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Fixed-Wing Aeromedical Evacuation of a Child With a Subtrochanteric Femur Fracture Immobilized Using Static Splints in a Resource-Limited Setting: A Case Report

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Abstract

Background: Subtrochanteric femur fractures are serious injuries associated with significant morbidity and, occasionally, mortality. Appropriate pre-hospital immobilization is essential to prevent secondary injury during patient transport. In resource-limited, geographically isolated settings, the success of immobilization depends not on device sophistication but on the correct application of available materials.

Case illustration: A 7-year-old female sustained a subtrochanteric right femur fracture following a high-energy motor vehicle accident on Natuna Island, Indonesia. The patient underwent aeromedical evacuation via military fixed-wing aircraft. The injured limb was immobilized using static rigid splints spanning the hip and knee joints, with the patient secured supine on a semi-rigid mattress using multi-point bandage fixation. Following an approximately two-hour flight, post-arrival radiographs showed no obvious interval fracture displacement, although comparison was limited by differences in radiographic positioning between the initial and post-evacuation images. The patient remained stable with no worsening pain, and subsequently underwent successful open reduction and internal fixation.

Discussion: Fracture stability was maintained through immobilization spanning both the hip and knee joints, which neutralizes the deforming muscular forces acting on the proximal femoral fragment. Four technical elements were critical: splint length sufficient to bridge both joints, bilateral medial and lateral placement, padding at bony prominences, and five-point bandage fixation. Traction splinting was intentionally avoided; static splinting was instead selected based on the fracture location, available equipment, and operational constraints of fixed-wing aeromedical transport.

Conclusion: In this case, properly applied static rigid splinting appeared to maintain fracture stability throughout fixed-wing aeromedical evacuation in a resource-limited setting, suggesting that correct execution of technique, rather than sophistication of materials, may be an important determinant of safe transport outcomes.

Keywords: aeromedical evacuation, subtrochanteric femur fracture, pediatric, static splinting, resource-limited setting, case report

Background

Subtrochanteric femur fractures, defined as fractures occurring within five centimeters distal to the lesser trochanter, account for approximately 10–15% of all proximal femur fractures, with an estimated incidence of 15–20 per 100,000 individuals annually.[1] While more commonly observed in older adults following low-energy falls, these fractures also occur in younger patients following high-energy trauma such as motor vehicle accidents.[2] In pediatric patients, high-energy subtrochanteric fractures carry significant hemorrhagic risk, given the location at the transition zone between cancellous bone in trochanteric region and predominant cortical bone, leading to a more vulnerable blood supply.[3] Pre-hospital immobilization is a cornerstone of femoral fracture management, serving to minimize pain, reduce ongoing hemorrhage, prevent neurovascular injury, and limit fracture displacement during transport.[4] The adequacy of immobilization determines whether the fracture remains mechanically stable throughout the transfer, a factor of particular importance when transport involves the additional physiological stressors of the aeromedical environment, including vibration, gravitational accelerations, and limited access for clinical reassessment.[5]

In resource-limited settings, where specialized devices such as traction splints or vacuum splints may be unavailable, clinicians must rely on static rigid splinting using basic materials. The effectiveness of this approach, however, is dependent on the proper technique of its application: appropriate splint length, correct joint positioning, adequate padding, and multi-point fixation are each critical to achieving fracture stability.[6] A well-applied static splint can reliably neutralize the deforming muscular forces acting on a proximal femur fracture and maintain reduction throughout transport. The Indonesian archipelago presents unique challenges for emergency trauma care, particularly on its outermost islands. Natuna Regency, located in the northern South China Sea, is a strategic territory with limited healthcare infrastructure and no orthopedic care specialist available. Aeromedical evacuation using any aircraft available represents the primary means of transferring critically injured patients to definitive care. Published documentation of the technical approach to pediatric femoral fracture immobilization in this context remains scarce.[7]

This case report describes the successful aeromedical evacuation of a 7-year-old with a subtrochanteric femur fracture from Natuna Island, despite a two-hour fixed-wing military aircraft flight. The biomechanical principles underlying the technique are discussed, with the aim of providing practical, reproducible guidance for clinicians working in similarly resource-limited environments. Given the scarcity of published accounts detailing the technical execution of pediatric femoral fracture immobilization in an island, military aeromedical context, this report aims to contribute a reproducible technical reference for clinicians facing comparable geographic and resource constraints.

