

# Evaluation of patient's daily activities with Free Non-Vascularized Fibular Head Graft (FNVFHG) as a treatment after resection of proximal humeral tumors



Muhammad Phetrus Johan<sup>1</sup>, Henry Yuriyanto<sup>1</sup>, Roichan Mochammad Firdaus<sup>2</sup>,  
Andi Firman Mubarak<sup>2</sup>, Luky Tandio Putra<sup>2\*</sup>, Tri Kurniawan<sup>2</sup>

## ABSTRACT

**Introduction:** Free non-vascularized fibular head graft (FNVFHG) is a method in handling bone defect after wide resection of the tumor.

**Methods:** This study used descriptive research with the sample of three cases of proximal humeral giant cell tumor that underwent bone resection and reconstructed with a free non-vascularized fibular head graft. The outcomes were measured by the Musculoskeletal Tumor Society (MSTS) score, range of motion of the shoulder, and activity of daily living.

**Results:** The overall MSTS score of 3 patients was 73%. Two patients were able to perform all the shoulder motions, including flexion, extension, abduction, external rotation, internal rotation with limited range of motion, while the other patient could only perform restricted internal rotation. Two patients performed all of their daily activities with the affected extremity, including personal hygiene (tooth brushing), writing, eating, holding a glass, dressing, and riding a motorcycle. In contrast, the other patient encountered difficulty performing tooth brushing and self-feeding with the affected extremity, using the contralateral upper extremity.

**Conclusions:** Free non-vascularized fibular head graft may serve as an option in handling bone defect after wide resection of musculoskeletal tumor at the proximal humerus. This method can be safely performed with an acceptable functional outcome.

**Keywords:** Non-vascularized fibular head graft, Giant Cell Tumor (GCT) of the bone, Musculoskeletal Tumor Society (MSTS) Score, Range of Movement, Daily activities.

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<sup>1</sup>Staff of Orthopaedic and Traumatology Department, Universitas Hasanuddin, Makassar, Indonesia

<sup>2</sup>Resident of Orthopaedic and Traumatology Department, Universitas Hasanuddin, Makassar, Indonesia

\*Corresponding author:

Luky Tandio Putra;  
Resident of Orthopaedic and Traumatology Department, Universitas Hasanuddin, Makassar, Indonesia;  
[Luky.tandio@gmail.com](mailto:Luky.tandio@gmail.com)

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## INTRODUCTION

Achieving an excellent upper limb function after resection of the proximal humerus for malignant bone tumor requires the use of a reconstruction technique capable of conserving function as a spacer over the long term and maintaining shoulder joint stability and good elbow joint function. Limb reconstruction options after tumor excision include non-vascularized or vascularized autograft, bone transport, and replacement with prostheses.<sup>1,2</sup> Among these, the non-vascularized and free vascularized autograft are good choices for reconstructing a gap in long bone resections, with the latter needing more revisions and complicated with a

more wound-healing problem related to the use of myocutaneous flap.<sup>3</sup>

The use of non-vascularized autograft in reconstruction may provide biologic incorporation and the ability to thrive in compromised soft tissue environments. Although several options exist for bone transfer (such as iliac crest, rib, or clavicle), the fibula is the most commonly used as a free autograft. The use of free fibula transfer to the humerus is well established for post-traumatic bone loss and nonunions. The ability of implanted fibular autograft to induce bone formation depends on the connection between autografts and the ends of the resected bone. One of the factors to determine the success of the graft incorporation is the

richness of the recipient's blood supply.<sup>4,5</sup>

In reconstruction as the treatment after resection of bone tumor at the proximal humerus, we prefer to use the free non-vascularized fibular head graft (FNVFHG) transfer method. That became the choice for reconstructing such defects due to its safety, faster, less expensive procedure, and less complication than vascularized fibular graft.<sup>3</sup> This research aims to evaluate patient's quality of life in carrying out daily activities after surgery, and it can be used as a reference for operative management methods.

## METHODS

This study was conducted on a quantitative descriptive-analytic study with the cross-

**Table 1.** Patient's demographic information

Patient	Age (yr)	Gender	Diagnosis	Length of humerus resection	Length of the fibular graft	Follow Up (mo/yr)
Patient 1	34	Male	Giant Cell Tumor Left Proximal Humerus	20.55 cm	22.8 cm	13 months
Patient 2	59	Male	Giant Cell Tumor Right Proximal Humerus	20.10 cm	22.42 cm	45 months
Patient 3	41	Male	Giant Cell Tumor Left Proximal Humerus	16.69cm	20.31 cm	2 months

**Table 2.** Musculoskeletal Tumor Society Score of patients after humerus tumor resection and reconstruction with a free non-vascularized fibular head graft.

