Defect Reconstruction Post En Bloc Excision of Aggressive Giant Cell Tumor of the Distal Radius: A Report on Two Cases

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ABSTRACT
Giant cell tumor (GCT) though benign, represents a locally aggressive neoplasm characterized by proliferation of mononuclear cells, bone destruction and a high rate of recurrence. Management of aggressive GCT of the distal radius and reconstruction of resultant defect after excision remains a challenge. This is a report on two cases presenting with aggressive GCT of the distal radius with bone destruction and cortical breach of the distal radius. Both cases required an enbloc excision of the distal radius with a tumor free margin of 3cm, and subsequent reconstruction of the defect with a non-vascularized fibula graft and radiocarpal arthrodesis using a T-plate. Union was achieved in both cases. There were no reported infections, fractures or recurrence within the follow up period. Defect reconstruction of the distal radius following enbloc excision of the distal radius leads to satisfactory outcomes.

Key words: Arthrodesis; enbloc excision; giant cell tumor, fractures

INTRODUCTION
The distal radius, a relatively common site for primary bone tumors plays a significant role in radiocarpal articulation, and therefore by extension, the functionality of the hand. Its complex anatomy and the need to obtain good tumour clearance create a dilemma in the management of both malignancies and high grade benign tumors involving the distal radius. High grade tumours such as giant cell tumors (GCT) which accounts for 5% of all primary bone tumors and 20% of benign tumors occasionally affects the distal radius.[1]

GCT although benign, represents locally aggressive neoplasms characterized by proliferation of mononuclear stromal cells, with a potential for local invasion, recurrence and a low likelihood of metastasis.[2] Although various treatment modalities have been proposed in the management of GCTs around the distal radius, these are mainly grouped into: Curettage of tumor with reconstruction of the distal radius using bone grafts or polymethyl-methacrylate.[3] and enbloc excision of the distal radius, with reconstruction using a vascularized or non-vascularized graft. This is usually accompanied with a partial or complete wrist arthrodesis.[4]

Traditionally, curettage alone of GCT's including the distal radius was a predominant modality of treatment but has been associated with a high rate of recurrence.[4]

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Campanacci et al classified GCT based on clinico-radiologic parameters, with grade I lesion being latent with well-defined margins and an intact cortex; a grade II lesion being active with well-defined margins but a thinned out/ moderately expanded cortex, and a grade III lesion being aggressive with indistinct borders or an associated cortical destruction.[2] Management of Campanacci grade III lesion of the distal radius presents a challenge, with a balance being sought between adequate tumor clearance and some preservation of wrist function. They require resection of the entire lesion with reconstruction of the accompanying defect, as thorough curettage and complete excision is the single most important factor in preventing recurrence.

Two case reports on the use of non-vascularized fibular graft in the treatment of aggressive GCT of the distal radius is presented. Both cases presented to the outpatient department of Nnamdi Azikiwe University Teaching Hospital, Nnewi; Nigeria; and procedures were carried out in the same institution.

CASE REPORT

Case 1:

A 23-year old man presented with a one year history of a progressively increasing distal radial mass on the right (dominant) hand. There was no preceding history of trauma, and there were no associated masses noted in any other part of the body. Examination revealed a single firm mass over the distal radial border of the wrist measuring 16cm x 14cm; non-tender, with no attachment to the overlying skin.

X-rays done revealed an expansile, aggressive and osteolytic lesion involving the distal radius with extension to the subchondral bone with attendant destruction and resorption of the cortices of the distal radius (Fig 1). Consent was obtained for an incisional biopsy, which was done and thereafter confirmed an aggressive distal radial GCT. The patient was then counseled and consent obtained for an enbloc excision of the distal radius and a radio-carpal fusion using a non-vascularized fibular graft.

Surgical Procedure:

With the patient under general endotracheal anaesthesia, and a tourniquet in situ, a 16cm incision over the anterior aspect of the forearm was made and the distal radius was accessed using a volar approach (Fig 2). A corticotomy of the radius was then done at a pre-operatively determined level; which was a 3cm safe margin from tumor involvement (Fig 3). Dissection remained extra-periosteal to avoid spillage of the tumour.

En bloc resection of the distal radius with the tumor insitu was done (Fig 4), leaving a resultant 12cm bone defect (Fig 5). The tumour bed was then irrigated copiously with hydrogen peroxide to take care of inadvertent tumor spillage.