Case illustration

A 7-year-old female presented to the aviation healthcare facility at Raden Sadjad Air Force Base, Natuna Island, for aeromedical evacuation fitness assessment and pre-flight preparation. She had been initially evaluated at the local government hospital in Natuna Regency on 29 April 2023, following a high-energy motor vehicle accident, where plain radiographs were obtained and basic immobilization was applied. Given the complete absence of orthopedic surgical capability on the island, referral to a secondary hospital was indicated. As the nearest orthopedic-capable facility was located over 550 kilometers away across open ocean — inaccessible by ground or sea transport within a clinically acceptable timeframe — the patient was scheduled for aeromedical evacuation via military fixed-wing aircraft, CN-295.

The patient, who weighed 30 kg, was assessed at the aviation medicine clinic on 4 May 2023, five days after the injury, and underwent aeromedical evacuation the following day. At initial presentation in our clinic, vital signs were within normal limits for age (heart rate 90 beats/minute, respiratory rate 20 breaths/minute, oxygen saturation 99% on room air, temperature 36.6°C), with a Glasgow Coma Scale of 15 (fully conscious) and a self-reported pain score of 4–5 out of 10. Primary survey was clear; secondary survey identified swelling and hematoma over the right femoral region, with localized tenderness and painful restriction of hip and knee range of motion. Neurovascular examination of the distal right limb was intact: dorsalis pedis and posterior tibial pulses were palpable, with preserved sensation and active toe movement. No open wounds were identified. Radiographs obtained at the local hospital demonstrated a wedge spiral subtrochanteric right femur fracture, classified as AO/OTA type 32-B1.1 (Figure 1); this classification was confirmed by an orthopedic surgeon consulted independently of the referral hospital, and formal radiology expertise reporting described the injury as a complete fracture of the proximal right femur.

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Figure 1. Initial plain radiographs of the right femur. Anteroposterior view (left) and lateral view (right) demonstrating a wedge spiral subtrochanteric fracture, with posterolateral cortical comminution.

Analgesia (intravenous paracetamol 300 mg) had already been administered at the local government hospital prior to referral. We assessed the patient as fit for aeromedical evacuation following pre-flight preparation. No additional intravenous fluid or medication was given at the aviation medicine clinic; the clinical focus was directed entirely toward optimizing fracture immobilization for the physiological demands of fixed-wing flight.

Pre-existing basic splinting from the local hospital was modified to be prepared for aeromedical transport. Three rigid wooden splints of appropriate length (measured from the inguinal crease to five centimeters below the plantar surface of the heel) were positioned along the posterior, medial and lateral aspects of the right lower extremity. This configuration was chosen specifically to restrict movement at both the hip and knee joints simultaneously, neutralizing the deforming muscular forces acting on the proximal fracture fragment. Wooden splints were covered with several layers of cotton bandage for padding and skin protection, minimizing skin friction. Cotton padding was applied at bony prominences, including the greater trochanter, lateral femoral condyle, fibular head, and malleoli. The splints were secured with cotton bandages at five fixation points: proximal thigh, mid-thigh, supracondylar region, proximal leg, and ankle. The patient was then positioned supine on a semi-rigid mattress, with body straps applied across the chest, pelvis, and lower limbs to provide supplementary restraint against movement during transport (Figure 2).

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Figure 2. Static rigid splinting applied to the right lower extremity. Wooden splints of appropriate length span from the inguinal crease to below the heel, with bandage fixation at five points, restricting movement at both the hip and knee joints. Patient was positioned on semi rigid mattress.

The patient was transported aboard a CN-295 military fixed-wing aircraft, and the flight lasted for about 2 hours. Continuous physiological monitoring was not available during the flight given the operational constraints of the aircraft cabin; the patient was observed intermittently by the accompanying crew, reported no worsening discomfort, and no in-flight complications were apparent. Formal vital sign and neurovascular reassessment resumed upon arrival at the referral hospital. Upon arrival at the referral hospital, repeat radiographs of the right femur showed no obvious interval fracture displacement compared with the initial imaging; however, this comparison was limited by differences in radiographic positioning between the two examinations (Figure 3).

