Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4, 684-691
2025
Publisher: Learning Gate
DOI: 10.55214/25768484.v9i4.6040

Comparasion of wrist arthrodesis with ulnar centralization and joint salvage with non vascularized fibular graft reconstruction surgery on distal radius giant cell tumor Campanacci 3 at single Centre

Yohanes Aprianto Senduk Widodo[1,2], Ferdiansyah Mahyudin[1,2*], Mohammad Hardian Basuki[1,2]
[1]Department of Orthopedics and Traumatology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia; yohaneswidodo88@gmail.com (Y.A.S.W.) ferdiansyah@fk.unair.ac.id (F.M.) basukimh@gmail.com (M.H.B.)
[2]Department of Orthopedics and Traumatology, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia.

Abstract: Giant cell tumor of bone (GCTB) is a benign neoplasm that is locally aggressive and mostly involves the epimetaphysis. Giant cell tumor is the sixth most common primary bone neoplasm, accounting for 20% of benign bone tumors and 5% of primary bone tumors, with the distal radius being the third most common site for GCTBs to occur, accounting for an average of 10% (8–13%) of GCTB occurrences. This study was conducted to determine the characteristics, clinical outcomes, and recurrence of GCTB of the distal radius Campanacci 3. This retrospective analytical observational study was conducted at a single center between 2015 and 2023. The study involved a comparison of wrist arthrodesis with ulnar centralization and joint salvage with non-vascularized fibular graft reconstruction in 23 patients with Campanacci 3 giant cell tumor of the distal radius. All patients were evaluated by identifying their characteristics (age, gender, tumor size, surgical procedure), functional outcomes including the Musculoskeletal Tumor Society (MSTS) score, and range of motion (ROM). The study population included slightly more females (52.2%) than males. The majority of cases occurred in the 20-30 year age range (30.4%). Most tumors were >10 cm (56.5%). Joint salvage with non-vascularized fibular graft reconstruction was performed in 56.5% of patients. There were no metastases or recurrences. A greater range of motion (>45 degrees) was observed in 52.1% of patients who underwent non-vascularized fibular graft reconstruction. 56.5% of patients achieved good MSTS scores (18-24). With the results of existing research characteristics and supported by data from other studies, there is significant evidence for joint salvage with non-vascularized fibular graft reconstruction resulting in higher functional outcomes than wrist arthrodesis.

Keywords: *Distal radius, GCTB, Joint salvage, Limb salvage, Wrist arthrodesis.*

1. Introduction

Giant cell tumor bone (GCTB) is a benign but locally aggressive neoplasm mostly involve epimetaphisis [1]. GCTBs are characterized by aggressive bone destruction and metastatic on lung despite as benign neoplasm. Cooper first reported Giant Cell Tumor in the 18th century, in 1940, Jaffe and Lichtenstein defined Giant Cell Tumor as more difficult to differentiate from other tumors [2].

Most giant cell tumors occur in the long bones, proximal tibia, distal femur, distal radius and proximal humerus, although giant cell tumors have also been reported to occur in the sacrum, calcaneus and leg bones. This tumor usually arises in the metaphysis of the epiphyseal plate. In general, these tumors cause bone destruction, local metastases, metastases to the lungs and lymph nodes (rare), or transform into malignancy (rare) [3].

These tumors represent approximately 20% of primary benign bone tumors. Mostly found at the age of 20-40 years, and rarely found in children. Incidentally in the United States and Europe, they

History: Received: 20 January 2025; Revised: 18 March 2025; Accepted: 22 March 2025; Published: 7 April 2025
* Correspondence: ferdiansyah@fk.unair.ac.id

account for approximately 5% of all primary bone tumors and 21% of all benign bone tumors. In China, 20% of GCTBs are found to be primary bone tumors. Women suffer from GCTB more often than men [4].

