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Functional Outcome in Non-Vascularized Fibular Grafting Following Distal Radius Giant Cell Tumor Resection in RSUD Dr. Saiful Anwar Malang: A Case Series and Literature Review

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ABSTRACT

Introduction: Giant cell tumor (GCT) is an aggressive neoplasm that accounts for 3 to 5% of all bone neoplasms globally and is 20% higher in Asian countries. The distal radius is one of the most commonly involved sites. A non-vascularized fibular graft following wide resection is the most widely practiced reconstruction procedure. Nevertheless, functional outcome and donor site complications remain a potential barrier to the procedure.

Objective: Evaluate the functional outcome and possible complications of the patients undergoing non-vascularized fibular grafting following wide resection of the distal radius GCT.

Patients & Methods: From 2021 to 2023, 3 patients with GCT of distal radius were treated with wide resection followed by non-vascularized fibular grafting. An orthopedic oncologist and an orthopedic hand & microsurgery surgeon performed the procedure. The Disabilities of the Arm, Shoulder, and Hand (DASH) score was obtained pre- and post-operatively approximately 1 year after surgery. Any possible donor site complications, such as peroneal nerve injury as well as knee and ankle instability, were also evaluated post-operatively.

Outcomes: Our patients' characteristics are middle-aged individuals (27 ± 4 years old) with slight female predominance. Pre- and post-operative DASH scores were 62 ± 16 and 10 ± 4, respectively (P 0.026). No significant donor site complication was encountered post-operatively.

Conclusion: The procedure of wide resection followed by non-vascularized fibular grafting in treating GCT of the distal radius due to fashionable functional outcomes was recommended with minimal complication risk.

Keywords: DASH score, distal radius, giant cell tumor, non-vascularized fibular graft, wide resection.

1. INTRODUCTION

A giant cell tumor (GCT) is a locally aggressive primary bone tumor typically composed of proliferated mononuclear cells with scattered macrophages. This entity is one of the most commonly found bone tumors, constituting 4-5% of all bone tumors.[1] Although considered benign bone mass, it can potentially develop metastasis, particularly to the lung. Therefore, prompt diagnosis and treatment are essential to prevent this potentially fatal condition. Nevertheless, the ideal treatment for this locally destructive neoplasm is still debated. While simple mass can be treated by routine meticulous intralesional curettage, complex cases require more extensive procedures.[2,3] To date, fibular graft transport is one of the treatment choices for bothersome GCT located at the peri-articular area.[3] Notwithstanding, functional outcomes and complications remain elusive, particularly at the donor site.[4] Therefore, we present a case series highlighting the aforementioned issues of distal radius GCT managed by autologous non-vascularized fibular grafting.

2. PATIENTS & METHODS

This retrospective study involved patients diagnosed with GCT of distal radius who underwent tumor resection with concomitant non-vascularized fibular grafting from 2021 to 2023 in Saiful Anwar General Hospital. We obtained the pre- and post-surgery data from medical records. The inclusion criteria were patients who were diagnosed with GCT of the distal radius, underwent tumor resection and non-vascularized fibular grafting procedure and were able to communicate appropriately to answer the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire as well as tell the complication related to the procedure. The exclusion criteria were patients who refused to participate in the study and could not communicate properly.

Pre-operative evaluation

Patients were diagnosed with GCT by our orthopedic oncologist surgeons. The diagnosis process included history taking, physical examination, and radiological and histological studies. A plain radiograph and MRI are conducted on every patient before histological analysis. After the workups, the clinicopathological conference involved orthopedic oncologist surgeons, pathologists, and radiologists. After the tumor resection and reconstruction decision, consultation with our orthopedic hand and the microsurgery surgeon was conducted before the surgery. A pre-operative DASH score was obtained for every patient.

Surgical procedure

The lesion at the distal radius was identified during the surgery, and the surrounding healthy tissue was recognized and resected (Figure 1A). The gap was filled by using the proximal fibular graft (Figure 1B) and fixed by the plate and screw method, as seen in Figure 2A. The post-procedure radiograph results are shown in Figure 2B.