Figure 3. Post-evacuation radiograph of the right proximal femur upon arrival at the referral hospital, showing no obvious interval fracture displacement compared with initial imaging; comparison was limited by differences in radiographic positioning between the two examinations.

The patient was admitted and, following pre-operative workup, underwent open reduction and internal fixation. Formal radiology expert reporting of the early postoperative radiograph (8 May 2023) described correctly

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positioned internal fixation (plate and screws) spanning the proximal to mid right femoral shaft, with a visible fracture line consistent with the early postoperative interval and satisfactory alignment (Figure 4). Follow-up documented radiographic union of the fracture on 11 June 2024, and the implant was subsequently removed on 25 June 2024, with a satisfactory clinical and radiographic outcome.

Figure 4. Early postoperative radiograph of the right femur (8 May 2023) following open reduction and internal fixation. Formal radiology expert reporting described correctly positioned internal fixation (plate and screws) spanning the proximal to mid femoral shaft, with a fracture line still visible, consistent with the early postoperative interval, and satisfactory alignment.

Discussion

This case demonstrates that a pediatric subtrochanteric femur fracture can be safely managed through an aeromedical evacuation of over 550 kilometers without fracture displacement, using static rigid splinting alone. Three domains merit discussion: the biomechanical basis of fracture stability through static splinting, the technical determinants of an effective application, and the aeromedical considerations specific to this transport environment.

Biomechanical Basis of Fracture Stability Through Static Splinting. Subtrochanteric femur fractures are subject to powerful deforming muscular forces that act continuously on the fracture fragments. The proximal fragment is pulled into flexion and external rotation by the iliopsoas, into abduction by the abductor muscle group, and into further external rotation by the short external rotators — while the distal fragment is drawn proximally by the quadriceps, hamstrings, and adductors.[8] Without effective immobilization, these unopposed forces produce progressive fracture displacement, increase soft tissue damage, and elevate the risk of secondary vascular injury.

Static rigid splinting counteracts these deforming forces through external mechanical constraint. When splints of sufficient length are applied to span both the hip and the knee joint simultaneously, the lever arm of the entire lower extremity is effectively immobilized as a single rigid unit. This eliminates the independent action of muscles crossing the fracture site and prevents further displacement.[9] The fracture is not reduced in the anatomical sense; rather, it is held in its current position with displacement prevented from progressing. The result is a mechanically stable construct that can tolerate the vibration and brief gravitational disturbances of aeromedical transport without loss of fracture position, as confirmed radiographically in this case.

This principle is supported by the AO Foundation's framework for pre-hospital management of femoral fractures, which emphasizes whole leg immobilization as the fundamental requirement for safe fracture stabilization during transport (Figure 5).[10]

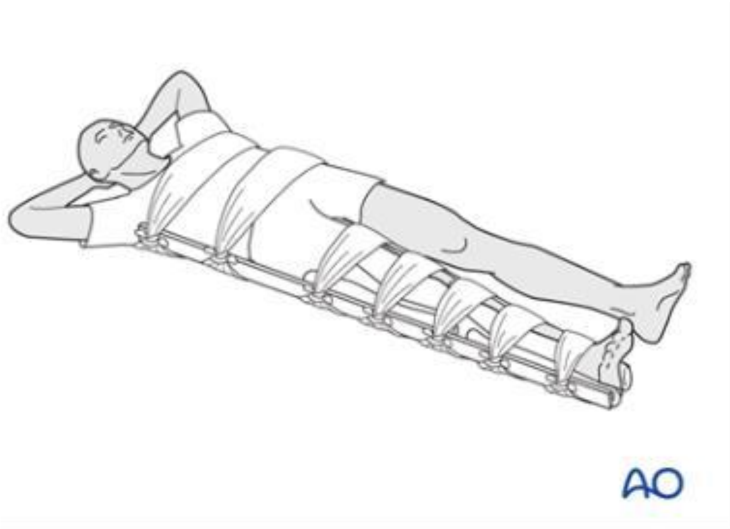

Figure 5. Illustration of static splinting for femoral fracture management, demonstrating biarticular immobilization spanning the hip and knee joints with multi-point fixation. Adapted from AO Surgery Reference (surgeryreference.aofoundation.org).[10]

