Case Report | Journal of Orthopaedic Case Reports 2020 October: 10(7):Page 80-84

Hemi-Fibular Grafting for Metacarpal Giant Cell Tumor – Surgical Technique

S. Senthil Sailesh[1], Sathish Muthu[2,3], N. Deen Muhammed Ismail[1]

Learning Point of the Article:

Hemi-fibular grafting an innovative method for the reconstruction of bone defect due to excision of giant cell tumor of metacarpal bone has been discussed in this article

Abstract

Introduction: Giant cell tumor (GCT) of small bones of hand is no so uncommon, especially in the metacarpals. Considering the aggressive behavior in the metacarpals, en bloc resection is often required. Following resection, reconstruction techniques available include tricortical iliac grafting, vascularized or non-vascularized fibular grafting, or metatarsal grafting. We present an innovative surgical technique for the management of such bone defects.

Case Report: A 14-year-old girl presented with pain and swelling over the dorsum of the right hand for 2 months which was progressively increasing in size. The range of movements of the metacarpophalangeal (MCP) joint was normal. Radiological evaluation showed a lytic lesion with a well-defined margin over the metaphyseal region of the second metacarpal without articular involvement. The lesion was diagnosed as GCT on biopsy. Reconstruction of bone loss was managed by hemi-fibular grafting technique which involves selective osteotomy of the anterior half of the middle third of the fibula for the reconstruction of bone loss. This new technique ensures a renewable source of autograft with good incorporation at the recipient site with good hand function despite maintaining the esthetic appearance of the hand. Lesion being very aggressive had two episodes of recurrence at 2–3 years of post-operative period which was excised.

Conclusion: This case illustrates the management of aggressive GCT of metacarpal bone by excision and reconstruction with hemi-fibular grafting technique. Hence, hemi-fibular grafting can be considered as an innovative technical substitute to the traditional methods of autograft harvesting with good regenerative potential at the donor site and better incorporation rates at the recipient site providing good functional results.

Keywords: Giant cell tumor, hemi-fibular graft, metacarpal GCT.

Introduction

Giant cell tumor (GCT) is a benign locally aggressive tumor involving the epiphysio-metaphyseal region of long bones in young adults. The involvement of small bones of hand is rare [1, 2, 3, 4]. Very few case reports of GCT involving metacarpals have been published in the literature [5, 6]. GCT of metacarpals is more aggressive than the rest of the regions of the body with a high rate of recurrence.

Although en bloc excision ensures local control, it hampers hand function, especially if it involves the index finger despite cosmetic concerns [3, 4, 5]. The goals of the treatment of GCT of metacarpal include good local control of the disease, meanwhile maintaining good hand function and cosmesis. Various reconstruction techniques include metatarsal substitution, vascularized or non-vascularized fibular graft, and iliac crest strut graft [1, 2, 3, 7, 8].

In this case report, we describe a procedure that can be a good option for lesions involving small bones of the hand, such as metacarpals using a hemi-fibular graft from the ipsilateral leg.

Access this article online

Website: www.jocr.co.in

DOI: 10.13107/jocr.2020.v10.i07.1928

Author's Photo Gallery

Dr. S. Senthil Sailesh

Dr. Sathish Muthu

Dr. N. Deen Muhammed Ismail

[1]Department of Orthopaedics, Institute of Orthopaedics and Traumatology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India.
[2]Government Hospital, Velayuthampalayam, Karur, Tamil Nadu, India.
[3]Orthopaedic Research Group, Coimbatore, Tamil Nadu, India.

Address of Correspondence:
Dr. Sathish Muthu,
Government Hospital, Velayuthampalayam, Karur, Tamil Nadu, India.
E-mail: drsathishmuthu@gmail.com