Patient	Musculoskeletal Tumor Society Score Indicators						Overall rating
	Pain	Function	Emotional Acceptance	Hand Positioning	Manual dexterity	Lifting ability	
Patient 1	5	4	5	2	5	4	83 %
Patient 2	5	4	4	2	5	4	80 %
Patient 3	4	1	3	2	5	2	56 %

**Table 3.** Shoulder joint range of motion

Patient	Range of Motion				
	Flexion 180°	Extension 60°	Abduction 180°	External Rotation 90°	Internal Rotation 70°
Patient 1	26°	14.5°	18.7°	40°	70°
Patient 2	30°	23°	50,7	45°	70°
Patient 3	0°	0°	0°	0°	30°

sectional study design. The subject of this study is the patients with bone tumors at the proximal humerus who were treated by proximal humeral resection and reconstructed by free non-vascularized fibular head graft (FNVFHG) (Figure 1) who admitted to Wahidin Sudirohusodo General Hospital from 2019 to 2020.

There were three patients included in this study as the subject. The patients were evaluated by the Musculoskeletal Tumor Society (MSTS) scoring system after the operation, range of motion of the shoulder, and various daily living activities.

The MSTS Rating Scale is widely used for evaluating functional instruments in patients' functional outcomes with extremity tumors. It comprises six items: pain, function, emotional acceptance, hand positioning, manual dexterity, and lifting ability. Each item is rated on a scale of 0 to 5. The total score ranges from 0 to

30, with higher scores indicating better function.<sup>6</sup>

## RESULTS

The subjects of this study consist of 3 patients, with all patients who are male and diagnosed with giant cell tumors of the proximal humerus. The length of humerus resected from those patients is 20.55 cm, 20.10 cm, and 16.69 cm, with the average length of humerus resected from these samples, is 19.11 cm. The evaluation was conducted at 13 months, 45 months, two months after surgery for patients 1, 2, and 3, respectively (Table 1).

In this study, we measured three aspects for the outcome of free non-vascularized fibular head graft procedure as the dependent variable. They are musculoskeletal tumor society score (MSTS), range of motion measurement, and activity of daily living.

The overall MSTS score of the three patients was 73%. We found that two patients have the result with an overall rating of 80 % or above, which means a good function, while the other patient got a score of 56%. Based on that result, we concluded from the MSTS score that our patients' functional outcome was acceptable (Table 2).

Shoulder active range of motion was evaluated on the patients (Figure 2 - 4). Two patients could perform all movement of the shoulder (flexion, extension, abduction, external rotation, and internal rotation). However, the patients could not achieve a full range of motion compared to the normal shoulder. The other patient was only able to perform restricted internal rotation (Table 3).

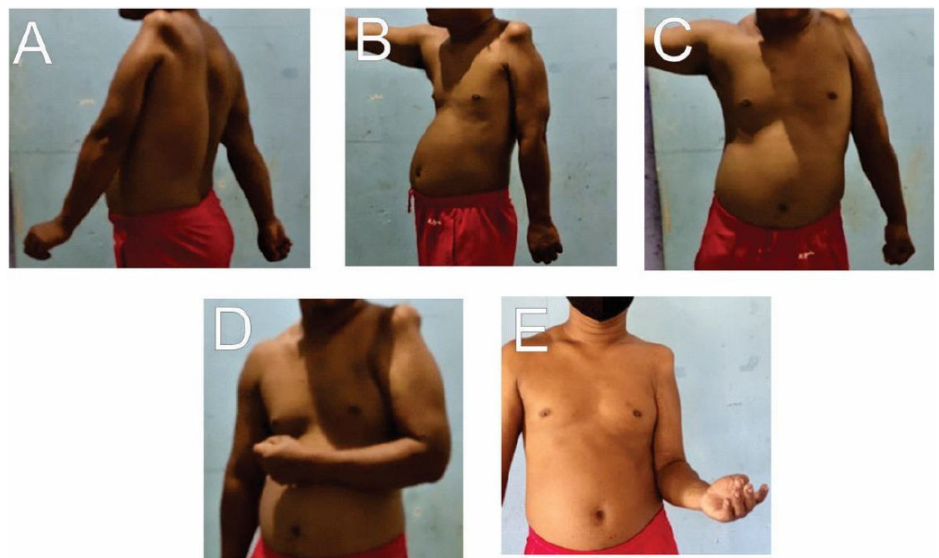
The last variable is the patients' daily activities. We evaluated the patients' hygiene ability, writing ability, self-feeding, holding a glass, dressing or buttoning, and driving ability (Figure 5 - 7). The result showed that patients 1 and 2 could perform almost all daily activities on themselves, except patient 1's writing ability cannot be evaluated because the patient is right-handed dominant. Patient 3 could hold a glass, buttoning and driving a motorcycle. However, he could not perform personal hygiene (tooth brushing) and self-feeding using his affected limb (Table 4).

