

*Original Article***Characteristics of Nonunion Fractures in Patients with Antebrachial Fractures at dr. Mohamad Soewandhie General Hospital Surabaya 2021-2022: A Retrospective Study**Tasya Monica¹ , Bimo Sasono² , Cempaka Harsa Sekarputri³ ¹Faculty of Medicine, Ciputra University, Surabaya, Indonesia²Orthopaedics Department, dr. Mohamad Soewandhie General Hospital, Surabaya, Indonesia³Department of Medicine, Ciputra University, Surabaya, IndonesiaCorrespondence should be addressed to Bimo Sasono, Orthopedic Department, Dr. Mohamad Soewandhie Hospital, Villa Kalijudan 9/10 blok K-5 Surabaya 60114, Indonesia. e-mail: bimo.sasono@ciputra.ac.id**ABSTRACT**

Background: Nonunion, a complication of fracture healing, can lead to patient morbidity. Contributing factors include age, gender, fracture type, multiple fractures, infection, prolonged nonsteroidal anti-inflammatory drug (NSAID) use, smoking, nutritional status, and history of chronic disease. This study aims to determine the prevalence and characteristics of nonunion antibrachial fractures at dr. Mohamad Soewandhie General Hospital Surabaya.

Methods: This retrospective descriptive study involved 111 patients. Data was gathered from medical records treated at dr. Mohamad Soewandhie General Hospital Surabaya for antibrachial fracture during 2021-2022. The study protocol obtained approvals from two local ethical committees. Data included demographics, fracture characteristics, fracture type, multiple fractures, infection, NSAID use, hypertension and diabetes history, smoking habits, and nutritional status by BMI calculation.

Results: This study found a 24.3% prevalence of antibrachial nonunion fractures at dr. Mohamad Soewandhie General Hospital Surabaya in 2021-2022, mostly in males (66.7%) aged 17-25 years (22.2%). Nonunion in antibrachial fractures is marked by high rates in closed (92.6%) and single fractures (92.6%). Notably, infections (22.2%), smoking (7.4%), and hypertension history (7.4%) are common contributors. Despite ideal BMI in many cases (44.4%), nonunion still occurred.

Conclusions: The study conducted at dr. Mohamad Soewandhie General Hospital in Surabaya revealed a high prevalence of antibrachial nonunion fractures at 24.3%, particularly among young males. It was found that closed, single fractures were the most common type, with infections, smoking, and a history of hypertension being significant contributing factors. Interestingly, even individuals with an ideal BMI were still at risk for nonunion.

Keywords: Prevalence; Nonunion; Antebrachial; Health Risk

INTRODUCTION

Nonunion can lead to significant morbidity in patients following fracture management.¹ It can be caused by multiple factors that disrupt normal bone healing.² In addition to surgical factors, external factors such as education level, environmental conditions, and cultural beliefs can also influence the possibility of complications and overall outcomes following surgery.³

According to Schmal et al., nonunion

fracture complications pose a significant financial burden, affecting approximately 1.9% of all fracture-related complications.⁴ In 2019, the World Health Organization (WHO) estimated that 440 million people experienced bone fractures. According to data from the 2018 Indonesian Basic Health Research, 9.2% of fractures in Indonesia resulted in disruption of daily activities. In East Java, the prevalence of upper extremity injuries was 32.3%.⁵ Based on accident data in Indonesia, young male patients between the ages of 10



and 15 who are involved in motorcycle accidents have a high risk of sustaining an antebrachial fracture. Nonunion management can lead to financial burdens and long-term disability for the patient.² Antebrachial nonunion fractures cause the greatest reduction in a person's quality of life compared to nonunion of other long bone fractures.⁶ Nonunion of the antebrachial results in functional and psychosocial disabilities for the afflicted individual.⁷

This research aims to identify the contributing factors to complications, specifically nonunion incidence, in the treatment of antebrachial fractures. The study will focus on patients treated at dr. Mohamad Soewandhie General Hospital Surabaya between 2021 and 2022. The findings will aid in developing strategies to prevent complications and improve patient outcomes.

