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Prevalence, Management Patterns, and Outcomes of Orthopedic Patients in a Disaster-Prone Area: A Retrospective Study at Datu Beru Hospital

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ABSTRACT:

Background: Orthopedic conditions represent an important component of hospital-based surgical and emergency care, particularly in disaster-prone regions where trauma burden may be influenced by geographical, environmental, transportation, and referral-related factors. Datu Beru Hospital, located in Takengon, Central Aceh, serves as an important healthcare facility for orthopedic patients in a region with challenging terrain and potential disaster vulnerability. However, local data regarding the prevalence, management patterns, and outcomes of orthopedic patients in this setting remain limited.

Objective: This study aimed to describe the prevalence, clinical characteristics, management patterns, and outcomes of orthopedic patients treated at Datu Beru Hospital, Takengon, Central Aceh, from 2023 to 2025.

Methods: This was a retrospective descriptive study using secondary data from orthopedic patients treated at Datu Beru Hospital between 2023 and 2025. A total of 766 orthopedic cases were included. Variables analyzed included year of presentation, sex, anatomical region, long-bone involvement, injury etiology, open or closed injury status, and referral status. Management patterns were described based on injury classification and referral distribution. Patient outcome was evaluated using referral status as the available outcome indicator. Data were analyzed descriptively and presented as frequencies and percentages.

Results: A total of 766 orthopedic cases were identified during the study period. The highest number of cases occurred in 2024, with 339 cases (44.3%), followed by 2025 with 277 cases (36.2%) and 2023 with 150 cases (19.6%). Most patients were male, accounting for 482 cases (62.9%). The most frequently affected anatomical region was the hand, with 206 cases (26.9%), followed by the leg with 119 cases (15.5%) and the foot with 89 cases (11.6%). Among cases with documented long-bone involvement, tibia-fibula was the most common site, with 116 cases (31.6%). Road traffic accident was the leading etiology, accounting for 394 cases (57.4% of valid cases). Closed injuries were more frequent than open injuries, representing 314 cases (76.0% of valid cases). Overall, 190 patients (24.8%) were referred, while 576 patients (75.2%) were managed without referral. The highest referral proportions were observed in spine injuries (90.9%), wrist injuries (85.7%), and

hip injuries (67.9%). These data are based on the uploaded manuscript and baseline dataset.

Conclusion: This study demonstrated that orthopedic cases at Datu Beru Hospital, Takengon, Central Aceh, were predominantly male and most frequently recorded in 2024. Hand injuries were the most common anatomical presentation, while road traffic accidents were the leading etiology. Most patients were managed without referral, suggesting that Datu Beru Hospital was able to handle the majority of orthopedic cases at the local hospital level. However, the high referral proportions among spine, wrist, and hip injuries indicate that these cases may require advanced evaluation, specialist intervention, or definitive orthopedic management. These findings provide important baseline data for strengthening orthopedic trauma services, optimizing referral pathways, and improving disaster-responsive hospital preparedness in Central Aceh.

INTRODUCTION

Indonesia is one of the most disaster-prone countries in the world due to its geographical location along the Pacific Ring of Fire and the convergence of major tectonic plates, including the Eurasian, Indo-Australian, and Pacific plates. In addition to geological hazards such as earthquakes, volcanic eruptions, and tsunamis, Indonesia also experiences a high burden of hydrometeorological disasters, including floods, landslides, extreme weather events, droughts, and forest and land fires. According to data from the Indonesian National Agency for Disaster Management (BNPB), thousands of disaster events occur annually across the country, with hydrometeorological disasters accounting for more than 90% of all recorded disasters in recent years. BNPB reported that Indonesia experienced approximately 4,727 disaster events throughout 2025, affecting more than 12 million people, with floods representing the most common disaster type nationwide.^{1,2,3}