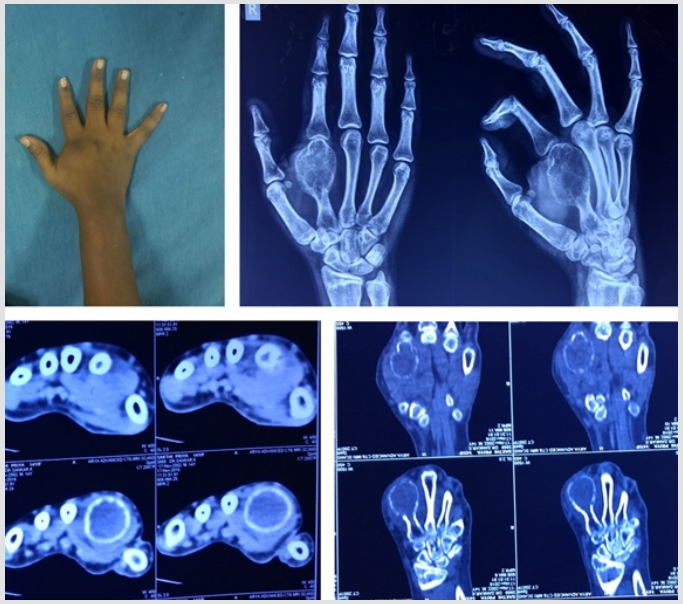

Figure 1: Pre-operative clinical and radiological evaluation of the lesion.

Case Report

A 14-year-old girl presented with pain and swelling over the dorsum of the right hand for 2 months, which was progressively increasing in size. The range of movements of the metacarpophalangeal (MCP) joint was normal. Radiological evaluation showed a lytic lesion with a well-defined margin over the metaphyseal region of the second metacarpal without articular involvement, as shown in (Fig. 1). Diagnosis by tissue biopsy came out to be GCT.

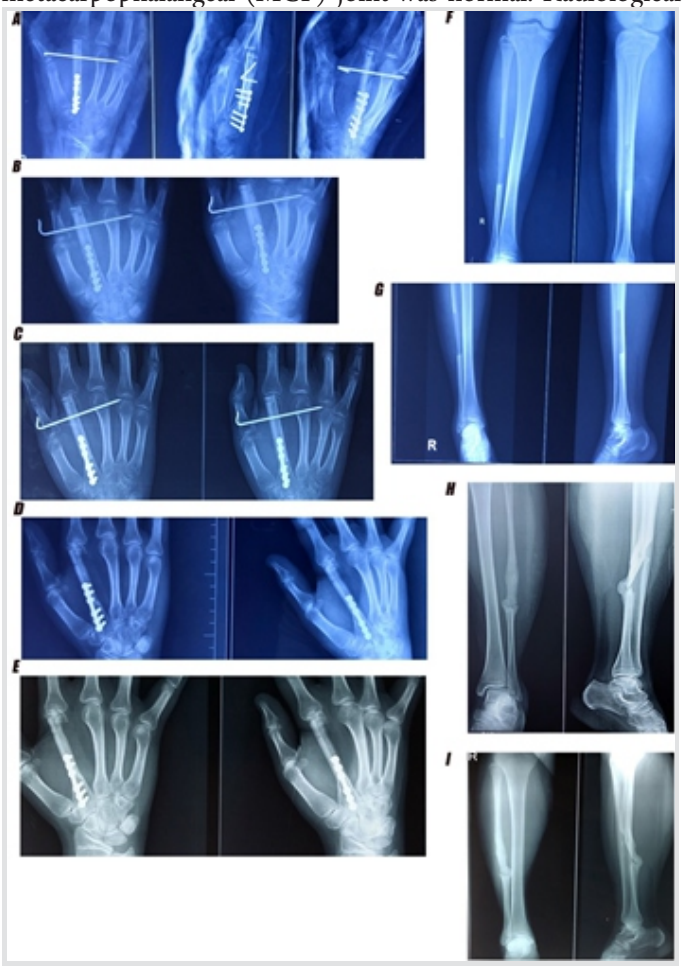

Figure 3: Follow-up radiograph series. (a-e) showing follow up radiographs at 3 monthly intervals till 1 year and (f-i) showing donor site remodeling during the corresponding intervals.