MATERIAL AND METHODS

Study Design and Sampling

This retrospective study focuses on patients who were treated for antebrachial fractures at dr. Mohamad Soewandhie General Hospital Surabaya in the years 2021-2022. Data was collected from their medical records and analyzed using a total sampling technique. A total of 111 patient records were included in the study. The study protocol was approved by the ethical committee of dr. Mohamad Soe-

wandhie General Hospital Surabaya (No. 021/KE/KEPK/2023) and the ethical committee of Ciputra University (No. 048/EC/KEPK-FKUC/VI/2023).

Data Collection

This study was conducted by collecting medical records of patients with antebrachial fractures who received treatment at dr. Mohamad Soewandhie General Hospital Surabaya between January 2021 and December 2022. The research and data collection took place at the hospital's medical records archive from September to October 2023. The collected data included patients' age, gender, type of fracture, occurrence of multiple fractures, infection, use of NSAIDs, history of hypertension and diabetes, smoking habits, and nutritional status measured by BMI calculation.

Data Analysis

The collected data was organized into a Microsoft Excel spreadsheet and grouped accordingly. Next, it was condensed into numerical values (represented as percentages) and analyzed using SPSS version 25.0 (IBM SPSS Statistics, New York, USA).

RESULTS

A total of 111 patients with antebrachial fractures were registered at dr. Mohamad Soewandhie

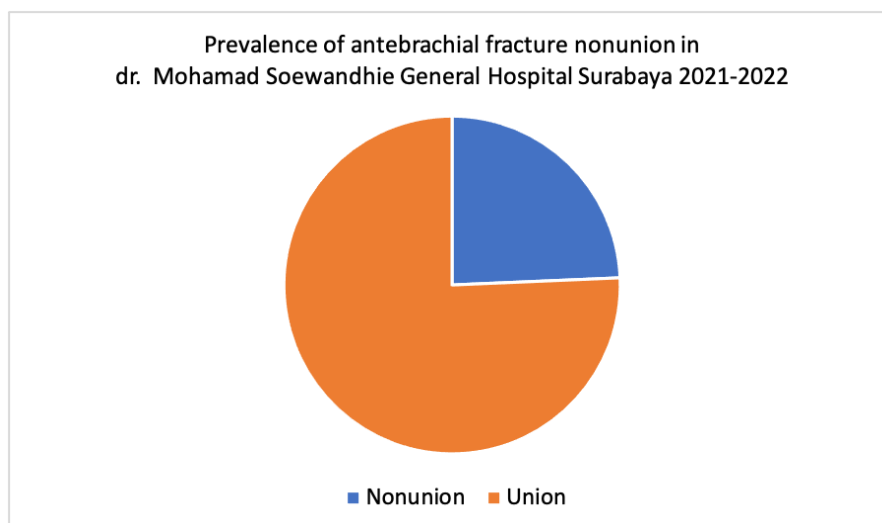


Figure 1. Prevalence of antebrachial fracture union and non-union in dr. Mohamad Soewandhie General Hospital Surabaya in 2021-2022



General Hospital Surabaya from January 2021 to 2022. Of these, 27 (24.3%) had nonunion fractures

and 84 (75.7%) had union fractures. The distribution of nonunion and union fractures can be seen in Figure 1.

Table 1. The distribution of characteristics among patients antebrachial fractures and nonunion antebrachial fractures at dr. Mohamad Soewandhie General Hospital Surabaya in 2021-2022.

