

Physiotherapy Management After Flexible Intramedullary Fixation in Tibia-Fibula Fracture With TBI: A Case Report

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Abstract

Background: Open tibia-fibula fractures caused by high-energy trauma may coexist with traumatic brain injury (TBI), creating concurrent orthopedic and neurologic rehabilitation challenges. Detailed physiotherapy reports in this clinical context remain limited.

Objective: To describe the clinical course and early outpatient physiotherapy management of a young adult with an open middle-third tibia-fibula fracture and concomitant TBI after a traffic accident.

Methods: This single-patient case report followed the CARE framework. An 18-year-old man underwent staged orthopedic and neurosurgical procedures before four outpatient physiotherapy visits from 12 to 22 September 2025. Outcomes included pain, ankle range of motion, muscle strength, limb measurements, the Lower Extremity Functional Scale (LEFS), and anxiety. Treatment included education, infrared, ankle pump exercise, passive and active range-of-motion exercise, resisted exercise, balance training, and non-weight-bearing gait training with crutches.

Results: Movement pain decreased from 2 to 1. Ankle dorsiflexion-plantarflexion changed from S 10°-0°-10° to S 40°-0°-21°, and inversion-eversion changed from T 18°-0°-30° to T 43°-0°-35°. Hip and ankle muscle strength remained 4/5. Anxiety decreased from 21 to 17. LEFS was 22/80 at baseline and was not repeated. By the fourth visit, the patient progressed from two crutches toward one crutch, although the criteria for progression were not documented.

Conclusion: The four-visit rehabilitation period was accompanied by descriptive improvements in movement pain, ankle range of motion, anxiety, and observed mobility. These changes cannot be attributed specifically to physiotherapy or generalized beyond this single case.

Keywords

Physical Therapy Modalities; Tibial Fractures; Fibula; Craniocerebral Trauma; Case Reports

Introduction

Open tibia-fibula fractures are severe musculoskeletal injuries frequently associated with high-energy trauma, including road traffic accidents. The subcutaneous position of the tibia makes it particularly vulnerable to open injury and extensive soft-tissue damage, often requiring staged management that may include debridement, temporary external fixation, soft-tissue optimization, and later conversion to definitive internal fixation.^{1,2} Delays in the management of open fractures, including delayed antibiotic administration, have also been associated with a higher risk of postoperative infection.³

High-energy trauma may produce multiple clinically important injuries in the same patient. Traumatic brain injury may coexist with long-bone fracture and can complicate the clinical course through impaired consciousness, prolonged immobilization, and competing priorities for surgical and rehabilitative care.^{4,5} Experimental and clinical literature has also described possible interactions between TBI and bone healing through neuroendocrine and neural pathways.⁶ These mechanisms represent external evidence and should not be interpreted as evidence of altered bone healing in an individual patient unless serial radiographic or biological outcomes are available.

For severe open fractures, external fixation is commonly used as temporary stabilization while soft-tissue conditions are addressed. The timing of conversion to internal fixation is influenced by injury severity, soft-tissue condition, infection status, and other clinical considerations.^{2,5} Negative-pressure wound therapy has also been used in complex wounds, although its benefit in fracture-related infection remains inconsistent across studies.⁷ These factors are clinically relevant and may influence physiotherapy planning. In patients with external fixation, rehabilitation and weight-bearing progression are reported to vary according to fracture location, fixation stability, and the evolving clinical status (including wound/soft-tissue considerations). Therefore, physiotherapy selection and progression should be individualized and coordinated with the surgical plan.⁸

Physiotherapy after tibial fracture may include pain management, range-of-motion exercise, strengthening, gait training, and functional retraining.^{9,10} Nevertheless, outpatient physical therapy use after tibial fracture is variable.¹¹ Existing reports have described rehabilitation after tibia-fibula fracture and after complex traumatic injury, but detailed descriptions of rehabilitation planning in a patient with an open middle-third tibia-fibula fracture, concomitant TBI, repeated surgery, external-fixator complications, soft-tissue management, and subsequent flexible intramedullary internal fixation remain limited.^{10,12}

The present case was selected because it illustrates an open middle-third tibia-fibula fracture accompanied by TBI, multiple surgical procedures, fixation complications, and the need to adapt physiotherapy to concurrent orthopedic and neurologic considerations. The clinical contribution is not an assertion of treatment efficacy, but a detailed description of how physiotherapy was delivered during a short early outpatient rehabilitation period in a patient with multiple treatment constraints. The report aimed to describe the patient's clinical and surgical course, the early outpatient physiotherapy program, and the changes observed in pain, ankle range of motion, muscle strength, anxiety, and functional mobility across four physiotherapy visits.

Methods

This study was prepared as a single-patient case report using the CARE reporting framework.¹³ The report describes the patient's clinical course and the physiotherapy assessment and management delivered during four outpatient visits. The patient was an 18-year-old male student who sustained a traffic accident on 13 June 2025. Available radiographic records dated 13 June and 31 July 2025 described a comminuted fracture involving the middle third of the right tibia and fibula. The patient also had a right occipital epidural hematoma and TBI, with a Glasgow Coma Scale score of 10 at the acute stage. Specific neurologic findings during the outpatient physiotherapy assessment were not evaluated or documented.