Aceh Province is recognized as one of the regions with substantial disaster vulnerability in Indonesia due to its mountainous terrain, high rainfall intensity, extensive forest areas, and previous history of major natural disasters. According to reports from BNPB and the Aceh Disaster Management Agency (BPBA), Aceh experiences recurrent disasters annually, including floods, flash floods, landslides, extreme weather events, earthquakes, and forest and land fires (karhutla).^{3,4} During the 2021–2025 period, hydrometeorological disasters represented the dominant hazard pattern in the province, causing considerable environmental, social, and economic impacts. BPBA documented approximately 387 disaster events in Aceh during 2025, with financial losses estimated at around IDR 249.5 billion. Forest and land fires constituted a major proportion of these events, particularly in the districts of Bener Meriah and Aceh Tengah, where 46 and 41 incidents were reported, respectively. Floods, landslides, and extreme weather events were also repeatedly documented each year in these regions.^{3,4}

The vulnerability of Aceh became increasingly evident during the large-scale hydrometeorological disasters that struck Sumatra in late 2025. BNPB and international reports documented severe floods and landslides affecting Aceh and neighboring provinces, resulting in hundreds of fatalities, massive displacement, destruction of infrastructure, and disruption of healthcare services.⁵ Several access routes to Central Aceh were temporarily disconnected because of landslides, bridge collapse, and road destruction, significantly limiting evacuation and emergency response efforts. Such disaster conditions may substantially increase the incidence of traumatic injuries, particularly orthopedic trauma, either directly through crush injuries, falls, and traffic accidents during disasters or indirectly through hazardous occupational and environmental exposures in high-risk areas. Therefore, understanding the epidemiology and management patterns of orthopedic injuries in disaster-prone regions is essential to improve disaster preparedness, optimize trauma care systems, and strengthen healthcare resource allocation in vulnerable areas such as Aceh Tengah and Bener Meriah.^{3,4,5}

Orthopedic conditions constitute a major component of emergency, surgical, and hospital-based healthcare services. These conditions include traumatic and non-traumatic disorders involving bones, joints, ligaments, tendons, muscles, and surrounding soft tissues. In clinical practice, orthopedic patients may present with a wide spectrum of conditions ranging from minor soft tissue injuries to fractures, open injuries, long-bone trauma, spinal injuries, and injuries requiring specialist intervention. The burden of orthopedic cases is particularly important because these conditions may cause pain, immobility, functional limitation, long-term disability, loss of productivity, and increased healthcare utilization.^{6,7}

In disaster-prone areas, orthopedic care has particular relevance. Natural disasters, geographical barriers, difficult terrain, transportation limitations, and limited access to advanced healthcare facilities may influence the number of orthopedic cases, injury patterns, referral needs, and patient outcomes. Hospitals located in disaster-prone or geographically challenging regions must be prepared to manage both routine orthopedic cases and sudden increases in trauma burden during disasters or mass-casualty situations. Therefore, local hospital-based data are essential to understand orthopedic service demand and to support preparedness planning.^{8,9}

The prevalence and distribution of orthopedic cases may vary across regions depending on demographic structure, transportation patterns, occupational exposure, road safety behavior, local geography, and accessibility of healthcare services. Road traffic accidents are commonly recognized as a major contributor to orthopedic trauma, particularly in areas with high motorcycle use and interdistrict mobility. Other etiologies, such as falls, blunt trauma, occupational injuries, and sports-related injuries, also contribute to the overall burden of orthopedic cases. These mechanisms may produce different anatomical injury patterns and may influence the need for referral or advanced management.¹⁰

Management patterns in orthopedic patients are influenced by the anatomical site of injury, involvement of long bones, open or closed injury status, suspected instability, neurovascular involvement, and the availability of local orthopedic resources. Patients with minor or stable injuries may be managed at the initial hospital, whereas patients with spine injuries, hip injuries, complex fractures, open fractures, or injuries requiring operative fixation may require referral to a higher-level facility. Thus, referral status can be used as an important indicator of case complexity, hospital capacity, and the need for advanced orthopedic management.^{1,10}

Patient outcomes in retrospective hospital-based orthopedic studies may be assessed using several indicators, including discharge status, complications, length of stay, operative management, functional recovery, mortality, or referral status. In the present dataset, referral status was the available outcome indicator. Therefore, this study describes referral as a practical outcome reflecting whether patients could be managed locally or required transfer for further care. Although referral status does not represent a complete clinical outcome, it provides important information regarding service capacity and the pattern of orthopedic case management at the hospital level.^{6,7}

Datu Beru Hospital, Takengon, Central Aceh, serves as an important healthcare facility for the local population and surrounding areas. Its location in Central Aceh makes it relevant for evaluating orthopedic service patterns in a disaster-prone and geographically distinctive region. However, published local data regarding the prevalence, management patterns, and outcomes of orthopedic patients in this setting remain limited. Therefore, this study was conducted to describe the prevalence, clinical characteristics, management patterns, and referral-based outcomes of orthopedic patients treated at Datu Beru Hospital from 2023 to 2025.