At the Cipto Mangunkusumo National Central General Hospital (RSUPNCM) in the period of 1990 - 1997, the GCTB incidence rate of all bone tumors, both benign and malignant, was recorded at 13%, with more male sufferers than women with a ratio of 5:3. The most common age group is 21–40 years. GCTB patients who came to RSUPNCM (1990 – 1997) were often in stage 2 with complaints in the lesion area. GCTB recurrence usually occurs within 3 years after therapy [5].

Some patients with lung metastases have progressive lung lesions that result in death, despite the fact that histological examination remains benign. The overall mortality rate from the disease for patients with lung metastases is approximately 15%. Patients with recurrent lesions or primary lesions that appear roentgen graphically aggressive (stage 3) are at high risk for lung metastases [6].

The Campanacci classification is a system used to grade GCTBs based on radiographic appearance, reflecting the severity and potential aggressiveness of the tumor. Campanacci grade I tumors show clear margins, minimal bone expansion, and no cortical damage. . Grade II tumors show well-defined margins, moderate bone expansion, and thinning of the cortical bone without destruction. Grade III shows ill defined margins, significant bony expansion, and cortical damage and extension into the soft tissue. Each grade reflects the severity and potential aggressiveness of the tumor, with Grade III being the most severe. This classification helps in planning treatment and assessing the patient's prognosis, [7].

Treatment options for GCTB of the distal radius include curettage, wide excision, arthrodesis, and joint salvage. The choice of treatment depends on factors such as tumor stage, location, and desired functional outcome. While various surgical techniques exist, there is ongoing debate regarding the optimal approach for Campanacci grade 3 GCTB of the distal radius to minimize recurrence and maximize functional outcomes.

This study aimed to compare the functional outcomes and recurrence rates of wrist arthrodesis with ulnar centralization and joint salvage with non-vascularized fibular graft reconstruction in patients with Campanacci 3 GCTB of the distal radius.

2. Methods

2.1. Study Design and Setting

This was an analytical observational study, with a retrospective design, conducted at Dr. Soetomo General Academic Hospital Department of Orthopedic and Traumatology. Data were collected from 2015 to 2023.

2.2. Study Participants

The study population consisted of all patients with GCTB of the distal radius treated at Dr. Soetomo General Academic Hospital]. Patients were identified through review of hospital records, surgical logs, etc. The final sample included 23 patients Patients were included if they met the following criteria: Specific classification, Campanacci stage 3, underwent surgical procedure with either wrist arthrodesis with ulnar centralization or joint salvage with non-vascularized fibular graft reconstruction, Consented to participate in the research, and minimum postoperative follow-up period of 6 months. Patients were excluded if they met any of the following criteria: GCTB of the distal radius not classified as Campanacci 3, Surgical treatment performed with curettage as the primary procedure.

2.3. Surgical Procedur

This study participants all GCTB distal radius were performed surgical procedure wide excision and wrist arthrodesis with Ulnar centralization or joint salvage with non vascularized fibular graft reconstruction as well as post-operative patients with a minimum 6-month follow-up period.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 684-691, 2025
DOI: 10.55214/25768484.v9i4.6040

2.4. Data Collection and Outcomes Measure

Data were collected from patient medical records, operative reports, and radiological images. The following data were collected: Patient demographics (age, gender), tumor characteristics (tumor size, laterality), Surgical procedure functional outcomes (MSTS score, Range of Movement), radiological outcomes (recurrence, and lung metastase). The following outcome measures were used: MSTS Score (Musculoskeletal Tumor Society) was used to assess functional outcomes. MSTS scores were assessed at assess musculoskeletal tumors by assessing 6 items, namely pain, function, emotion, dexterity, hand position and muscle strength. Range of Motion (ROM) of the ⁅wrist joint was measured using a instrument (goniometer). The following movements were assessed dorsiflexion and palmarflexion. Recurrence was defined as the presence tumor lesion post surgery by clinical examination and radiological imaging.

2.5. Statistical Analysis

Statistical analysis was performed using SPSS. Descriptive statistics (mean, standard deviation, percentages) were used to summarize patient data. Differences between surgical groups were compared using t-tests or chi-square tests, as appropriate. A p-value < 0.05 was considered significant.