Technical Determinants of Effective Static Splinting. The outcome in this case was attributable to the standard procedure of splinting, which incorporated four key elements. First, splint length was measured to span from the inguinal crease extended into flank to below the plantar surface of the heel, ensuring that both the hip and knee joints were included in the immobilized segment which is consistent with the biarticular principle.[11,12] Undersized splints that terminate proximal to the knee are a common error that leaves the distal deforming forces unconstrained.
Second, bilateral splint placement at medial and lateral aspect provided symmetric constraint against both varus and valgus angulation, as well as rotational forces.[13] A single-sided splint, while simpler to apply, creates an asymmetric construct that is vulnerable to angular deformity under load.
Third, padding at bony prominences (greater trochanter, lateral femoral condyle, fibular head, and malleoli) distributed pressure evenly across the contact surfaces,[14] preventing pressure injury during the transport and ensuring the patient's comfort and cooperation with the immobilization.
Fourth, five-point bandage fixation at the proximal thigh, mid-thigh, supracondylar region, proximal leg, and ankle, created a distributed securing system that prevented migration of the splints during transport without creating focal pressure points.[14]

The use of a semi-rigid mattress as a supplementary dorsal platform further constrained posterior displacement and distributed vibration-induced forces across the entire posterior surface of the limb, functioning analogously to a long posterior splint.
Together, these elements produced a mechanically sound construct that maintained fracture stability across a two-hour fixed-wing flight. This single case suggests that properly applied basic materials and technique may be sufficient to maintain fracture stability during aeromedical transport.

Aeromedical Considerations. Fixed-wing aeromedical evacuation introduces physiological stressors not present in ground transport, including vibration, reduced partial pressure of oxygen at cabin altitude, and gravitational accelerations during takeoff, turbulence, and landing.[15] For fracture patients, the most clinically relevant factors are continuous vibration and brief inertial forces during flight maneuvers, which act on the fracture site through the distal limb segment. A properly applied static splint effectively eliminates this distal lever arm, preventing motion at the fracture site.

Traction splinting was not applied in this case. This decision was based on the fracture location and the equipment available at the point of care, together with commonly cited concerns regarding the behavior of traction systems under the vibration, turbulence, and gravitational accelerations encountered during fixed-wing flight.[5] Static splinting was therefore selected as the technique considered most appropriate for this patient and this transport environment, consistent with general aeromedical transport principles.[15]

Relevance for Resource-Limited and Remote-Area Practice. The central lesson of this case is not that static splinting is a substitute for superior options, but that properly executed technique is the primary determinant of fracture stability during transport, regardless of the resources available. This principle has broad applicability across resource-limited settings, whether military, civilian, disaster response, or community health contexts. Indonesia's archipelagic geography, with over 17,000 islands and dozens of inhabited outermost territories served by facilities of comparable capacity, makes the reproducibility of this technique particularly relevant. Neighboring nations with isolated island communities or highland areas face analogous constraints. Training in correct static splinting technique including biarticular coverage, bilateral placement, systematic padding, and multi-point fixation, should be a core competency for all clinicians practicing in remote and resource-limited environments.[13]

Limitations

This report describes a single case without a comparison group, and conclusions regarding the general safety and reliability of static splinting during aeromedical evacuation should be interpreted with appropriate caution. Fracture stability during transport was assessed indirectly, through pre- and post-evacuation radiographs and clinical observation, rather than through continuous or objective measurement of fracture-site movement in flight. Continuous physiological monitoring during the flight itself was not available due to operational constraints of the aircraft cabin, and formal reassessment resumed only upon arrival at the referral hospital. Comparison of pre- and post-evacuation radiographs was further limited by differences in patient positioning between the two examinations. These factors limit the strength of the conclusions that can be drawn from this single case.

Conclusion

This single case suggests that a pediatric subtrochanteric femur fracture may be transported via fixed-wing aeromedical evacuation without obvious fracture displacement, using static rigid splinting in a resource-limited setting. The favorable outcome appeared attributable to the principle used in static splinting rather than to the sophistication of the materials used. As this report describes a single patient without a comparison group, these observations should be interpreted with caution. Clinicians working in remote areas and disaster response settings may benefit from familiarity with the biomechanical principles and technical details of static splinting, as correct execution of this basic technique may help maintain fracture stability during aeromedical transport.

