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Case Report

Behaviour distal radius giant cell tumour: Contemporary and innovative management of an uncommon presentation: A case report

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Abstract

Giant cell tumour (GCT) of the distal radius is an uncommon benign but locally aggressive bone neoplasm that poses a surgical challenge due to its anatomical location and potential for joint destruction. Its management in advanced stages, such as Campanacci grade III, often requires en bloc resection followed by structural reconstruction to restore function and stability. We report the case of a 36-year-old woman diagnosed with a Campanacci III GCT of the distal radius. The patient underwent en bloc tumour resection followed by reconstruction using a structural allograft and dynamic compression plate fixation. Additionally, an ulnar osteotomy and screw fixation were performed to stabilize the distal radioulnar joint. Postoperative radiographs confirmed appropriate graft-host integration. Clinically, the patient experienced mild, non-disabling pain and preserved wrist range of motion and distal radioulnar joint stability during follow-up. This case highlights the efficacy of using structural allografts in the management of advanced GCT of the distal radius. This approach allows for joint preservation, functional recovery, pain control, and avoids donor site morbidity associated with autografts. Although infrequent, such tumours require individualized, multidisciplinary management supported by detailed surgical planning.

Keywords: Giant cell tumour, Distal radius, En bloc resection, Structural allograft, Orthopaedic oncology, Bone reconstruction.

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1. Introduction

Giant cell tumour is a rare primary metaphysis-epiphysis benign tumour. Its location on distal radius corresponds to the third in frequency.[1] Several techniques have been described for the reconstruction of this anatomical area with stability, mobility and adequate pain control through the use of structural allografts after en bloc resection of the tumour.[2] Giant cell tumour appears between 20 and 40 years of age, being 56% more common in women. Even though it is a benign entity, it presents a malignant behaviour with metaphyseal and joint destruction, plus the risk of lung metastasis (1% to 6% of the cases).[3] Treatment of choice for advanced CAMPANACCI III stages is en bloc resection of the tumour and replacement with allograft and stabilization with plates. There have been a limited number of series reports and case reports related to which is the best reconstruction technique.[4]

This report describes the case of a 36-year-old woman diagnosed with a Campanacci Stage III giant cell tumour of the distal radius. The chosen surgical strategy involved en bloc tumour resection, reconstruction with a distal radius structural allograft, dynamic compression plating, and distal radioulnar joint stabilization through ulnar osteotomy and screw fixation. The case highlights the clinical decision-making process and evaluates the postoperative functional outcomes, with particular attention to pain control, graft consolidation, and joint stability.

2. Case Report

37-year-old woman without medical history, with a 2-month history of falling from her own height, resulting in indirect trauma to the left wrist, with pain and functional limitation. Despite the time since the event, local inflammatory signs increased, then she decided to consult. On physical

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examination, she presented limited extension and supination of the wrist joint, no joint effusion, and pain on palpation of the radial styloid. Radiographs were taken, one at the time of the consultation and another as a follow-up, allowing for the observation of both the initial lesion and its progression, highlighting significant changes in the image (**Figure 1**).

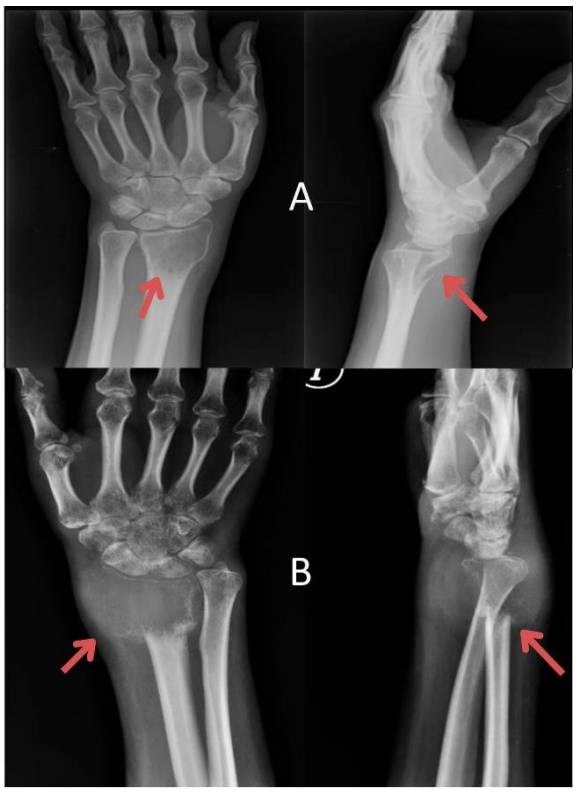

Figure 1: Distal radius lesion with radiographic progression; **A):** Distal radius with multiloculated cystic images (geographic pattern), in addition to lytic lesions with bone loss (cortical thinning) and absence of radiocarpal osteoarthritis or fractures. **B):** Distal radius with geographic pattern progression and lytic lesions with cortical destruction and apparent extension to soft tissues, with a 3-month difference between images

Given the imminent suspicion of a tumor lesion, complementary paraclinical tests were requested: magnetic resonance imaging of the wrist (**Figure 2**), chest x-rays and histopathological study of the lesions.