3. Result

In this study, researchers took data from 23 GCTB patients in the distal radius with Campanacci 3. The study collected balanced data, with an equal distribution of 47.8% for males and 52.2% for women with GCTB at distal radius. The age group that was more frequently affected by GCTB was generally those in the second decade to the 3rd decade, between 21-30 years. Distribution of patients based on age divided by decade. This study classified tumor sizes as either greater than 10 cm or less than 10 cm. Among all patients, 56.5% had lumps larger than 10 cm before surgery, while 43.5% had tumor sizes smaller than 10 cm.(Table 1).

Table 1.
Demographic data of patients.

No	Characteristic	Wrist Arthrodesis (Ulnar centralization)	Joint Salvage (Non vascularized Fibular graft)
1	Number of patient	10 (43.5%)	13 (56.5%)
2	Age		
	21-30 Years Old	1 (4.3%)	6 (26.1%)
	31-40 Years Old	2 (8.6%)	4 (17.4%)
	41-50 Years Old	4 (17.4%)	2 (8.6%)
	51-60 Years Old	1 (4.3%)	-
	61-70 Years Old	2 (8.6%)	1 (4.3%)
3	Gender		
	Female	6 (26.1%)	6 (26.1%)
	Male	4 (17.4%)	7 (30.4%)
6	Tumor size		
	<10 cm	2 (8.6%)	8 (34.7%)
	>10 cm	8 (34.7%)	5 (21.7%)

The most frequently performed surgical procedure on patients with GCTB distal radius in this study was Joint Salvage (Non vascularized Fibular graft reconstruction), with a frequency of 56.5% of the total patients. (Table 1) In this study, it was found that there were no metastases in all GCTB distal radius patients post surgery.

Postoperative radiological examination is very important to see existing lesions and recurrence of the disease. This study shows whether there are lytic lesions that occur post-operatively, the result is that all patients do not show lytic lesions on the post-operative radiological images. (Table 1)

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 684-691, 2025
DOI: 10.55214/25768484.v9i4.6040

Examination of joint range of motion shows how the patient's movements function after the procedure is carried out. In this study there were 12 patients who had free ROM, and 11 limited. (Table 1)

This research involves the analysis of MSTS scores, with the highest score being 30 points for an excellent outcome and 24 points for a good outcome (Table 1). When compared to age and surgical procedure, MSTs Score ($p = 0.019$ and $p = 0.000$, respectively), had a statistical significancy.(Table 2) Similar to MSTs, ROM DF and PF also statistically significant when compared to age and surgical procedure ($p = 0.000$ and $p = 0.000$ respectively for ROM DF and $p = 0.0012$ and $p = 0.0000$ for ROM PF, respectively). (Table 3) Sex and lesion size do not have any statistical significancy when being compared to MSTs Score and ROM DF and PF.

Table 2.
Analysis of Demographic Characteristics, Procedure and Lesion size with MSTs Score.

Characteristic	MSTs Score		P-value
	Excellent	Good	
Sex			
Male	4 (17.4)	7 (30.2)	0.68
Female	6 (26.1)	6 (26.1)	
Age			
21-30 Years Old	1 (4.3)	7 (30.4)	
31-40 Years Old	1 (4.3)	4 (17.4)	0.019
41-50 Years Old	6 (26.1)	0	
51-60 Years Old	1 (4.3)	0	
61-70 Years Old	1 (4.3)	2 (8.7)	
Procedure			
Fibular Graft Reconstruction	10	3	0
Wrist Arthrodesis (ulna Centralization)	0	10	
Lesion Size			
<10	2 (8.7)	8 (34.8)	0.405
>10	8 (34.8)	5 (21.7)	

Table 3.
Analysis of Demographic Characteristics, Procedure and Lesion size with ROM DF and PF.