**Table 4.** Patient's daily activity

Patient	Daily Activities					
	Personal hygiene (toothbrush)	Writing ability	Self-feeding	Holding a glass	Dressing or buttoning	Driving ability (Riding motorcycle)
Patient 1	√	Can not be evaluated (patient is right hand dominant)	√	√	√	√
Patient 2	√	√	√	√	√	√
Patient 3	-	Can not be evaluated (patient is right hand dominant)	-	√	√	√



**Figure 1.** A. Pre-operative X-ray of patient 1 with bone tumor (Giant Cell Tumor) at the left proximal humerus. B. Postoperative X-ray of patient 1 (13 months post-surgery) treated by proximal humerus resection and reconstructed by free non-vascularized fibular head graft (FNVFHG)



**Figure 2.** Range of motion of the first patient after resection of bone tumor at the left proximal humerus and reconstruction with FNVFHG (A.Flexion; B.Extension; C.Abduction; D.Internal Rotation; E.External Rotation). Follow-up at 13 months after surgery.

## DISCUSSION

The predilection of giant cell tumor is commonly found on the distal femur, proximal tibia, distal radius, proximal humerus.<sup>7</sup> In our study, all the patients had a giant cell tumor in the proximal humerus.

The MSTS overall rating score for our patients are 83%, 80%, and 56 %, with an average of 73%. This result has an almost similar functional rate compared

with Kubo et al. study. Their study demonstrated the MSTS rating score of 75,6% after a fibular graft procedure at the proximal humerus, which was successfully incorporated into the donor site. There was no morbidity postoperative both on the donor site and recipient site.<sup>5</sup>

On the other study, based on Janssen et al., they compared the MSTS score assessed by the physician and by the patient. The result demonstrated that the median score was higher in physician examination than patients' perspectives by 8 points (65, IQR: 49-83 vs. 57 IQR: 40-70;  $p < 0.001$ ). This study showed the importance of the physician to understand the patient's perception. Therefore, we have to carefully assess the MSTS score by involving the

patients more in the assessment.<sup>8</sup>

The next variable is the range of motion of the shoulder joint (Fig.1-3). The mean degree range of motion (ROM) was flexion 18.67°, extension 12.5°, abduction 23.13°, internal rotation 56.67°, and external rotation 28.33°. Two patients can perform all the shoulder motions with limited range. One patient can only perform a restricted internal rotation of the shoulder joint. Our result showed that there were shoulder movement restrictions after the operation, especially on flexion and abduction. This result is appropriate with Kubo et al. in which a shoulder restriction is found, especially on flexion and abduction.<sup>5</sup> In our study, patient 3 with marked restriction of movement might



**Figure 3.** Range of motion of the second patient after resection of bone tumor at the right proximal humerus and reconstruction with FNVFHG (A.Flexion; B.Extension; C.Abduction; D.Internal Rotation; E.External Rotation). Follow-up at 45 months after surgery.



**Figure 4.** Range of motion of the third patient after resection of bone tumor at the left proximal humerus and reconstruction with FNVFHG (A.Flexion; B.Extension; C.Abduction; D.Internal Rotation; E.External Rotation). Follow-up at two months after surgery.

be due to the lack of rehabilitation with a short duration of follow-up (2 months). We suggest that optimal rehabilitation with longer follow-up on patient three will provide a more active range of motion than the other patients. Evaluation of the activity of daily living showed that two patients could perform almost all daily activities (personal hygiene, writing ability, self-feeding, hand-holding ability, dressing/ buttoning ability, and riding a motorcycle) on their self except patient 1's writing ability which was not able to be evaluated because the patient is right-handed dominant. Patient 3 could not do personal hygiene and self-feeding with his affected left upper extremity due to weakness of active elbow flexion. However, the patient was able to hold a glass, perform buttoning, and ride a motorcycle. This result suggested that patient 3 needed some assistance to do his daily activity.