T1-weighted images with fat suppression reveal a mass completely replacing the distal metaphysis of the left radius, with predominantly high signal intensity and peritumoral edema, without evident extension to the soft tissues. No cystic or hemorrhagic areas are observed within the tumour.

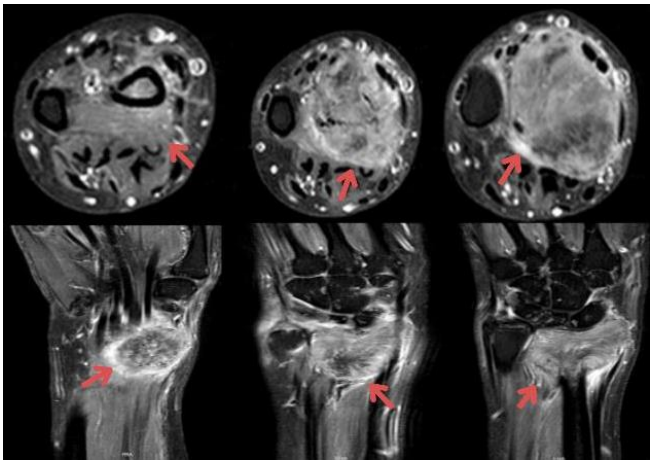

Figure 2: Magnetic resonance imaging (MRI) of the left wrist showing tumour replacement of the distal radial metaphysis

In May 2022, the patient was taken for a core needle biopsy. The findings reported:

1. Giant cell bone tumor
2. Mitotic activity: 1 mitosis in 10 high-power fields.
3. Obvious necrosis.
4. Immunohistochemistry: positive for CD68, P63, KI67 and P53 positive in 10% of the cells.

During follow-up one month after the diagnostic imaging, an increase in swelling was observed compared to previous assessments, considering CAMPANACCI III stage giant cell tumor of the left distal radius.

Then, after four days, en bloc resection of the left distal radius through a dorsal approach (**Figure 3**), followed by reconstruction with an osteochondral radius allograft and fixation using a dynamic compression plate, was proposed (**Figure 4** and **Figure 5**).

Figure 3: Surgical approach to the distal radius

Dorsal approach to the radius selected due to the dorsal predominance of the tumor mass, preserving a safety zone in the palmar region to avoid injury to the vascular bundles.

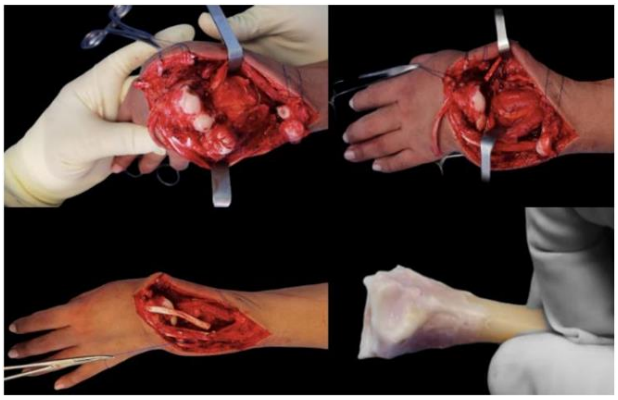

Figure 4: Surgical resection of the distal radius

Dorsal approach to the radius with section of the 2nd, 3rd, and 4th extensor compartments to allow direct access to the tumor. A radiocarpal capsulotomy was performed while preserving the dorsal aspect of the carpus for future reconstruction. A transverse diaphyseal osteotomy of both the radius (with sampling of a radial segment for pathology) and the ulna was carried out, followed by en bloc resection of the distal radius.