MATERIAL AND METHODS

Study Design

This study was a retrospective descriptive study using secondary data from orthopedic patients treated at Datu Beru Hospital, Takengon, Central Aceh.

Study Setting and Period

The study was conducted at Datu Beru Hospital, Takengon, Central Aceh. Data were collected from orthopedic patient records during the period from 2023 to 2025.

Study Population and Sample

The study population consisted of all orthopedic patients treated at Datu Beru Hospital during the study period. A total of 766 orthopedic cases were included in the final analysis.

Sampling Technique

This study used a total sampling technique, in which all eligible orthopedic cases recorded during the study period were included.

Study Variables

The variables analyzed included year of presentation, sex, anatomical region, long-bone involvement, injury etiology, open or closed injury status, and referral status.

The year of presentation was categorized into 2023, 2024, and 2025. Sex was categorized as male and female. Anatomical region included hip, wrist, shoulder, spine, leg, thigh, hand, knee, arm, forearm, foot, and ankle. Long-bone involvement included femur, clavicle, tibia-fibula, radius-ulna, and humerus. Etiology was categorized as road traffic accident, fall injury, blunt injury, and sport injury. Injury type was classified as open or closed. Referral status was categorized as referred or not referred.

Definition of Management Patterns and Outcomes

Management patterns were described using available indicators, including open or closed injury classification and referral status. Referral status was used to describe whether patients were managed at Datu Beru Hospital or required transfer to another healthcare facility.

The outcome of this study was referral status. Patients categorized as not referred were considered managed without referral, while referred patients were considered to require further management at another facility.

Statistical Analysis

Data were analyzed using descriptive statistics. Categorical variables were presented as frequencies and percentages. Cross-tabulation was used to describe referral patterns according to year, anatomical region, long-bone involvement, etiology, and open or closed injury status.

RESULTS

1. Baseline Characteristics of Orthopaedic Trauma Patients

Based on year of presentation, the highest number of cases was recorded in 2024, with 339 cases (44.3%), followed by 2025 with 277 cases (36.2%), and 2023 with 150 cases (19.6%). Most patients were male, accounting for 482 cases (62.9%), while female patients accounted for 284 cases (37.1%).

The most frequently affected anatomical region was the hand, with 206 cases (26.9%), followed by the leg with 119 cases (15.5%), foot with 89 cases (11.6%), forearm with 81 cases (10.6%), and thigh with 64 cases (8.4%). Less frequently affected regions included the ankle with 10 cases (1.3%), knee with 17 cases (2.2%), and spine with 22 cases (2.9%).

Among cases with documented long-bone involvement, valid data were available for 367 cases (47.9%), while 399 cases (52.1%) had missing data for this variable. The most commonly involved long bone was the tibia-fibula, with 116 cases (31.6% of valid cases), followed by the radius-ulna with 99 cases (27.0%), femur with 76 cases (20.7%), humerus with 44 cases (12.0%), and clavicle with 32 cases (8.7%).

Etiological data were available for 686 cases (89.6%), while 80 cases (10.4%) had missing data. The most common etiology was road traffic accident, accounting for 394 cases (57.4% of valid cases), followed by shaft and blunt injuries with 189 cases (27.6%), fall injuries with 87 cases (12.7%), and sport injuries with 16 cases (2.3%).

Data regarding open or closed injury status were available for 413 cases (53.9%), while 353 cases (46.1%) had missing data. Among valid cases, closed injuries were more frequent, occurring in 314 cases (76.0%), whereas open injuries were recorded in 99 cases (24.0%).