The study conducted by Saleh et al. showed that there are no morbidities, and the patient can perform daily activities such as personal hygiene, writing, self-feeding, holding a glass, and driving or riding for the patient who had undergone free vascularized fibular head graft as the procedure after giant cell tumor resection on humerus on three years postoperative follow up.<sup>9</sup>

## CONCLUSION

Free non-vascularized fibular head graft (FNVFHG) may serve as an option method in bone defect after wide resection of musculoskeletal tumor of the proximal humerus. This method can be safely performed without any significant morbidities and yield an acceptable functional outcome based on MSTs score, range of shoulder motion, and daily activity observation. However, further studies with more samples are needed to confirm our results.

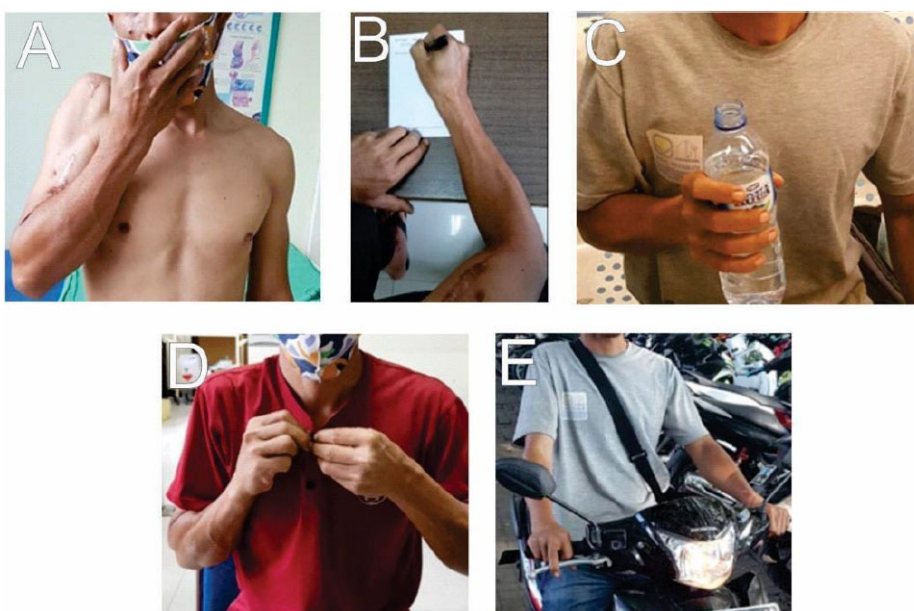
## DISCLOSURE

### Author Contribution

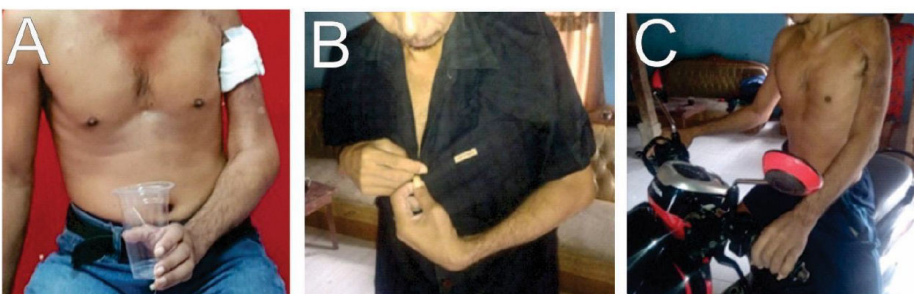
MPJ and HY contributed in making research concepts and design. RMF, AFM, LTP, and TK contributed in literature search, clinical studies, and experimental studies. HY contributed in data acquisitions and analysis. All author



**Figure 5.** Activities of daily living of first patient at 13 months after surgery. A. Self-feeding; B. Dressing/buttoning; C. Riding a motorcycle



**Figure 6.** Activities of daily living of the second patient at 45 months after surgery. A. Eating; B. Writing ability; C. Holding a bottle; D. Dressing/buttoning; E. Riding a motorcycle



**Figure 7.** Activities of daily living of the third patient at two months after surgery. A. Holding a glass; B. Dressing/buttoning; C. Riding a motorcycle

contributed in manuscript preparation and editing.

#### Conflict of Interest

The authors declare that this article has no conflict of interest.

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None.

#### Ethical Statement

Health Research Ethics Committee Universitas Hasanuddin has approved this study with letter number No. 807/UN4.6.4.5.31/PP36/2020.

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