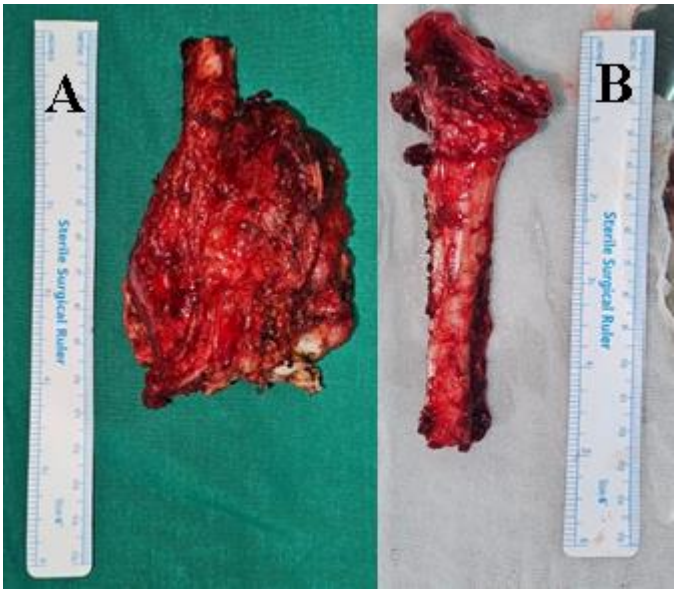

Figure 1. (A) GCT resection of distal radius and (B) fibular graft.

Figure 2. (A) Fixation by plate and screws and (B) Radiograph follow-up following the procedure

Post-operative evaluation

Post-operatively, the patient was observed at the ward. The vital signs and drain production were monitored. Potential donor site complications, particularly the peroneal nerve injury, were observed by asking the patient if there was any sensory or motoric disturbance in the area innervated by the corresponding nerve. Had the condition been stable and no nerve injury or other possible complications been suspected, the patient was discharged, and hand exercise commenced as soon as possible. Routine follow-up was scheduled, and the DASH score was obtained. After the wound at the donor site healed, the stability of the ankle and knee were examined to exclude any potential fibular complications.

Clinical assessments

The DASH score was used as the tool to evaluate the functional outcome. This 30-item questionnaire was asked of the patient pre- and post-operatively. The post-operative evaluation was conducted with a minimum time of 1 year.[5] It indicates least severe (0 scores) to most severe (100 scores) disability.[6] Complication of the donor site at the lower leg was assessed if any sign of drop foot or sensory disturbance at the front and outer half of the leg, together with knee or ankle instability, is detected post-operatively.

Statistical analysis

A paired t-test was used to compare pre-and post-surgery and the relationship between variables. $P < 0.05$ was considered statistically significant. Statistical analysis was conducted using Statistical Package for Social Science version 26.0 (SPSS 26.0).

This study conducted a systematic review to assess the efficacy and complication rate of non-vascularized fibular grafting in treating giant cell tumors or other bone defect issues. The research adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines for proper reporting and methodology.

Search Strategy

We conducted a systematic search in databases by utilizing specific search terms such as "non-vascularized fibular grafts" and "Giant Cell Tumour" or “Giant Cell Tumor” or “GCT” along with "DASH." The search encompassed articles published from 2016 to 2023 on PubMed, SCOPUS, and Proquest platforms. Titles, abstracts, and articles containing these keywords were reviewed, applying predetermined inclusion criteria to identify relevant studies for inclusion in the systematic review. We considered various observational studies (e.g., cohort, case-control, or cross-sectional studies) published in English or Indonesian. Additionally, we explored further studies through the reference lists of the initially identified articles.

Study Selection

The criteria for including studies were established based on the patient (P), interventions (I), comparator (C), and outcomes (O) framework. For patients (P), it involved those with Giant Cell Tumour (GCT) of the distal radius who had undergone non-vascularized fibular grafting. Regarding interventions and comparators (I/C), any other intervention was considered. The outcomes (O) assessed included the DASH Score, quality of life, and complications resulting from the intervention. Exclusion criteria encompassed 1) duplicate reports, 2) inadequate data for analysis, and 3) non-full-text articles, reviews, and studies lacking a comparative aspect. Titles and abstracts of the retrieved articles were carefully reviewed to assess their relevance and eligibility for inclusion.

Data Collection and Quality Assessment

We independently gathered data from the selected studies. Any discrepancies were resolved through discussion. For each article included, various details were extracted, including the author's name, study location, intervention outcomes, complications, and the study's conclusion.