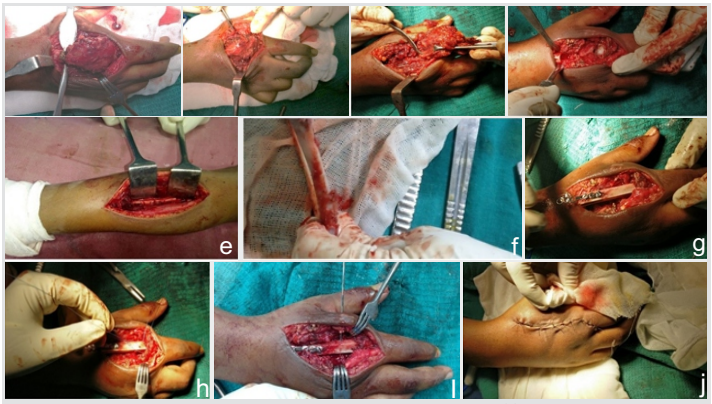

Figure 2: Excision of the lesion and hemi-fibular grafting technique. (a) Showing the lesion being demarcated form the normal bone; (b) showing the exposure of the lesion; (c) shows mass being excised; (d) showing the graft bed preparation; (e) showing the hemi-fibular graft harvest; (f) showing hemi-fibular graft preparation; (g) showing graft fixation with 2 mm mini-plate; (h) showing metacarpophalangeal Joint ligament reconstruction; (i) showing transverse K-wire fixation; and (j) showing wound being closed.

Surgical technique

We planned for wide excision of the metacarpal region sparing the MCP joint and reconstruction with hemi-fibular grafting. Through the dorsal approach, the lesion was exposed and the normal level of the bone was identified. Excision of the lesion followed by extended curettage with hydrogen peroxide was performed to ensure, no residual tumor cells were left in the graft bed. The MCP articular cartilage with a flake of cancellous bone was preserved to maintain the joint function.

The graft was harvested from the middle third of the ipsilateral fibula, as illustrated in (Fig. 2). The length of the graft required was measured and harvested from the anterior half of the fibula leaving the thicker posterior half in situ to help in earlier weight-bearing of the donor limb. The graft is placed in the recipient

Figure 4: Clinical outcome illustrating the range of movements achieved and the functional activity restoration postoperatively on follow-up.

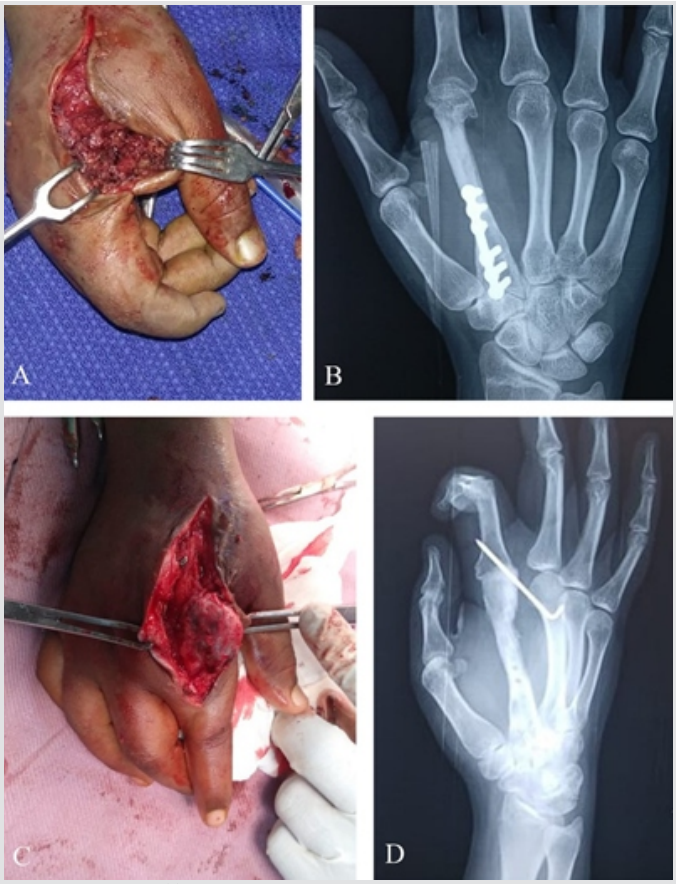

Figure 5: Recurrence. (a) Showing the clinical picture of spillover recurrence from the web space; (b) showing the radiological image at 2 years with intact incorporated graft with plate; (c) showing the clinical picture of the recurrent tumor at 3 years; and (d) showing plate removal and attempted fusion at the metacarpophalangeal joint.

bed and reconstruction was attempted at the MCP joint with ethibond and the graft was stabilized to the carpal bones with 2 mm mini-plate. To achieve additional stability at MCP joint, a transverse k-wire was placed. After the surgical procedure, a below elbow slab was applied. The patient was followed up serially every fortnightly for 3 months and every 3 months for 1 year and every 6 months thereafter.