	Patients with antebrachial fractures (n = 111)		Patients with nonunion antebrachial fractures (n = 27)	
	n	%	n	%
Demographic data				
Gender				
Female	41	36.9	9	33.3
Male	70	63.1	18	66.7
Age group				
Toddlers (aged 1-5 years)	4	3.6	2	7.4
Children (aged 6-11 years)	16	14.4	4	14.8
Early adolescents (aged 12-16 years)	20	18.0	4	14.8
Late teens (aged 17-25 years)	15	13.5	6	22.2
Early adulthood (aged 26-36 years)	9	8.1	1	3.7
Late adulthood (aged 36-45 years)	13	11.7	4	14.8
Early elderly (aged 45-55 years)	16	14.4	3	11.1
Late elderly (aged 55-65 years)	19	9	2	7.4
Senior (aged > 65 years)	8	7.2	1	3.7
Risk factors				
Fracture type				
Open fracture	11	9.0	2	7.4
Close fracture	101	91.9	25	92.6
Multiple fractures				
Yes	61	55.0	2	7.4
No	50	45	25	92.6
Infection				
Yes	35	31.5	6	22.2
No	76	68.5	21	77.8
Smoking habits				
Yes	9	8.1	2	7.4
No	102	91.9	25	92.6
History of long-term NSAID use				
Yes	-	-	0	0
No	-	-	0	0
History of diabetes				
Yes	-	-	0	0
No	-	-	0	0
History of hypertension				
Yes	-	-	2	7.4
No	-	-	25	92.6
Body Mass Index				
Underweight	-	-	10	37.0
Ideal	-	-	12	44.4
Overweight	-	-	5	18.5



The characteristics of patients with antebrachial fractures and nonunion antebrachial fractures at dr. Mohamad Soewandhie General Hospital Surabaya in 2021-2022 are presented in Table 1. Out of the 111 patients, 36.9% (41) were female and 63.1% (70) were male. The majority of patients belonged to the early adolescent age group (18.0%), while the lowest number was observed in toddlers (3.6%). Closed fractures were reported in 91.9% (101) of patients. Multiple fractures were found in 55.0% (61) of the antebrachial fractures. In 68.5% (76) of these cases, the fractures were not accompanied by any infections. Additionally, only a small percentage of patients (8.1% or 9) with antebrachial fractures had a history of smoking.

The majority of nonunion antebrachial fractures occurred in males (66.7%) compared to females (33.3%). Among the patients, those in their late teens (22.2%) had the highest frequency of fractures. Most of the fractures were closed (92.6%), with only a small percentage (7.4%) being multiple fractures. A large number (77.8%) of the fractures were not accompanied by infection. Only 7.4% of the patients had a history of smoking. Past medical records showed that 7.4% of the patients had a history of hypertension or were currently taking hypertension medication. The distribution of nutritional status, based on body mass index, was almost equal between underweight patients (37.0%) and those with an ideal weight (44.4%).

DISCUSSION

The present study examined 111 cases of antebrachial fractures, of which 27 (24.3%) resulted in nonunion and 84 (75.7%) achieved union. These cases were retrospectively analyzed using medical records from patients treated at dr. Mohamad Soewandhie General Hospital Surabaya during the period 2021-2022. The prevalence of nonunion was notably higher in males (66.7%) compared to females (33.3%). According to a study conducted by Boussakri H et al. involving

21 patients with nonunion fractures, male patients were more likely to experience nonunion in radius and ulna fractures compared to female patients.⁸

In this study, only 2 patients (7.4%) developed multiple nonunion antebrachial fractures. Research by Quan et al. involved studying 223 patients with nonunion fractures after limb surgery. The study found that only a small percentage (6.7%) of patients had multiple fractures, indicating that multiple fractures are not a common characteristic of nonunion fractures.⁹ Based on the research conducted by Mundi et al., open fractures are considered a significant risk factor for nonunion. The study revealed that open fractures increase the risk of nonunion by 2.8 times compared to closed fractures.¹⁰ In this study, we found that nonunion fractures were more common in closed fractures, with 25 out of 27 nonunion fractures occurring in closed fractures of the antebrachial region.