Characteristic	ROM DF (%)		P-value	ROM PF (%)			P-value
	15° – 30°	30° – 45°		-15° – 0°	15° – 30°	30° – 45°	
Sex							0.619
Male	5 (21.7)	6 (26.1)	0.827	5 (21.7)	0	6 (26.1)	
Female	6 (26.1)	6 (26.1)		5 (21.7)	1 (4.3)	6 (26.1)	
Age							0.0012
21-30 Years Old	0	8 (34.8)		0	0	8 (34.8)	
31-40 Years Old	1 (4.3)	4 (17.4)		1 (4.3)	0	4 (17.4)	
41-50 Years Old	6 (26.1)	0	0	6 (26.1)	0	0	
51-60 Years Old	1 (4.3)	0		1 (4.3)	0	0	
61-70 Years Old	3 (13.0)	0		2 (8.7)	1 (4.3)	0	
Procedure							0.0000
Fibular Graft Reconstruction	1 (4.3)	12 (52.2)	0	0	1 (4.3)	12 (52.2)	
Wrist Arthrodesis	10 (43.5)	0		10 (43.5)	0	0	
Lesion Size							0.099
<10 cm	3 (13.1)	7 (30.4)	0.232	2 (8.7)	1 (4.3)	7 (30.4)	
>10 cm	8 (34.8)	5 (21.7)		8 (34.8)	0	5 (21.7)	

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 684-691, 2025
DOI: 10.55214/25768484.v9i4.6040

4. Discussion

This study investigated the characteristics, functional outcomes, and recurrence of Campanacci 3 GCTB of the distal radius treated with two different surgical procedures. Incidence of GCTB distal radius with surgical procedure wrist arthrodesis and joint salvage in our center was 23 patients, where during the data collection period for this study all patients could be followed. This is in accordance with previous retrospective research, where the ratio of male patients was greater than female at 13:12, with peak incidence of GCT based on age in this study occurred in the third decade (20-30 years) at 69% [8]. The results of this study show that female greater than male, for the majority of ages affected by GCT are those aged 20-30 years, amounting to 30.4%, followed by those aged 30-40 years at 26.1%. Apart from that, tumor size is also very important. In other research there 51.7% tumor size measuring >10 cm and 48.3% measuring <10 cm [8]. In this study, tumor size was classified before the procedure, smaller than 10 cm and bigger than 10 cm. The percentage of GCTB measuring <10 cm were 43.5%, while those measuring >10 cm were 56.5%. The Campanacci score is used to classify the level of aggressiveness of bone tumors, especially GCTBs.

Recurrence is often described in various studies to relate to which actions have higher recurrence rates. In a systematic review study conducted by Koucheki, et al. [9] there were 2 large groups of procedures performed on GCTB, namely curettage and excision. Where the surgical procedure carried out varied between wide excision compared to curettage, namely 51% for wide excision and 49% for curettage, other research conducted by Cao, et al. [8] showed that wide excision was 66.7% compared to 33.3% for curettage. In this study, surgical procedures in distal radius GCT cases we chose to evaluate and compare were wide excision with arthrodesis with Ulnar centralization (43.5%) compared to joint salvage with non vascularized fibular graft reconstruction (56.5%). In other studies Curettage shows up to 6x more recurrence in GCT of the distal radius compared to wide excision [9]. This shows that the choice of surgical procedure in a particular case greatly determines the risk to the patient. In other Research examined distant metastases in 24 patients out of 470 patients with GCT for 20 years. This showshat the number of metastases that occur tends to be low 5.1 % [10]. In this study, 23 patients with GCT of the distal radius showed no metastasis. The radiological images show that there are no lytic lesions, this indicates that there is no further development of the tumor or recurrence. The patient's joint movements is important to evaluate, in other study with surgical procedure joint salvage show 78.9 % range of movement is limited and 21.1% is free [11]. In this study show an average in a free condition 52.1% and limited range of movement 47.9%. The choice of Surgical procedure is important for evaluate the clinical outcome. Scoring using MSTS is generally used to clinically assess musculoskeletal tumors. In previous research 11 patients with evaluation for 1 year showed an MSTS score of 18-24. (Barik et al, 2020) This shows good function. In this study shows minimal complaints and good function in patients with average score is 27 (34.7%) and MSTS scores tend to be high with range 22-28. The results suggest that joint salvage with non-vascularized fibular graft reconstruction may be a viable option for Campanacci 3 GCTB of the distal radius, offering good functional outcomes. However, these findings should be interpreted cautiously due to the limitations of the study, and further research is needed confirm these findings in a prospective and randomized controlled trial