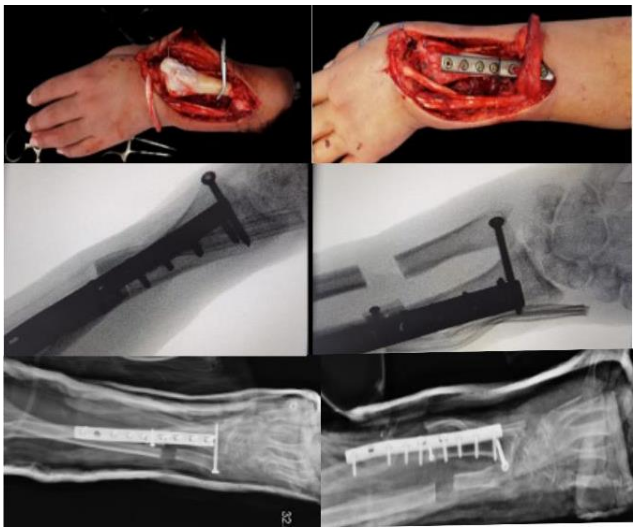

Figure 5: Surgical reconstruction of the ulna with structural allograft and autograft

Measured structural allograft, in addition to application of autograft of the ulna fixed with interfragmentary compression screw, with subsequent positioning of dynamic compression plate in proximal and distal aspects, fixation and stabilization with compression screw in distal radioulnar joint with satisfactory stability. The final images include postoperative radiographs showing the correct alignment and stability of the graft.

Prophylactic surgery antibiotics were administered, (vancomycin 154egimen), and continued for 48 hours postsurgery. Movility was restraint with sugar tong splint, forearm pronated for 30 days, and gradual rehabilitation was initiated with active and passive exercises. Patient follow-up was done clinically and radiologically.

Musculoskeletal Tumor Society Scale (ISOLS-MSTS) was applied for functional evaluation; the range of mobility recorded in assessments was through a goniometer with 25 degrees' extension, 45 degrees' flexion, 10 degrees' radial deviation and 30 degrees' ulnar deviation (**Figure 6**).

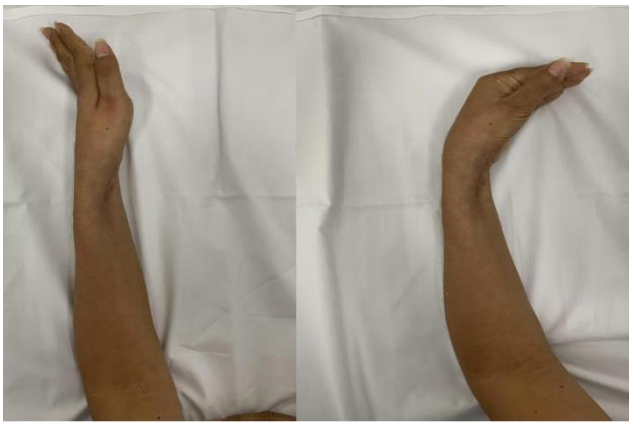

Figure 6: Wrist extension and flexion movements

Final clinical images demonstrate functional recovery with preserved range of motion.

3. Discussion

The distal radius is an uncommon site for benign tumors, but it is the third most common location for giant cell tumors. Advanced stages with damage to the cortex of the distal radius, associated fractures and extension to soft tissues limit the option of bone curettage and use of adjuvant therapy.[1,5-7] It is worth highlighting the lack of bone stock and the high rate of tumor recurrence, especially in the distal radius (33% recurrence).

As treatment of these injuries, an useful alternative and good recommendation is to use structural allograft plus en bloc resection of the distal radius and its secondary fixation with a dynamic compression plate, according to the literature review carried out and confirmed in the present case. This technique proposes 4 objectives: a. safe resection of the tumor with a low recurrence rate, b. functional wrist joint with acceptable ranges of mobility, c. painless joints and d. radiocarpal and ulnar radius with satisfactory stability for daily activities. Publications with this type of technique are limited, there are few case reports.

Implantation of osteoarticular allografts became an important treatment method during the 1960s.[8] In cases of advanced CAMPANACCI III stages, curettage of the lesion in patients with low bone reserve and invasion of the radiocarpal joint is not treatment of choice. Allografts allow not only wide resection of the lesion and low local recurrence, osteoinductive biological adaptability and lower immunogenicity, better geometry and biomechanics compared to the native radius and preservation of the joint capsule and ligaments, ending in better stability. On the other hand, as the upper limbs support no weight, there's a greater

probability of integration and consolidation of the allograft, compared to the lower limbs, where weight means a greater risk of causing consolidation disorders. Due to the geometry and better biomechanical correlation of the distal radius allograft, the functional results are superior to other techniques.