Overall, 190 patients (24.8%) were referred, while 576 patients (75.2%) were not referred.

2. Referral Status According to Year of Presentation

The highest absolute number of referred cases was observed in 2024, with 75 referred cases, followed by 2025 with 69 referred cases, and 2023 with 46 referred cases. However, the highest proportion of referral was observed in 2023, where 46 of 150 cases (30.7%) were referred. In 2024, 75 of 339 cases (22.1%) were referred, while in 2025, 69 of 277 cases (24.9%) were referred.

Table 1. Referral Status According to Year of Presentation

Year	Referred	Not Referred	Total	Referral Proportion
2023	46	104	150	30.7%
2024	75	264	339	22.1%
2025	69	208	277	24.9%
Total	190	576	766	24.8%

3. Referral Status According to Anatomical Region

Referral patterns varied across anatomical regions. The highest referral proportion was observed in spine injuries, with 20 of 22 cases (90.9%) referred, followed by wrist injuries with 24 of 28 cases (85.7%), and hip injuries with 19 of 28 cases (67.9%). Moderate referral proportions were observed in arm injuries with 17 of 45 cases (37.8%), knee injuries with 6 of 17 cases (35.3%), and thigh injuries with 19 of 64 cases (29.7%). The lowest referral proportion was observed in hand injuries, with only 15 of 206 cases (7.3%) referred.

Table 2. Referral Status According to Anatomical Region

Anatomical Region	Referred	Not Referred	Total	Referral Proportion
Hip	19	9	28	67.9%
Wrist	24	4	28	85.7%
Shoulder	6	51	57	10.5%
Spine	20	2	22	90.9%
Leg	30	89	119	25.2%
Thigh	19	45	64	29.7%
Hand	15	191	206	7.3%
Knee	6	11	17	35.3%
Arm	17	28	45	37.8%
Forearm	18	63	81	22.2%
Foot	14	75	89	15.7%
Ankle	2	8	10	20.0%
Total	190	576	766	24.8%

4. Referral Status According to Long-Bone Involvement

Among patients with documented long-bone involvement, 118 of 367 cases (32.2%) were referred, while 249 cases (67.8%) were not referred. The highest referral proportion was observed in femur injuries, with 31 of 76 cases (40.8%) referred. This was followed by radius-ulna injuries with 39 of 99 cases (39.4%), humerus injuries with 17 of 44 cases (38.6%), and tibia-fibula injuries with 30 of 116 cases (25.9%). The lowest referral proportion was observed in clavicle injuries, with only 1 of 32 cases (3.1%) referred.

Table 3. Referral Status According to Long-Bone Involvement

Long Bone	Referred	Not Referred	Total	Referral Proportion
Femur	31	45	76	40.8%
Clavicle	1	31	32	3.1%
Tibia-fibula	30	86	116	25.9%
Radius-ulna	39	60	99	39.4%
Humerus	17	27	44	38.6%
Total	118	249	367	32.2%

5. Referral Status According to Etiology

Among cases with documented etiology, 154 of 686 cases (22.4%) were referred, while 532 cases (77.6%) were not referred. The largest number of referred cases occurred among patients with road traffic accidents, with 105 referred cases. However, the highest referral proportion was observed among sport injuries, with 9 of 16 cases (56.3%) referred. This was followed by fall injuries with 30 of 87 cases (34.5%), road traffic accidents with 105 of 394 cases (26.6%), and shaft and blunt injuries with 10 of 189 cases (5.3%).

Table 4. Referral Status According of Etiology

Etiology	Referred	Not Referred	Total	Referral Proportion
Road traffic accident	105	289	394	26.6%
Fall injuries	30	57	87	34.5%
Shaft and blunt injuries	10	179	189	5.3%
Sport injuries	9	7	16	56.3%
Total	154	532	686	22.4%

6. Referral Status According to Open or Closed Injury Status

Among cases with documented open or closed injury status, 114 of 413 cases (27.6%) were referred, while 299 cases (72.4%) were not referred. Among open injuries, 11 of 99 cases (11.1%) were referred. Among closed injuries, 103 of 314 cases (32.8%) were referred. In this dataset, closed injuries showed a higher referral proportion than open injuries.