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None.

Author Contributions

GA was the treating physician responsible for clinical assessment, pre-flight preparation, and aeromedical evacuation planning. GA conceived the report, performed the literature review, drafted the manuscript, and approved the final version for submission.

Informed Consent

Written informed consent was obtained from the patient's parent for publication of this case report, including the accompanying clinical images and radiographs. Identifying details have been omitted or anonymized to the extent possible while preserving the clinical and educational value of the report.

Conflict of Interest

The author declares no conflict of interest.

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References

1. Garrison I, Domingue G, Honeycutt MW. Subtrochanteric femur fractures: current review of management. EFORT Open Rev. 2021;6(8):702-709. [https://doi.org/10.1302/2058-5241.6.200048]

2. Seeley M, Caird MS, Li Y. Subtrochanteric femur fractures in children. In: Kocher M, editor. Pediatric Femur Fractures: A Practical Guide to Evaluation

and Management. Boston, MA: Springer US; 2016. p. 99-115.

3. Panteli M, Mauffrey C, Giannoudis PV. Subtrochanteric fractures: issues and challenges. Injury. 2017;48(10):2023-6. [https://doi.org/10.1016/j.injury.2017.09.001]

4. Mitchnik IY, Talmy T, Radomislensky I, et al. Femur fractures and hemorrhagic shock: Implications for point of injury treatment. Injury. 2022;53(10):3416-22. [https://doi.org/10.1016/j.injury.2022.08.053]

5. Rainford DJ, Gradwell DP, editors. Ernsting's Aviation and Space Medicine. 5th ed. Boca Raton: CRC Press; 2016. p. 646.

6. Abarbanell NR. Prehospital midthigh trauma and traction splint use: recommendations for treatment protocols. Am J Emerg Med. 2001;19(2):137-140. [https://doi.org/10.1053/ajem.2001.21302]

7. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia 2022 [Internet]. Jakarta: Kementerian Kesehatan RI; 2023 [cited 2026 May 12]. Available from: https://www.kemkes.go.id/

8. Egol KA, Koval KJ, Zuckerman JD. Handbook of Fractures. 5th ed. Philadelphia, PA: Wolters Kluwer; 2015.

9. Irajpour A, Kaji NS, Nazari F, Azizkhani R, Zadeh AH. A comparison between the effects of simple and traction splints on pain intensity in patients with femur fractures. Iranian Journal of Nursing and Midwifery Research. 2012;17(7):530-3. PMID: 23922601

10. AO Foundation. AO Surgery Reference: Nonoperative treatment with limited resources — femoral shaft fractures [Internet]. Available from: https://surgeryreference.aofoundation.org [cited 2026 May 12].

11. Butler BA, Lawton CD, Christian R, Harold RE, Gourineni P, Sarwark JF. Long leg splinting for pediatric femur fractures. Journal of orthopaedics. 2018 Dec 1;15(4):971-3. [https://doi.org/10.1016/j.jor.2018.08.043]

12. Mathes C, Mansy L, Berglund L, Grote C. Preoperative Immobilization for Pediatric Femur Fractures. J Pediatr Soc North Am. 2025 Oct 1;13:100278. [https://doi.org/10.1016/j.jposna.2025.100278]

13. Lyng A, Fisher J, Tollefsen A, et al. Prehospital trauma compendium: management of suspected femoral shaft fractures — a position statement and resource document of NAEMSP. Prehosp Emerg Care. 2025;29(2):1-14. [https://doi.org/10.1080/10903127.2025.2493846]

14. Boyd AS, Benjamin HJ, Asplund C. Principles of Casting and Splinting. Am Fam Physician. 2009;79(1):16-22. PMID: 19145960

15. MacDonald RD, Mottram AR. Transport considerations for the critically ill patient. In: Tintinalli JE, Ma O, Yealy DM, et al., editors. Tintinalli's Emergency Medicine: A Comprehensive Study Guide. 9th ed. New York: McGraw-Hill; 2020. p. 118-126.