3.1. Clinical analysis

Records regarding ranges of mobility are from good to excellent, according to series published in the literature, a retrospective series of 17 patients with 58.9-month follow-up, presented mobility flexion ranges from 21 to 51 degrees, extension 36 to 52 degrees, supination 58 to 70 degrees and pronation 50 to 80 degrees within the evaluation using ISOLS-MSTS functional scales (Musculoskeletal Tumor Society Functional Score), average scores of 86%.[6]

Another retrospective series of 12 patients with a 12-month follow-up reports wrist flexion-extension of 60% on the contralateral side; 100% of the patients were satisfied with the mobility achieved, 11 patients denied presence of pain, only one patient presented moderate pain after 110 months, with complete resolution.[9] A recent retrospective series of 15 patients published average ranges of motion dorsiflexion 46.7 degrees, palmar flexion 33 degrees, supination 61.3 degrees and pronation 72.3 degrees, 27 mmHg average grip strength, and average MAYO scale scores of 70, and modified SF-36 mean score of 71. All patients were able to perform daily activities with no pain.[10]

3.2. Radiological analysis

Consolidation rates with the use of allografts are satisfactory. However, the series publish 15% non-union.

Non-union of the allograft was recorded in two of the patients in the report by Scoccianti et al, one of them required iliac crest autograft 19 months after the initial surgery and the second patient rejected the option of new intervention due to personal reasons; the rest of the patients recorded adequate consolidation at 4-8 months.[6] In another series, graft integration occurred in 11 of the 12 patients, the patient with nonunion was diagnosed 6 months after the intervention and required a bone graft, achieving an acceptable result.[9] In this series, 100% of patients achieved complete union at the allograft-native bone interface, with radiographic complete union in an average of 6, ranging from 3 to 9 months.

Allograft fracture rates are rare.[10] The literature records 5.9% of the cases directly related to the use of the selected implant. Fixation with long LCP plates (low compression plates) with at least 6 distal and proximal cortices (rigid) can reduce mechanical stress on the graft, reducing the risk of mechanical failure.

In the reviewed reports, complications required revision of the failed allograft and subsequent arthrodesis.[6] Other complications, such as fracture of the distal epiphysis of the allograft, required management with a cast, achieving satisfactory healing.[5]

Another of the studies reviewed reported the conversion of failed allograft to arthrodesis in seven cases out of 24 patients, four of these due to graft fracture, two due to radiocarpal osteoarthritis and one due to radioulnar instability distal to palmar.[11] Current reports record very low failure rates with this technique,[9] nonunion rates at the allogeneic and native bone interface range between 0-22% and 11% bone resorption rate. There are no complications such as graft rejection or infection.

In all reviewed studies, osteoarthritis of the radiocarpal joint was found. In the report by Bianchi, seven out of 12 patients presented dorsal subluxation of the distal radioulnar joint, being mild (0.5 - 1cm) in 6 cases and severe (4 cm) in one case, being clinically and functionally stable.[5] 100% of patients had radiocarpal osteoarthritis in the 2 to 5 years' follow-up.

Regarding instability of the distal radioulnar joint, the preferred option for the union of the distal radioulnar joint is the use of screws instead of nails, which can increase the risk of infection and additionally improves stability, by suturing precisely the capsule in the radiocarpal joint and reinserting the triangular fibrocartilage to the allogeneic bone, in addition to the preservation of dorsal and palmar secondary stabilizers, improving reconstructed joint stability and avoiding dorsal subluxation, present in 58% of cases, usually with painless wrist mobility, but aesthetic deformity. Complications recorded in the literature with this method are stress fractures, which heal spontaneously in a small percentage.[8] Most common ones require a second time to change the graft. On this basis, the best option is reconstruction with allograft: it is a less invasive technique compared to the use of autografts, with the risk of donor site morbidity and, in addition, it reduces the available options when revision surgery is required. However, allograft is susceptible to degenerative joint changes after 5 years of the intervention, with joint mobility pain. Infection rates were not recorded in any of the series.[12]

4. Conclusion

Surgical resection of the distal radius in adults can be performed with favorable functional results using structural allograft. Allograft failure due to mechanical causes with proper plate stability is rare, radiocarpal degenerative changes (osteoarthritis) between the allogeneic radius and the carpal bones are painless, and wrist mobility is usually within functional ranges for the patient's activities.[13]

In order to verify the long-term effectiveness and efficiency of this promising surgical technique, studies in larger series and with longer follow-ups are required. The case series published to date are limited by small number of patients, and, due to lack of patient adherence to controls,

follow-up in some cases is not optimal. Other observations include lack of extension of controls for a longer time. In long term, results tend to worsen and reports in current literature are retrospective, increasing the probability of bias.

5. Source of Funding

None.

6. Conflict of Interest

None.

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