Table 6. Referral Status According of Etiology

Injury Type	Referred	Not Referred	Total	Referral Proportion
Open	11	88	99	11.1%
Closed	103	211	314	32.8%
Total	114	299	413	27.6%

DISCUSSION

This study describes the prevalence, management patterns, and referral-based outcomes of orthopedic patients treated at Datu Beru Hospital, Takengon, Central Aceh, a healthcare facility located in a disaster-prone and geographically challenging area. A total of 766 orthopedic cases were identified during the 2023–2025 study period. The highest number of cases was recorded in 2024, most patients were male, and the hand was the most frequently affected anatomical region. Road traffic accident was the leading etiology, while most patients were managed without referral. However, injuries involving the spine, wrist, and hip showed high referral proportions, indicating that these anatomical regions may represent more complex cases requiring advanced orthopedic evaluation or treatment. These findings were derived from the available baseline and manuscript data.

The distribution of cases across the study period showed that the highest number of orthopedic patients was recorded in 2024, accounting for 44.3% of all cases. This finding may reflect a higher volume of orthopedic presentations during that year, changes in hospital utilization, improved case recording, or increased trauma incidence. However, because this study used retrospective descriptive data, the annual distribution should not be interpreted as a true incidence trend without population-based denominators, total emergency department visits, or annual hospital admission rates. Nevertheless, the finding provides useful baseline information regarding the yearly burden of orthopedic care at Datu Beru Hospital.^{11,12}

Male patients represented the majority of cases, accounting for 62.9% of all orthopedic patients. This pattern may be related to greater exposure to outdoor activities, transportation-related injury, occupational risk, and high-energy trauma mechanisms. In many orthopedic trauma settings, males are more frequently involved in road traffic accidents and work-related injuries. In the context of Central Aceh, mobility across interdistrict roads, motorcycle use, and occupational activities may contribute to this male predominance. However, this study did not include data on age, occupation, vehicle type, or activity at the time of injury, so further analysis is required to explain this pattern more precisely.

The most common anatomical region involved was the hand, followed by the leg, foot, forearm, and thigh. The predominance of hand injuries may be explained by the role of the hand as a protective structure during falls, collisions, and occupational trauma. The hand is also frequently exposed during daily activities and manual work. Although hand injuries were the most prevalent, their referral proportion was relatively low. This suggests that many hand injuries in this dataset may have been manageable at Datu Beru Hospital without the need for transfer. However, the absence of detailed injury classification, such as tendon injury, neurovascular involvement, fracture displacement, or soft tissue severity, limits further interpretation.^{13,14}

Road traffic accident was the leading etiology, accounting for more than half of valid cases. This finding indicates that transportation-related injuries remain a major contributor to orthopedic burden in this region. Road traffic accidents are often associated with high-energy mechanisms and may cause fractures, soft tissue injuries, long-bone involvement, and multiple injuries. In disaster-prone or geographically challenging areas, road traffic injuries may have greater implications because access to definitive care can be affected by distance, terrain, weather, road conditions, and referral transport availability. Therefore, road safety measures and hospital preparedness for traffic-related trauma are important components of orthopedic service planning.

Long-bone involvement was documented in 367 cases, with tibia-fibula being the most commonly affected long bone, followed by radius-ulna and femur. The high frequency of tibia-fibula involvement may be related to road traffic accidents, especially among motorcycle users, where the lower extremities are highly exposed to direct impact. Long-bone injuries are clinically important because they may require immobilization, radiological evaluation, pain control, neurovascular assessment, and in selected cases operative fixation. Among long-bone injuries, femur cases showed the highest referral proportion, which is

clinically reasonable because femoral fractures may be associated with significant pain, blood loss, immobility, and the need for specialist orthopedic management.¹⁰

Management patterns in this study were described using available variables, particularly open or closed injury status and referral status. Among cases with documented injury type, closed injuries were more common than open injuries. Closed injuries accounted for 76.0% of valid cases, while open injuries accounted for 24.0%. In general, open orthopedic injuries require urgent attention because of the risk of contamination, infection, soft tissue compromise, and the need for debridement or operative management. However, in this dataset, closed injuries showed a higher referral proportion than open injuries. This finding should be interpreted cautiously because nearly half of the cases had missing data regarding open or closed status, and the severity of each injury was not available.^{15,16}