A non-vascularized fibular graft (13cm) was then harvested from the right fibula, (about 10cm above the ankle joint) and thereafter inserted into the defect- bridging the transected radius and the carpus (Fig 6). A radiocarpal arthrodesis was then done using an 8-hole T plate (Fig 7). Due to an observed positive ulna variance, an ulna shortening osteotomy and plate osteosynthesis was done. The wound bed was thereafter closed in layers. Post-operative X-rays were done afterwards. Patient was discharged after one week, and at three weeks, the operation site was fully apposed and healed (Fig 9). Sutures were then removed and physiotherapy begun, which was carried on for three months.

Case 2:

A 32-year old man presented with a mass at the left distal radius (non-dominant hand) of 1 year duration. There was no ulceration or discharge, but there was a history of progressive increase in the size of the mass. There was also no preceding history of trauma (Fig 10).

Radiographic examination showed an osteolytic tumour of the distal radius with attendant bony destruction, and an extension of the tumour to the subchondral bone. There was also bony deformation of the distal ulna via pressure effect of the distal radial tumor. A working diagnosis of GCT-Campanacci grade III was made. An incisional biopsy was done which confirmed GCT of the distal

Fig 1: Showing tumor of the distal radius with cortical destruction

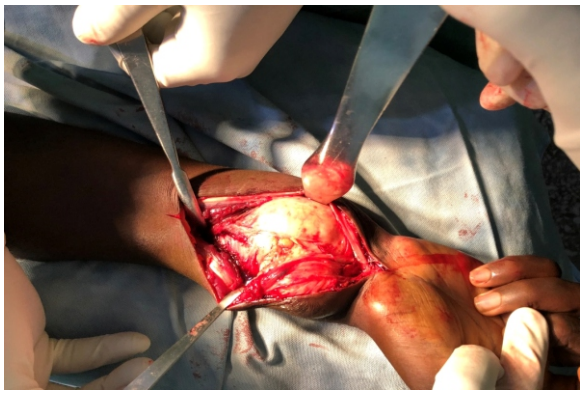

Fig 2: Volar approach to the distal radius

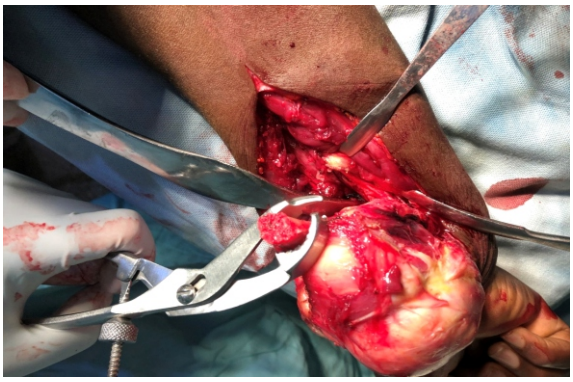

Fig 3: Corticotomy done distal to the tumor

Fig 4: Excised tumor

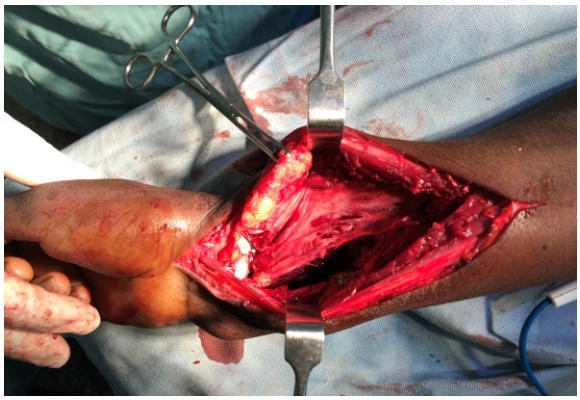

Fig 5: Resultant bone defect

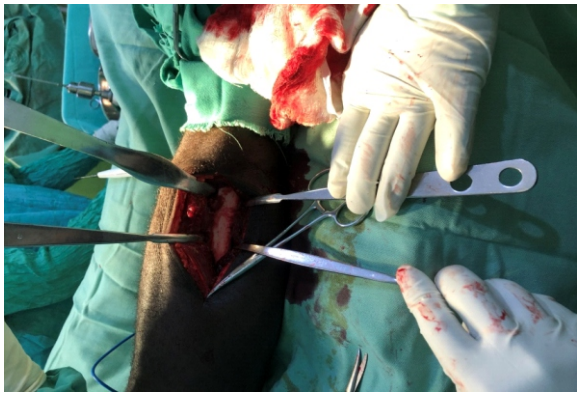

Fig 6: Non vascularized fibula graft being harvested

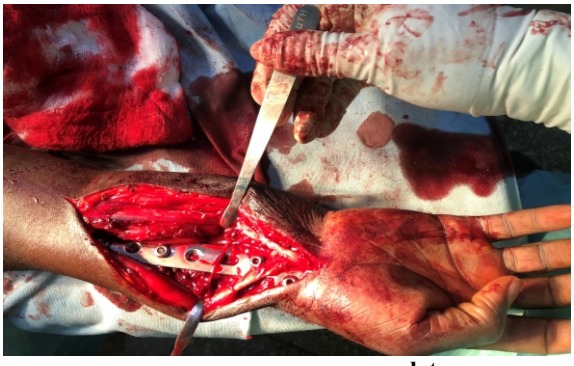

Fig 7: Fixation of fibula graft with T– plate

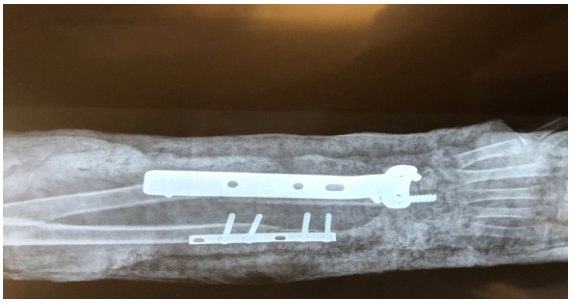

Fig 8: Post - op X - rays

Fig 9: 3 weeks Post-op visit

Fig 10: Distal radial mass

Fig 11: Volar approach to the distal radius

Fig 12: Corticotomy of the distal radius

Fig 13: T- plate radiocarpal arthrodesis

Fig 14: post op x-rays at 8 weeks

radius. Counseling and consent for an enbloc resection of the distal radius and radiocarpal arthrodesis using a non-vascularized fibular graft was then obtained.

Surgical procedure:
With the patient under general endotracheal anaesthesia, an arm tourniquet was inflated. Using a volar approach to the radius (Fig 11), a corticotomy of the radius was done at a pre-operatively determined level ensuring tumour free margins (Fig 12). The radius up to the subchondral bone was then dissected and disarticulation of the radiocarpal joint was then done leaving a resultant defect of 10cm. Dissection remained extraperiosteal to avoid tumor spillage. Irrigation of the wound bed with hydrogen peroxide was done. A non- vascularized fibular graft was harvested from the right leg and used to bridge the defect. A radio-carpal arthrodesis was achieved via an 8-hole T-plate (Fig 13). The wound bed was thereafter closed in layers. Post-operative X-rays obtained after 7 weeks showed progressive callus formation (Fig 14).