3. RESULTS

Table 1 shows the characteristics of our patients. From 2021 to 2023, we performed distal radius GCT and reconstruction with non-vascularized fibular grafting for three patients. The mean age of the patient is 27 ± 4 years old, with slight female predominance. The pre-operative DASH score of all patients was consistently around 50 points or above, with a mean score of 62 ± 16, indicating moderate to severe impairment. The post-operative DASH score was obtained and showed improvement, with a mean score of 10 ± 4 points (P value 0.026). There was no donor site injury, as reflected by the absence of peroneal nerve injury and knee or ankle instability during physical examination.

Table 1. Characteristics of the patients

No	Gender (Age)	Pre-Operative DASH	Post-Operative DASH	Donor Site Complication	P Value
1	M (23)	48	9	No	0.026
2	F (31)	60	7	No	
3	F (27)	80	15	No	

All information about the article included is shown in Table 2.

Table 2. Characteristics of the included study

Study, year	Country	Study Design	Outcome intervention	Complication	Conclusion
Bradley, 2016[7]	Australia	Systematic Review	VBGs had better radiographic and functional outcomes than NVBs in minor defect	grafts to long-bone defects suggested that vascularization might increase the risk of complications (>10cm)	vascularized grafts had superior Harris hip and pain scores
Siregar, 2021[8]	Indonesia	Case series	good result with good functional outcomes after NVBGs	NA	Complete and comprehensive ORIF with autologous non-vascularized fibular graft, stabilized fracture by LC-DCP for 1st patient and femoral locking plate for 2nd patient, allowing early rehabilitation and early mobilization resulting in better outcome for the patient.
Idulhaq, 2021[9]	Indonesia	Case Report	MSTS and CAIT showed promising results with proximal fibular autograph	No complication	Reconstruction of distal fibula GCT with proximal fibular autograft showed a great result.
Singh, 2022[4]	Malaysia	Retrospective Cohort	The average MSTS score was 78.4 %, the TESS score was 84%, and the DASH score was 25.2. The average time to radiological union was 12.5 weeks. 64% (29–78%) of the range of	The complication rate was 20%.	Fibula autograft arthroplasty by autologous non-vascularized osteoarticular fibula graft is a feasible reconstruction method after distal radius resection

			movement is preserved compared to the normal side.		with good functional outcomes.
Lenze, 2017[10]	Switzerland	Retrospective Cohort	Primary union was achieved in 94% (SR 87%, HR 100%) of patients, and 85% (SR 81%, HR 88%) showed hypertrophy at the graft-host junction. The functional outcome was highly satisfactory (mean MSTS score 86%).	The complication rate was 36%, with four patients (11%) developing local recurrence.	Non-vascularised fibula grafts for reconstruction of segmental and hemicortical bone defects following meta- /diaphyseal tumor resection at the extremities showed a better outcome.
Kaewpornsawan, 2017[11]	Thailand	Retrospective Cohort	The mean postoperative Mayo Elbow Performance Score was significantly higher than the mean preoperative score. y. The mean Foot and Ankle Disability Index score was 100	NA	A free, non-vascularized fibular graft is a simple and reliable procedure.

4. DISCUSSION

GCT is an aggressive bone tumor that contains mononuclear cell proliferation with scattered macrophages. It is one of the most commonly encountered bone tumors, ranging from 3 to 5% of all bone neoplasms. A recent study even revealed a higher number in Asian countries, with a prevalence of up to 20%. The peak age of the neoplasm first described by Cooper in 1818 is between 20 and 45 years old, consistent with our findings. Nonetheless, several reports also mentioned several cases of individuals over 50.2,3 There are variations regarding gender preponderance. While recent literature from Asian countries reveals slight male predominance, much literature globally states a higher prevalence among females,3,12 Gender characteristics of our patients follow the worldwide epidemiological pattern. This slight discrepancy stresses the need for a large-scale study to disclose the epidemiological pattern of GCT, particularly in Indonesia.