Referral status was used as the available outcome indicator in this study. Overall, 24.8% of patients were referred, while 75.2% were not referred. This suggests that most orthopedic patients could be managed at Datu Beru Hospital without transfer to another facility. In a disaster-prone area, this finding is important because local capacity to manage common orthopedic conditions may reduce delays in care, decrease referral burden, and improve continuity of treatment. However, referral remains essential for cases requiring advanced imaging, specialist orthopedic procedures, complex fracture management, or multidisciplinary care.

The highest referral proportion was observed in spine injuries, followed by wrist and hip injuries. Spine injuries had a referral proportion of 90.9%, indicating that most patients with spinal trauma required transfer for further evaluation or management. This is clinically appropriate because spinal injuries may be associated with instability, neurological deficit, spinal cord injury, and the need for advanced imaging or specialist intervention. Hip injuries also showed a high referral proportion, likely reflecting the complexity of injuries such as femoral neck fracture, intertrochanteric fracture, acetabular injury, pelvic involvement, or dislocation. Wrist injuries also had a high referral proportion, possibly due to fracture displacement, intra-articular involvement, instability, or the need for reduction and fixation.^{11,17}

In the context of a disaster-prone area, the findings have practical implications for hospital preparedness. Orthopedic injuries are common in disaster and mass-casualty situations, especially fractures, soft tissue injuries, and limb trauma. A hospital serving a disaster-prone region must be able to provide rapid triage, early stabilization, pain control, wound management, fracture immobilization, and timely referral when needed. The high burden of road traffic accident-related injuries and the high referral proportion for selected anatomical regions suggest that Datu Beru Hospital may benefit from strengthening orthopedic triage protocols, emergency fracture stabilization resources, referral communication systems, and coordination with higher-level orthopedic centers.

This study also highlights the need for a more structured orthopedic trauma registry. Several clinically important variables were not available in the dataset, including age, occupation, mechanism details, fracture classification, injury severity, neurovascular status, operative management, length of hospital stay, complications, discharge status, mortality, and functional outcome. Because referral status was the only available outcome indicator, this study could not evaluate broader clinical outcomes such as recovery, complications, reoperation, disability, or mortality. Future studies should include these variables to provide a more comprehensive assessment of management patterns and outcomes.

The main strength of this study is that it provides local hospital-based baseline data on orthopedic patients in Central Aceh, particularly in a disaster-prone area where orthopedic preparedness is highly relevant. However, this study has several limitations. First, the retrospective descriptive design limits causal interpretation. Second, missing data were present in several variables, especially long-bone involvement and open or closed injury status. Third, management patterns could only be inferred from available variables and did not include detailed treatment modalities such as conservative treatment, surgery, immobilization, wound debridement, or rehabilitation. Fourth, referral status was used as a proxy outcome and does not fully represent clinical outcome.

Despite these limitations, this study provides an important overview of orthopedic patient prevalence, management distribution, and referral-based outcomes at Datu Beru Hospital. The findings may support hospital planning, resource allocation, orthopedic service strengthening, and disaster-responsive trauma care development in Central Aceh. Further prospective studies with more complete clinical variables are needed to identify predictors of referral, evaluate treatment outcomes, and improve orthopedic care pathways in disaster-prone settings.^{11,14}

CONCLUSION

This study showed that orthopedic patients treated at Datu Beru Hospital, Takengon, Central Aceh, were predominantly male, with the highest number of cases recorded in 2024. The hand was the most frequently affected anatomical region, while road traffic accident was the leading etiology. Most patients were managed without referral, indicating that a substantial proportion of orthopedic cases could be handled at the hospital level. However, high referral proportions among spine, wrist, and hip injuries suggest that these cases may require advanced evaluation, specialist care, or definitive orthopedic management.

As Datu Beru Hospital is located in a disaster-prone area, these findings provide important baseline data for strengthening orthopedic service preparedness, improving trauma triage, optimizing referral pathways, and supporting disaster-responsive hospital planning in Central Aceh.

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