5. Conclusion

Results of this study provides valuable insights into the characteristics, functional outcomes, and recurrence of Campanacci 3 GCTB of the distal radius]. The findings suggest that both wide excision with arthrodesis and joint salvage with non-vascularized fibular graft reconstruction are effective treatment options for Campanacci 3 GCTB of the distal radius, with joint salvage demonstrating promising functional outcomes. Further research is warranted to determine the long-term outcomes and optimal treatment strategies for this challenging condition.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 684-691, 2025
DOI: 10.55214/25768484.v9i4.6040

Figure 1.
Surgical procedure with wrist arthrodesis A. Clinical picture before surgery, B. Preoperative radiography, C. Preoperative imaging with appearance solid mass with cystic components, multiloculated in the epi-metaphysis, does not appear to encase AVN, D. Underwent wide excision with Ulnar centralization, E. Postoperative radiography, F. 1 year follow up radiography, G. Range of movement wrist post operative with Dorsal flexion 15° Wrist and Plantar flexion -15°.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 684-691, 2025
DOI: 10.55214/25768484.v9i4.6040

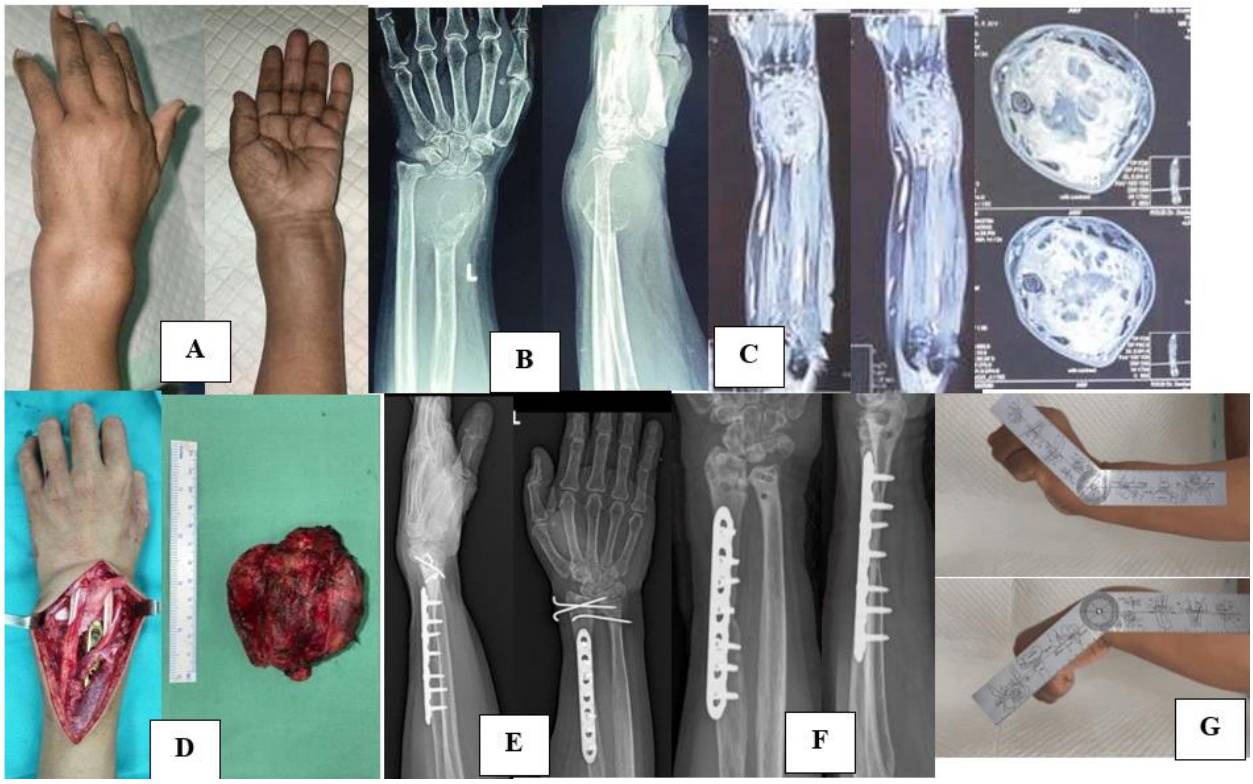

Figure 2.
Surgical procedure with joint salvage with non vascular fibular graft A. Clinical picture before surgery, B. Preoperative radiography, C. Preoperative imaging with appearance expansile lesion, with solid, cystic components in the distal epi-meta-diaphysis, D. Underwent wide excision with non vascularized fibular graft, E. Postoperative radiography, F. 2 year follow up radiography, G. Range of movement wrist post operative with Dorsal flexion 45° Wrist and Plantar flexion 45°.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

References

[1] D. Muscolo, M. Ayerza, and L. Aponte-Tinao, "(iv) Giant cell tumours of bone," *Current Orthopaedics*, vol. 15, no. 1, pp. 41-50, 2001.