This benign bone neoplasm can develop in various anatomical regions, though it has several predilections: distal femur, proximal tibia, and distal radius. The occurrence at distal radius accounts for approximately 10% of all cases. GCT in this part of the body might develop significant impairment for the affected individuals due to the complex function of the wrist joint.12,13 Nevertheless, the exact treatment of distal radius GCT is still debatable because of the broad variation of treatment choices and relatively poor outcomes. Thus, considering the aforementioned reasons, selecting the foremost treatment method is paramount. GCT can generally be treated conservatively or surgically, depending on the lesion's size, location, and characteristic, i.e., the presence of a pathological fracture or malignant transformation.2,3 While a conservative approach, such as the use of denosumab therapy, has gained popularity recently, operative management is still the mainstay of the treatment in most cases.14 Operative management aims to maximize the functional status while minimizing the risk of recurrence, which is as high as 5 to 17%, with local curettage solely. To achieve this, several surgical techniques have been proposed. Traditionally, intralesional curettage followed by graft placement has been practiced for most GCT lesions around the globe. However, this procedure might not be practical for large or articular lesions requiring more extensive procedures.[13,15,16]

Recent advances in musculoskeletal surgery have made it possible for more complicated surgical techniques, including treating GCT. Previously, wide resection followed by arthrodesis was the preferred method for articular lesions. Nowadays, wide resection followed by reconstruction might be performed. Several reconstruction methods might be employed: fibular grafting, ulnar translocation, tri-cortical iliac grafting, and distal ulnar centralization.[13,15] Among these, fibular grafting, either vascularized or non-vascularized, is one of the most popular methods. Although vascularized fibular grafting has the advantage of preserving the blood supply of the donor, thus conserving the biological and mechanical properties of the bone, it is not flawless. The graft, which relies on microvascular anastomoses of the arterioles, is technically demanding and would increase the surgery duration, which might escalate the infection risk. This grafting method also risks bony overgrowth,

especially in weight-bearing areas. Moreover, vascularized grafts were more likely to require surgical revision due to wound breakdown, nonunion, graft fracture, or mechanical problems. Thus, Allsopp *et al*. advocated the restriction of its application whenever possible. Alternatively, non-vascularized fibular grafting could be implemented, mainly if the defect is less than six cm.[7] This surgical procedure has the advantage of easier implementation and shorter surgical time. It has been proven effective in managing benign and malignant bone lesions in various sites, such as the humerus, elbow, radius, and femur. The procedure that has been widely used for more than 60 years consists of graft harvesting and fixation by using plates and screws in sequence. Several studies have reported remarkable outcomes of this procedure regarding functional and union rates.[7-11,15] Some literature even supports its application in the setting of longer bone defects, as long as 12 cm.[10,11] Our patients showed favorable improvement in DASH score postoperatively. Therefore, considering the remarkable DASH score evaluation, we recommend using a non-vascularized bone graft for the reconstruction method after resection of GCT on the distal radius. In addition, the absence of a weight-bearing factor decreases the risk of developing bony overgrowth complications in this area. Moreover, our experience showed that the fibular graft might size over 6 cm (Figure 2) and still yield positive results. This fact attests to previous authors' recommendations for longer graft size utilization.[10,11]

Behind the paramount result of fibular grafting, there lies devastating complications, especially on the donor side. While the risk of surgical site infection is inevitable and might be controlled by the shorter surgical duration, peroneal nerve injury is one of the most feared complications. The renowned complication is the impairment of foot dorsiflexion and numbness at the lateral side of the leg.[2] This iatrogenic complication can be avoided by meticulous surgical exposure, which calls for experienced surgeons who are familiar with the anatomy of the corresponding region. During our observation, no peroneal nerve injury was discovered after the surgery. Other possible complications are knee and ankle instability because the fibula plays a role in the stability of those structures. Fortunately, no knee or ankle instability was identified during the subsequent follow-up. These facts expand our support for this procedure. However, our study is not without limitations. Although our hospital is a prime referral center in the region that frequently deals with GCT cases, the number of patients who fulfill the criteria to undergo this procedure is still somewhat sparse. Therefore, a larger study with larger samples might help elucidate the benefits of this procedure.

5. CONCLUSION

GCT of the distal radius calls often calls for extensive procedures such as resection followed by reconstruction. Our study showed that non-vascularized fibular grafting following tumor resection could be recommended for this entity. However, a larger study comprising more respondents might be needed to validate our results.

ETHICAL APPROVAL

Health Research Ethics Commission General Hospital Saiful Anwar provided ethical approval for this study with a number (400/005/CR/102.7/2025).

CONFLICT OF INTEREST

We declare that no competing financial interests or personal relationships could have appeared to influence the work reported in this manuscript.