FOLLOW UP:
The post-operative period was uneventful in both patients; and there were no soft tissue infections. Both patients were followed up for a mean period of 18 months. The average range of movements for both patients post operatively were 62° of pronation (60-64); 58° of supination. The revised musculoskeletal tumor society score of case 1 and case 2 were 86.6% and 83.3% respectively.[5]

DISCUSSION
Aggressive GCT of the distal radius presents a unique challenge to the managing orthopaedic surgeon due to both the complex structures surrounding the distal radius and the management of the resultant bone defect post en bloc excision of the tumor. Several techniques have been met with varying levels of success. These include ulnar transposition, use of corticocancellous graft from the iliac crest or vascularized or non-vascularized fibular graft.
Reconstruction of radial defect by ulnar transposition tends to sacrifice movement at the both the forearm and wrist joint; and a majority of patients have reported stress fractures.[6] Some authors have also reported promising results with the use of a distal radial allograft.[7, 8] However, this technique has also been met with several untoward effects. These include cost of allograft, availability, finding an appropriate donor, delayed healing, potential for infection and graft rejection[9]. In a study done by Kocher et al, a high rate of wrist arthrodesis and resultant pain following use of radial allograft was reported.[10] One patient in their study ultimately required an amputation.[10]
Vascularized fibular autograft is another technique that has been given favorable outcomes in defect reconstruction of the distal radius. However, it is a technically demanding procedure typically lasting for several hours. Limitations to its frequent use include cost, lack of available expertise, donor site morbidity including laxity of the knee joint when the proximal fibula is harvested.[11, 12]
Non-vascularized fibula graft offers a viable alternative in reconstructing distal radial defects, leading to a stable arthrodesis of the wrist joint. The use of non-vascularized fibula grafts was first reported in 1945, in the treatment of congenital absence of the radius.[13] Since then, its use has been expanded in the treatment of most bone defects.
Its advantages include minimal donor site morbidity, easy accessibility and rapid graft incorporation.[5] In this index case report, satisfactory outcomes were obtained in both cases. Although there were limitations in the range of motion of the forearm, both patients could still functionally use the affected hand in carrying out routine activities.
Radiocarpal arthrodesis has been achieved via several methods after inserting the non-vascularized fibula into the radial defect. Some authors have used a K-wire or an intramedullary rush pin with satisfactory outcome.[14] However, in this index study, T-plates were utilized for radio-carpal fixation with satisfactory outcomes.
In conclusion, aggressive GCT of the distal radius