Results

Graft showed good incorporation on radiological analysis, as shown in (Fig. 3) during follow-up. The patient had improvement in range of movement and hand functions post-surgery during follow-up, as shown in (Fig. 4). Donor fibula has regrown fully despite sustaining a stress fracture at 3 months follow-up.

Table 1: The comparison of the functional score variability at various time points

Michigan hand functional scoring					
Score category	Pre-operative	1 year post-operative	1st recurrence	2nd recurrence	4 years post-operative
General score	41.1	92.6	85.4	73.2	79.4
Work score	30	75	62.1	56	68
Pain score	35	85	65	45	55
Appearance score	25	87.5	55.2	35.4	56.2
Final score	33.3	95.8	86.4	74.2	83.5
Michigan hand outcome score	36	89	74.3	68	74

At 2 years follow-up, the patient developed mass in the first web space which was tissue diagnosed as tumor recurrence and surgical excision was done. At 3 years follow-up, the patient developed a mass at the MCP joint which was also tissue diagnosed as tumor recurrence. Surgical excision of the lesion, along with the removal of the plate followed by fusion of the metacarpophalangeal joint, was done, as shown in (Fig. 5). The patient was symptom-free since the last recurrence till now at 4 years of follow-up.

Clinicoradiological evaluation at final follow-up showed improved range of movement and function based on Michigan Hand Function Score compared to the initial pre-operative status which deteriorated with each recurrence and improved later on at the final follow-up at 4 years, as shown in (Table 1). No evidence of distant metastasis was noted from computed tomography chest and bone scan until recent follow-up. The patient was under regular follow-up in view of the aggressiveness of the lesion, notorious for recurrence.

Discussion

Although the technique of free fibular grafting was introduced in the 20th century [9], there was controversy regarding its successful fusion outcome compared to vascularized fibular grafting [10, 11]. Despite all the critical comments, the technique has been established in various studies as a reliable method of reconstruction of segmental and hemi-cortical bone defects following tumor resection [12].

Utilizing the technique of free fibular grafting and modifying it by harvesting only the anterior half of the fibula, we developed this technique of hemi-fibular grafting for the management of bone loss in the management of GCT of small bones of the hand. Saikia et al. [2] treated two such patients with metacarpal GCT by ray amputation in one and wide resection and tricortical iliac crest bone grafting in the other. Another study involving three patients utilized methodology, such as curettage, cryosurgery, and cementation [3]. Our method reduces the need for amputation, reduces the morbidity associated with the above-mentioned procedures.

We performed selective osteotomy of anterior half of the fibula for the reconstructive purpose and retained the posterior cortical structure to aid in the transfer of 7.12% of the load transfer that normally takes place across an intact fibula preventing any significant biomechanical changes due to the grafting procedure [13]. Free fibular grafting attains the vascularity from the perforating vessels from the graft bed; hence, preparation of the recipient site remains a key step to get a successful integration of the graft to the host bone [14]. By bisecting the graft, the surface area of the graft in contact with the graft bed is increased to facilitate integration.

We use graft from the middle third of the fibular for four reasons: First, to prevent injury to the common peroneal nerve from procedures involving proximal third fibula. Second, to prevent injury to the superficial peroneal nerve distally. Third, the middle third graft harvest reduces the alteration in the contact area stress and crest value stress of the tibiotalar joint [13]. Finally, various anatomical studies have demonstrated that the nutrient artery for fibula was located away from the middle third region in 80% of the cases resulting in safer grafting procedure, precluding vascular compromise to the donor bone [15, 16]. The added advantage of the procedure is that the donor bone regenerates from the periosteal sheath from the posterior strut resulting in a renewable source of autograft for future needs.

