when the cortices are not strong enough, allograft filling or use of a strut allograft provides a good option for prosthetic support.

In our cases we used a semiconstrained Conrad-Morrey prosthesis[4]. This prosthesis can be used without it resting on the epitrochlea or the epicondyle. Humeral, diaphyseal and ulnar stem support guarantees stable prosthetic fixation. At the humeral level, there is an anterior fin that enhances the component's fixation, preventing it from toggling in extension and contributing to rotational stability.

Mansat et al[4] classify bone defects found during ulnar prosthetic revisions in the following way: a) humerus: type I, the bone covers the periarticular area up to the olecranon fossa; type II, the defect covers the distal third of the humeral shaft, up to the point at which the primary stem extended; and type III, the defect affects an area that is more proximal to the old humeral stem. B) ulnar defects are classified as follows: type I, when the defect covers the area of the olecranon and the triceps attachment site; type II, when the defect covers the bone around the whole of the ulnar stem and type III, when the bone defect covers the distalmost area of the ulnar stem. Mansat et al[4] use strut allografts for defects that are at least type II in the humerus and

in the ulna. Our two cases, according to Mansat's classification, would also be type II both in the humeral and ulnar areas.

Complications are usual in this kind of surgery. The most frequent are infection[4,6], failed allograft healing[4,7], which was our case, and allograft fractures[4,8]. Other less frequent complications are la triceps detachment[9], allograft resorption[4], and formation of a sterile granuloma[9].

Deep infection of the strut allograft is a serious complication that must be reckoned with. This may require the extraction of the grafted material, which tends to lead to poor functional results for the afflicted elbow. Mansat et al[4] report 4 cases of deep infection of the 13 cases they operated, Dean et al[6] mention 2 cases out of a total 23 and Urbaniak et al[4] had 2 cases of infection in their series of 12 patients. The incidence of infection is related with the amount of surgeries performed on the afflicted elbows. To prevent this complication, a meticulous operative technique is essential, sparing the soft tissues and using antibiotic prophylaxis. Furthermore, Mansat et al[4] recommend adding 1g vancomicyn for every 40 g of cement used.

Failed allograft incorporation is a usual complication that has been described in up to 22% of hip and knee allografts used in revision procedures. Mansat et al[4] report the case of 2 patients with failed allograft integration that affected the humeral area (in one of the patients there was no integration between the humerus and the allograft, and in the other fixation was achieved by means of cerclage wiring). The other two revisions of the humeral area carried out by Mansat et al[4] did osteointegrate, one without the need of hardware and the other with a plate and cerclage wiring. All allografts used in the lunar area in Mansat et al's series[4] were subjected to osteosynthesis (4 plates and 5 cerclage wires (all of which became incorporated. This means that good primary stabilization between prosthesis, allograft and host bone is necessary to prevent this complication. In our cases the ulnar allograft was stabilized by means of a plate plus cerclage wiring, and the humeral allograft was stabilized using a long stem that went beyond the area lying between the allograft and the host bone by more than 10 cm. In the humerus, unlike the ulna, we saw signs of incorporation, although at present it is the fixation devices that are supporting the whole construct. So we can conclude that it is necessary to obtain good stabilization of the construct, either with fixation devices or a long prosthetic stem. An important factor is that there should be no cement present at the interface between the allograft and the host bone since it could interfere with osteointegration[4].

Another complication is allograft fracture. The causes for these are: a) leaving a short stem inside the allograft, which stresses the need to use a stem that goes beyond the allograft-host bone interface when technically possible (this is easier in the humerus than in the ulna, given the length of ulnar stems) or b) the use of an inappropriate fixation method for the allograft[8]. Mansat et al[4] report one fracture in their series but we have not had this complication.

As can be seen, many complications can appear during the follow-up period. A review of the literature[10-13] for the results obtained in the use of prostheses with strut allografts, in total hip and knee replacements, reveals good results in 55-85% of cases, and the need for a further revision in 10- 45%. Our series is too short, both in terms of time and number of patients, to draw conclusions, but Mansat et al[4] report 54% of good results globally and a re-revision rate of 38%. Therefore, the results of anconeal prosthetic revisions using strut allografts are poorer than those of other joints, but they compare favorably with the use of articular allografts[4].

To conclude, combination of a prosthesis and a strut graft can be a good way of addressing patients who present with a massive bone deficit at the time of implanting a total elbow prosthesis. Incorporation of the allograft and implant survivorship could be enhanced if we achieve a solid fixation of the construct, by means of plates, cerclage wiring, or the long stem itself.

In spite of all, the complications rate can be quite high. This technique should be reserved for specific cases, when it is not possible to reconstruct the bone defect using prostheses (custom made or not) with no extra bone or prostheses with morselized or cortical allografts..

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Conflict of interests

The authors have declared to have no conflict of interests.