can be managed by enbloc excision of the tumor and defect reconstruction with a non-vascularized fibula graft leading to satisfactory results.

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Consent: Written informed consent was obtained from the patients for publication of this case report and all accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Author contributions:
Dr Obiegbu H. O: Concept, study design and analysis. Dr Awachie D. S: Interpretation of data

Data availability:
The data used to support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Xu XC, Xu M, Sung RX, Fu ZH, Liu XP. Long term outcome of giant cell tumors of bone around the knee treated by an enbloc resection of tumor and reconstruction with prosthesis. Orthop Surg 2010. 2(3): 211-217
2. Campanacci M, Giunti A, Olmi R. Giant cell tumors of bone: A study of 209 cases with long term follow up. Hal J Orthop Traumatol. 1975; 1: 249-257
3. Panchwagh Y, Puri A, Shah M. Giant cell tumor-distal end radius: Do we know the answer? Indian J Orthop 2007. 41(2): 139-145
4. Saika KC, Borgohain M, Bhuyan SK, Goswami S, Bora A, Ahmed F. Resection-reconstruction arthroplasty for giant cell tumor of the distal radius. Indian J Orthop. 2010; 44(3): 327-32
5. Enneking WF, Dunham W, Gebhardt MC, Malawar M, Pritchard DJ. A system for the functional evaluation of reconstructive procedures after surgical treatment of tumors of the musculoskeletal. Clin Orthop Relat Res. 1993; 286: 241-246
6. Lackman RD, McDonald DJ, Beckenbaugh RD, Sim FH. Fibular reconstruction for giant cell tumor of the distal radius. Clin Orthop Relat Res. 1987; 4(218): 232-8
7. Liu YP, Li KH, Sun BH. Which treatment is best for giant cell tumors of the distal radius? A meta-analysis. Clin Orthop Relat Res. 2012; 470(10): 2886-94
8. Chadha M, Arora SS, Singh AP, Golati D. Autogenous non-vascularized fibula for treatment of giant cell tumor of distal end radius. Arch Orthop Trauma Surg. 2010; 130(12): 1467-73
9. Bassiony AA. Giant cell tumor of the distal radius: wide resection and reconstruction by non-vascularized proximal fibula autograft. Ann Acad Med Singapore. 2009; 38(10): 900-4
10. Kocher MS, Gebhardt MC, Mankin HJ. Reconstruction of the distal aspect of the radius with the use of an osteoarticular allograft after excision of a skeletal tumor. J Bone Joint Surg Am. 1998; 80(3): 407-19
11. Agarwal A. Fibula donor site following non-vascularized harvest: clinic-radiological outcome at minimal five year follow up. Int Orthop. 2019; 43(8): 1927-31
12. Li P, Fang Q, Qi J, Luo R, Sun C. Risk factors for early and late donor site morbidity after free fibula flap harvest. J Oral MaxilloFAC Surg. 2015; 73(8): 1637-40
13. Starr DE. Congenital absence of radius. A method of surgical correction. J Bone Joint Surg Am. 1945; 27(4): 527-7
14. Jafari D, Shariatzadeh H, Okharatpour M, Razavipour M, Safdari F. Giant cell tumor of distal radius: En bloc resection and partial wrist arthrodesis using non-vascularized fibula autograft. Shafa Ortho. 2017; 4(2): 1174-77