This method of grafting has certain limitations. This method is not applicable to weight-bearing joints and in procedures involving the reconstruction of large bone defects which are beyond the scope of the procedure described. Large studies with a greater number of cases are needed in the future to validate the surgical procedure for wider acceptability as a common reconstructive option in a similar scenario.

Conclusion

This case illustrates the aggressive GCT of metacarpal bone managed by excision and reconstruction of bone defect with hemi-fibular grafting. Hence, hemi-fibular grafting can be considered as an innovative technical substitute to the traditional methods of autograft harvesting with good regenerative potential at the donor site and better incorporation rates at the recipient site providing good functional results.

Clinical Message

This case report illustrates the hemi-fibular grafting technique as a reconstruction method for the management of bone loss arising from the excision of GCT involving small bones of the hand.

References

1. Kapoor A, Golwalaa P, Patela K, Desaib D, Yeluric S. Giant cell tumor of first metacarpal. Internet J Orthop Surg 2003;2:1.
2. Saikia KC, Bhuyan SK, Ahmed F, Chanda D. Giant cell tumor of the metacarpal bones. Indian J Orthop 2011;45:475-8.
3. Shahid M, Varshney M, Maheshwari V, Mubeen A, Guar K, Siddiqui M. Duplication of appendix: An accidental finding. BMJ Case Rep 2011;2011:bcr0120113679.
4. Goldenberg RR, Campbell CJ, Bonfiglio M. Giant-cell tumor of bone. An analysis of two hundred and eighteen cases. J Bone Joint Surg Am 1970;52:619-64.
5. Murphey MD, Nomikos GC, Flemming DJ, Gannon FH, Temple HT, Kransdorf MJ. From the archives of AFIP. Imaging of giant cell tumor and giant cell reparative granuloma of bone: Radiologic-pathologic correlation. Radiographics 2001;21:1283-309.
6. Dahlin DC, Cupps RE, Johnson EW Jr. Giant-cell tumor: A study of 195 cases. Cancer 1970;25:1061-10.
7. Averill RM, Smith RJ, Campbell CJ. Giant cell tumours of the bones of the hand. J Hand Surg 1980;5:39-50.
8. Dingels WR, Rolle HJ. Case report of a giant cell tumor of the second metacarpal bone and implantation of a cement prosthesis. Handchirurgie 1979;11:251-4.
9. Walter M. Résection de l'extrémité inferieur du radius pour ostéosarcome. Bull Mem Soc Chir Par 1911;37:739-47.
10. Krieg AH, Lenze U, Gaston MS, Hefti F. The outcome of pelvic reconstruction with non-vascularised fibular grafts after resection of bone tumours. J Bone Joint Surg Br 2010;92:1568-73.
11. Taylor GI, Miller GD, Ham FJ. The free vascularized bone graft. A clinical extension of microvascular techniques. Plast Reconstr Surg 1975;55:533-44.
12. Lenze U, Kasal S, Hefti F, Krieg AH. Non-vascularised fibula grafts for reconstruction of segmental and hemicortical bone defects following meta- /diaphyseal tumour resection at the extremities. BMC Musculoskelet Disord 2017;18:289.
13. Yang L, Xu HZ, Liang DZ, Lu W, Zhong SZ, Ouyang J. Biomechanical analysis of the impact of fibular osteotomies at tibiotalar joint: A cadaveric study. Indian J Orthop 2012;46:520-4.
14. De Boer HH, Wood MB. Bone changes in the vascularised fibular graft. J Bone Joint Surg Br 1989;71:374-8.
15. Kocabiyik N, Yalcin B, Ozan H. Variations of the nutrient artery of the fibula. Clin Anat 2007;20:440-3.
16. Guo F. Observations of the blood supply to the fibula. Arch Orthop Trauma Surg 1981;98:147-51.

Conflict of Interest: Nil
Source of Support: Nil

Consent: The authors confirm that Informed consent of the patient is taken for publication of this case report

How to Cite this Article

Sailesh SS, Sathish M, Ismail NDM. Hemi-Fibular Grafting for Metacarpal Giant Cell Tumor – A Surgical Technique. Journal of Orthopaedic Case Reports 2020 October;10(7): 80-84