Based on a study of 27 patients with nonunion of antebrachial fracture treated at dr. Mohamad Soewandhie General Hospital Surabaya during 2021-2022, the most common age group affected was teenagers, with 6 patients (22.2%) between the ages of 17 and 25. In contrast, only 1 patient (3.7%) was in the early-adult age group (26-35 years old) and 1 patient (3.7%) was elderly (over 65 years old). The age of patients upon arrival for treatment was categorized according to the age group classification of the Indonesian Ministry of Health: toddlers, children, early adolescence, late teens, early adulthood, late adulthood, early elderly, late elderly, and seniors.⁵ The ages of the patients ranged from 2 years to 78 years. The average age was 28.33 years, and the median age was 24. Research by Mills et al. suggests that the rate of nonunion fractures decreases as age increases, with the risk of nonunion fractures of teenagers and young adults around 9%.¹¹

In the study, six out of 27 patients (22.2%) with nonunion antebrachial fractures had an infection. According to Brinker et al.,



19% of the 211 patients with nonunion of antebachial fractures had an infection.¹² Infection can disrupt normal bone healing processes leading to problems such as bone lysis, necrosis, festering, and mechanical complications, especially concerning the stability of implants in areas with loose fractures.⁸ As a result, infection is a significant biological risk factor that contributes to the development of nonunion.¹²

Smoking compromises bone health by decreasing bone mineral density. It also elevates carbon monoxide levels in the bloodstream, hindering hemoglobin's ability to bind oxygen effectively. Consequently, damaged tissues receive less oxygen, impeding their healing process.¹³ In research, among 27 patients, only two (7.4%) who experienced nonunion were found to be smokers. This observation may be attributed to the fact that the majority of the patients were young children and teenagers, making it challenging to evaluate smoking habits in the population. This is in contrast to the findings of Sanjay and Shanthappa, where only three patients aged 22-30 years were found to be smokers.¹⁴

According to a study conducted by Heath et al., patients with obesity may experience union faster. In this study, 10 patients (37%) were underweight, 12 patients (44.4%) had a healthy weight, and 5 patients (18.5%) were severely overweight. Body mass index can be used to assess nutritional status, with a low BMI indicating an increased risk of falls and fractures.¹⁵ Ensuring adequate nutrition is crucial as it impacts bone density, specifically where collagen provides the framework for cells like fibroblasts and osteoblasts. Additionally, BMP acts as precursor cells for bone formation during the healing process of fractures, contributing to callus formation.¹⁶

A previous study in Taiwan conducted by Wu et al. found that hypertension is strongly associated with an increased risk of nonunion.¹⁷ The prevalence of hypertension among patients with antebachial fracture nonunion at dr. Mohamad Soewandhie General Hospital Surabaya who received

treatment in 2021-2022 was 7.4% (2 patients). This low prevalence may be attributed to the age group in which the nonunion predominantly occurred. According to the Centers for Disease Control and Prevention's prevalence data, hypertension increases with age. The prevalence is 22.4% in adults aged 18-39, 54.5% in the group aged 40-59 years, and 74.5% in seniors aged > 60 years.¹⁸

The development of diabetes mellitus, particularly characterized by an abnormal immune response, significantly affects the healing process of bone fractures.¹⁹ Diabetes significantly impacts bone metabolism and the healing process, potentially leading to impaired healing and increased risks of complications in fractured bones, as suggested by a prior study conducted by Gortler et al.²⁰ In this study, none of our patients with antebachial fracture nonunion had a previous diagnosis of diabetes before surgery.

Additionally, a study by George et al. discovered that the utilization of non-selective NSAIDs, COX-2 inhibitors, and long-term opioid therapies (before fracture occurrence) raises the risk of nonunion.²¹ However, this research did not find any instances of long-term NSAID use in cases of nonunion antebachial fractures. It was difficult to assess the history of long-term NSAID use as it was not present in any of our patients. Therefore, a more extensive and diverse population should be included in further cohort studies to obtain conclusive results.

CONCLUSION

The incidence of antebachial nonunion fracture at dr. Mohamad Soewandhie General Hospital Surabaya from 2021 to 2022 was 24.3%. Risk factors associated with an increased incidence of nonunion included male gender, early adolescence, infection, and closed fractures. Factors with no significant impact on nonunion occurrence included the presence of multiple fractures, nutritional status, smoking history, hypertension history, diabetes history, and NSAID use.



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