[2] Lesley ann-goh, "Giant cell tumor imaging,," *Journal of Orthopaedic Oncology*, 2011.
[3] V. O. Lewis, A. Wei, T. Mendoza, F. Primus, T. Peabody, and M. A. Simon, "Argon beam coagulation as an adjuvant for local control of giant cell tumor," *Clinical Orthopaedics and Related Research®*, vol. 454, pp. 192-197, 2007.
[4] R. Forsyth and P. Hogendoorn, "Bone: Giant cell tumor," *Atlas of Genetics and Cytogenetics in Oncology and Haematology*, 2003.
[5] E. Hutagalung, "Giant cell tumor of bone," *J Bedah Indonesia*, 2001.
[6] S. Sukpanichyingyong and T. Sangkomkamhang, "Clinical outcomes of grade 3 giant cell tumor of bone after extended intralesional curettage," *J Orthop Oncol*, vol. 3, no. 118, p. 2, 2017.
[7] A. F. Mavrogenis, V. G. Igoumenou, P. D. Megaloikonomos, G. N. Panagopoulos, P. J. Papagelopoulos, and P. N. Soucacos, "Giant cell tumor of bone revisited," *Sicot-j*, vol. 3, p. 54, 2017.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 684-691, 2025
DOI: 10.55214/25768484.v9i4.6040

[8] H. Cao *et al.*, "Epidemiological and clinical features of primary giant cell tumors of the distal radium: a multicenter retrospective study in China," *Scientific Reports*, vol. 7, no. 1, p. 9067, 2017. https://doi.org/10.1038/s41598-017-09486-6

[9] R. Koucheki *et al.*, "Management of giant cell tumors of the distal radius: A systematic review and meta-analysis," *European Journal of Orthopaedic Surgery & Traumatology*, vol. 33, no. 4, pp. 759-772, 2023.

[10] S. Viswanathan and N. Jambhekar, "Metastatic giant cell tumor of bone: Are there associated factors and best treatment modalities?," *Clinical Orthopaedics and Related Research®*, vol. 468, pp. 827-833, 2010.

[11] M. Gierlotka *et al.*, "Incidence, treatment, in-hospital mortality and one-year outcomes of acute myocardial infarction in Poland in 2009–2012—nationwide AMI-PL database," *Polish Heart Journal*, vol. 73, no. 3, pp. 142-158, 2015.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 684-691, 2025
DOI: 10.55214/25768484.v9i4.6040