Original Article

The Risk Factors of Patients with Cruris Fracture Nonunion in Dr. Mohamad Soewandhie Hospital in 2021-2022: A Case-Control Study

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ABSTRACT

Background: The crural region is highly susceptible to injury in Indonesia, with fractures being a common occurrence. If not properly treated, these fractures can lead to complications such as nonunion. To investigate the risk factors for nonunion cruris fractures, this study was conducted at Dr. Mohamad Soewandhie Hospital, examining age, gender, working status, education, trauma mechanism, and previous treatment history.

Methods: This case-control study analyzed patient records from 2021 - 2022 at Dr. Mohamad Soewandhie Hospital, comparing 12 nonunion and 24 union cruris fracture cases. Data on age, gender, work, education, trauma, and treatment history was collected between August and October 2023. Statistical analysis was performed using the Mcnemar and Wilcoxon tests, with a significance level of $p < 0.05$.

Results: A study of 149 cruris fractures found 12 nonunions, primarily affecting males aged 26-45 or 46-65. Notably, the highest nonunion rate (41.7%) was in the 12-25 age group ($p = 0.027$). Males were more affected, with 7 nonunion cases (58.3%) ($p = 0.041$). Working class patients had the highest fracture and nonunion rates (83.3%) ($p < 0.001$). High school education was most common among nonunion cases (75%) ($p = 0.374$). High-energy trauma was reported in almost all nonunion cases (91.7%) ($p < 0.001$). All nonunion patients had a history of ORIF ($p = 0.102$).

Conclusions: The study revealed that age, gender, work status, and trauma mechanism significantly influenced nonunion cruris fractures at Dr. Mohamad Soewandhie Hospital in 2021-2022. Patient education and past treatment history had no significant impact.

Keywords: Cruris fracture; Health risk; Nonunion; Risk factors

INTRODUCTION

The crural region, comprised of the medial tibia and lateral fibula bones, is the most commonly injured body part in Indonesia, accounting for 67.9% of all injuries involving the lower extremities.[1,2] Fractures are one of the potential injuries that can happen to bones, which can be cracks, crushes, or ruptures of the cortex.[3] Healthy bones, which are incredibly strong, are able to endure the impact of shocks. However, if the bones lack strength, they can easily break. Fractures are mainly caused by physical trauma, violence, and medical conditions that weaken bones, such as osteoporosis.[4]

Some factors influence bone healing, including patient age, gender, and trauma mechanism. Nonunion occurs when a fracture fails to heal within the expected timeframe and cannot heal without further intervention.[5] The crural region has one of the highest prevalences of fractures, with nonunion occurring in 14% of cases.[6] NNonunion etiology can be attributed to various factors, categorized as host and mechanical factors. Age and gender are considered host factors, while the fixation method is a mechanical factor.[7]

The patient's age is believed to have varying levels of risk for nonunion, depending on the type of bone.[8] Gender plays a signifi-

cant role in predicting nonunion, as men are at a greater risk due to their gender-associated injury patterns and types of physical activity.[9] The use of a low energy trauma mechanism was found to be highly reliable in predicting fracture union.[10] However, the high-energy trauma mechanism is a strong predictor of fracture nonunion. Conservative treatment has the highest nonunion rate compared to operative treatment. However, there was little difference between external fixation and ORIF regarding their nonunion rates.[11] There has been no prior research on the correlation between a patient's education and working status with the risk of nonunion in cruris fractures. Hence, these variables were selected to determine their impact on the occurrence of nonunion in cruris fractures.

This study aimed to identify the risk factors that contribute to cruris fracture nonunion among patients at Dr. Mohamad Soewandhie Hospital. The findings from this research can serve as a foundation for further comprehensive studies and investigations into other potential risk factors. Notably, this is the first study of its kind conducted at Dr. Mohamad Soewandhie Hospital, making it a valuable source of information on the epidemiology of cruris fracture nonunion in 2021-2022.

MATERIAL AND METHODS

Study Design and Sampling
This study employed a case-control design with an analytical and observational approach.

Participants
The subjects were patients who met the inclusion criteria, namely experiencing a cruris fracture at Dr. Mohamad Soewandhie Hospital in 2021 – 2022 and having complete medical record data. The exclusion criteria for the research subjects was patients with bone fracture complications other than nonunion.

Ethical Clearance
Ethical approval for this study was obtained from the Health Research Ethics Commission of the Faculty of Medicine of Ciputra University (No. 065/ EC/ KEPK-FKUC/ VII/2023 and the Health Research Ethics Commission of Dr. Mohamad Soewandhie Hospital (No. 019/KE/KEPK/2023).

Data Collections
Data was collected from the medical records of the patients who met the inclusion criteria. The collected data included the age, gender, working status, education, trauma mechanism, and previous treatment history of the patients. The data was collected from August to October 2023 using a total sampling technique. The study compared 12 cases of nonunion cruris fracture and 24 cases of union cruris fracture in a 1:2 ratio.