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REFERENCES

[1] Hashim, H., & Bakar, N. S. (2020). Intracranial giant cell tumor—a case report. Egyptian Journal of Radiology and Nuclear Medicine, 51(1), 187. https://doi.org/10.1186/s43055-020-00033-0

[2] Warwick, D., Blom, A., & Whitehouse, M. (2021). Apley and Solomon's concise system of orthopaedics and trauma. Taylor & Francis Group. https://books.google.co.id/books?id=zV4rzgEACAAJ

[3] Sobti, A., Agrawal, P., Agarwala, S., & Agarwal, M. (2016). Giant cell tumor of bone - An overview. The Archives of Bone and Joint Surgery, 4(1), 2–9.

[4] Singh, A., Wei, K. T., Haseeb, A., et al. (2022). Functional outcome following excision of giant cell tumor of the distal radius and reconstruction by autologous non-vascularized osteoarticular fibula graft. Journal of Orthopaedic Surgery, 30, 1–14. https://doi.org/10.1177/23094990221104885

[5] Ido, Y., Uchiyama, S., Nakamura, K., et al. (2016). Postoperative improvement in DASH score, clinical findings, and nerve conduction velocity in patients with cubital tunnel syndrome. Scientific Reports, 6, 1–8. https://doi.org/10.1038/srep30975

[6] Gummesson, C., Atroshi, I., & Ekdahl, C. (2003). The disabilities of the arm, shoulder, and hand (DASH) outcome questionnaire: Longitudinal construct validity and measuring self-rated health change after surgery. BMC Musculoskeletal Disorders, 4, 1–6. https://doi.org/10.1186/1471-2474-4-11

[7] Allsopp, B. J., Hunter-Smith, D. J., & Rozen, W. M. (2016). Vascularized versus nonvascularized bone grafts: What is the evidence? Clinical Orthopaedics and Related Research, 474(6), 1319–1327. https://doi.org/10.1007/s11999-016-4697-7

[8] Siregar, H., Gunawan, R., & Fitriadi, D. (2021). A case series: Non-vascularized autologous fibular graft in the treatment of major segmental bone defect after post-traumatic at diaphyseal femur. Open Access Macedonian Journal of Medical Sciences, 9, 175–181. https://doi.org/10.3889/oamjms.2021.6012

[9] Idulhaq, M., & Azizi, M. L. (2021). Proximal fibular autograft reconstruction after resection of giant cell tumor of the distal fibula. Journal of Orthopaedic Traumatology Surabaya, 10, 53.

[10] Lenze, U., Kasal, S., Hefti, F., et al. (2017). Non-vascularized fibula grafts for reconstruction of segmental and hemicortical bone defects following meta-/diaphyseal tumour resection at the extremities. BMC Musculoskeletal Disorders, 18, 1–11. https://doi.org/10.1186/s12891-017-1552-4

[11] Kaewpornsawan, K., & Eamsobhana, P. (2017). Free non-vascularized fibular graft for treatment of large bone defect around the elbow in pediatric patients. European Journal of Orthopaedic Surgery & Traumatology, 27, 895–900. https://doi.org/10.1007/s00590-017-1987-2

[12] Cao, H., Lin, F., Hu, Y., et al. (2017). Epidemiological and clinical features of primary giant cell tumors of the distal radius: A multicenter retrospective study in China. Scientific Reports, 7, 1–6. https://doi.org/10.1038/s41598-017-01674-x

[13] Agrawal, A. C., Garg, A. K., Choudhary, R., et al. (2021). Giant cell tumor of the distal radius: Wide resection, ulna translocation with wrist arthrodesis. Cureus, 13, 1–9. https://doi.org/10.7759/cureus.18653

[14] Zou, C., Lin, T., Wang, B., et al. (2019). Managements of giant cell tumor within the distal radius: A retrospective study of 58 cases from a single center. Journal of Bone Oncology, 14, 100211. https://doi.org/10.1016/j.jbo.2019.100211

[15] Kamal, A. F., & Muhamad, A. (2020). Outcomes of en bloc resection followed by reconstruction of giant cell tumor around knee and distal radius: A case series. Annals of Medicine and Surgery, 49, 61–66. https://doi.org/10.1016/j.amsu.2019.12.029

[16] Yang, Y. F., Wang, J. W., Huang, P., et al. (2016). Distal radius reconstruction with vascularized proximal fibular autograft after en-bloc resection of recurrent giant cell tumor. BMC Musculoskeletal Disorders, 17, 1–6. https://doi.org/10.1186/s12891-016-0971-9.