Statistical Analysis
The Mcnemar and Wilcoxon tests were used in the analysis of this comparative study, with a significance of $p < 0.05$. The Mcnemar test was conducted on the independent variables with two categories, such as gender, working status, and trauma mechanism, while the Wilcoxon test was used for the independent variables with more than two categories, including age, education, and previous treatment history. The data analysis was performed using the SPSS 26.0 software (IBM SPSS Statistics, New York, USA).

RESULTS

Out of the 149 cruris fracture cases identified, 12 were nonunion cases that met the inclusion criteria. As the study employed a 1:2 ratio, 24 cases of cruris fracture union that also fulfilled the inclusion criteria were included. The data in Table 1 displays the frequency distribution of the risk factors for nonunion cruris fractures among the patients at Dr. Mohamad Soewandhie Hospital from 2021 to 2022. Based on the analysis results, the age groups with the most cruris fracture patients were 26–45

Table 1. The frequency distribution of the risk factor data for patients with nonunion cruris fractures in Dr. Mohamad Soewandhie Hospital from 2021 to 2022.

Risk Factors	Patients with nonunion (n=12)		Patients with union (n=24)		p value
	n	%	n	%	
Age					
>65 years old	0	0	3	12.5	0.027
46 – 65 years old	3	25	9	37.5	
26 – 45 years old	4	33.3	8	33.3	
12 – 25 years old	5	41.7	3	12.5	
6 – 11 years old	0	0	1	4.2	
Gender					
Male	7	58.3	15	62.5	0,041
Female	5	41.7	9	37.5	
Working Status					
Working	10	83.3	18	75	< 0.001
Non-Working	2	16.7	6	25	
Education					
Elementary School	1	8.3	3	12.5	0.374
Middle School	1	8.3	5	20.8	
High School	9	75	14	58.3	
Bachelor's Degree	1	8.3	2	8.3	
Trauma Mechanism					
High Energy	11	91.7	21	87.5	< 0.001
Low Energy	1	8.3	3	12.5	
Previous Treatment History					
Conservative	0	0	1	4.2	0.102
External Fixation	0	0	2	8.3	
ORIF	12	100	21	87.5	

years and 46–65 years old. However, the age group with the highest proportion of nonunion patients was 12–25 years old, at 5 patients (41.7%). This suggests that age plays a significant role in the nonunion of cruris fractures, with a p-value of 0.027. Based on the distribution of gender, it is evident that the majority of cruris fracture and cruris fracture nonunion patients are male. Among the nonunion patients, 7 individuals (58.3%) were male. The gender factor was found to be statistically significant with a p-value of 0.041. The working class has the highest number of patients with both cruris and nonunion cruris fractures, with a significant proportion of 10 (83.3%) being nonunion. Working status had a highly significant value ($p < 0.001$).

The majority of patients with cruris and nonunion cruris fractures had a high school education, with 9 nonunion cases (75%). The education level did not show significant differences ($p = 0.374$). Out of all patients, the majority had encountered high-energy trauma, with 11 patients (91.7%) developing nonunion. Furthermore, the trauma mechanism has significant importance with a p-value of $p < 0.001$. All patients (100%) with a nonunion cruris fracture had a prior history of undergoing ORIF. This treatment was the most commonly used among patients. The significance value of previous treatment history was calculated to be $p = 0.102$.

DISCUSSION

In this study, the cruris fracture nonunion cases were the main focus, with cruris fracture union cases used as a control. The results showed a significance value of $p < 0.05$ for age, gender, working status, and trauma mechanism, indicating their influence on the nonunion outcome in patients at Dr. Mohamad Soewandhie Hospital. However, education and previous treatment history, with a significance value of $p > 0.05$, were found to have no impact.

This finding is consistent with the study conducted by Tian et al., which demonstrated the significant impact of age, gender, trauma mechanism, and previous treatment history.[11] However, it contrasts with the findings of Alam et al., where age was not found to be significant with a $p > 0.05$.[12] According to a study conducted by Ali et al., gender was found to have a significance value of $p < 0.05$.[13] Similarly, Rante et al. found that trauma mechanism also had a significance value of $p < 0.05$.[14] Further research by Zura et al. revealed that previous treatment history also had a significance value of $p < 0.05$.[15]

This study found that the results are consistent with previous research regarding the correlation between gender and trauma mechanism, while there are contradicting findings on age and previous treatment history. There is a lack of research on the effects of education and working status on nonunion fractures, particularly cruris fractures. These results can provide valuable insights for physicians in predicting the likelihood of nonunion in patients with cruris fractures, allowing them to prepare effective treatment methods.

CONCLUSION

Based on the conducted research, it was determined that patient education and prior treatment history did not significantly impact nonunion cruris fractures at Dr. Moha-

mad Soewandhie Hospital between 2021 and 2022. Age, gender, working status, and trauma mechanism were found to have a significant influence on the occurrence of nonunion cruris fractures. This suggests that these factors play a role in the development of this condition. Future research could investigate the potential influence of other factors, such as nutrition and medical history, on nonunion cruris fractures. This would provide a more comprehensive understanding of the various factors contributing to this condition.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

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