The orthopedic course included debridement and external fixation on 14 June 2025, revision of the external fixation after implant failure on 19 June 2025, negative-pressure wound therapy for a right crural soft-tissue defect on 15 July 2025, and conversion to flexible intramedullary internal fixation on 31 July 2025. Neurosurgical management included craniotomy for hematoma evacuation on 21 June 2025 and later cranioplasty on 3 October 2025. The available record did not provide information on whether the October procedure altered rehabilitation after the four physiotherapy visits.

The case was selected because it represented an open middle-third tibia-fibula fracture accompanied by TBI, repeated surgical procedures, fixation complications, and the need to adapt physiotherapy to orthopedic and neurologic constraints. Diagnostic information available for the report included the initial orthopedic diagnosis, TBI with epidural hematoma, GCS 10 at the acute stage, operative history, and radiographic descriptions. At the first outpatient physiotherapy assessment, the patient had right lower-limb muscle atrophy, a still-moist incision with slight fluid leakage, a tendency toward foot eversion, and non-weight-bearing ambulation using two crutches. A structured outpatient neurologic examination related to the previous TBI was not available.

Movement pain was assessed using the Visual Analogue Scale. Ankle range of motion was measured with a goniometer. Manual Muscle Testing was used to assess hip flexor, extensor, abductor, and adductor strength and ankle plantarflexor and dorsiflexor strength. Limb measurements were obtained with a measuring tape. Functional status was assessed with the Lower Extremity Functional Scale, and anxiety was assessed with the Hamilton Rating Scale for Anxiety.¹⁴ Hip and knee range-of-motion data were not available and were therefore not reported as outcomes.

Thigh circumference was measured 15 cm above the patella, calf circumference 10 cm below the patella, and limb length from the anterior superior iliac spine to the medial malleolus. All reported measurements were performed by the same physiotherapist using the available measurement procedures across visits. No inferential statistical analysis was performed because the report describes one patient. Changes are presented descriptively.

The outpatient program was delivered at Dr. Tadjuddin Chalid General Hospital, Makassar, between 12 and 22 September 2025. Documented intervention components were education regarding wound care and loading, infrared, ankle pump exercise, passive and active range-of-motion exercise, active resisted exercise, single-leg stance, transfer practice from lying to sitting to standing with crutches, and non-weight-bearing walking exercise with crutches. The treatment rationale was to address pain, restricted ankle mobility, muscle weakness, balance limitations, and impaired gait while considering the orthopedic and neurologic history.

Available treatment parameters were as follows: infrared was applied for 10 minutes at a distance of 30 cm using 100 W; ankle pump exercise was performed for 3 to 4 repetitions; passive and active range-of-motion exercise for 8 repetitions across 3 to 4 sets; active resisted exercise for 8 repetitions across 3 to 4 sets; single-leg stance for 3 to 4 repetitions; transfer practice from lying to sitting to standing with crutches for 3 to 4 repetitions; and non-weight-bearing walking exercise with crutches for 3 to 4 repetitions. Session duration, home-program frequency, resistance intensity, and explicit criteria for increasing, maintaining, or stopping exercise were not available and were not inferred.

At the first visit, the patient was documented as non-weight-bearing on the right lower limb and used two crutches. By the fourth visit, the record documented progression toward one crutch. The source of the weight-bearing prescription and the clinical criteria supporting this progression were not available. Therefore, the progression is reported descriptively without attributing it to a documented loading protocol.¹⁵

Written informed consent for the use of clinical information and publication was reported as having been obtained from the patient with anonymization. The available source documents did not provide the ethics committee name, ethical approval number, waiver number, or institutional policy establishing that ethical approval was not required.

A formal patient perspective was not available. Adherence to treatment or a home exercise program was not assessed. The effect of cranioplasty on subsequent rehabilitation, neurologic status, loading, or treatment planning was also not evaluated in the available record.

Results

The patient presented for outpatient physiotherapy approximately three months after the initial orthopedic procedure with pain and restricted right lower-limb movement. Initial findings included right lower-limb muscle atrophy, a still-moist incision with slight fluid leakage, a tendency toward foot eversion, and non-weight-bearing ambulation using two crutches. Baseline LEFS was 22/80 and was classified in the source manuscript as severe functional limitation. The chronological relationship between trauma, surgical management, outpatient physiotherapy, and subsequent cranioplasty is presented in Table 1.

Table 1. Clinical timeline of the reported case

Date	Clinical event
13 June 2025	Traffic accident; open middle-third right tibia-fibula fracture with right occipital epidural hematoma and TBI (GCS 10).
14 June 2025	Debridement and external fixation of the right lower-limb open fracture; intensive care admission with reduced consciousness.
19 June 2025	External-fixator implant failure; repeat debridement and external-fixator revision.
21 June 2025	Craniotomy for hematoma evacuation.
25 June 2025	Central venous catheter insertion after craniotomy.
15 July 2025	Negative-pressure wound therapy for a right crural soft-tissue defect.
31 July 2025	Conversion to flexible intramedullary internal fixation of the tibia.
12 September 2025	Initial outpatient physiotherapy assessment and first visit.
16, 18, and 22 September 2025	Second, third, and fourth physiotherapy visits with reassessment.
3 October 2025	Cranioplasty; subsequent rehabilitation implications were not evaluated.

Radiographs from the time of injury and after conversion to internal fixation are reproduced from the medical record in Figures 1 and 2. Both available radiographic descriptions identify the fracture at the middle third, supporting the anatomical terminology used throughout this final version.



Figure 1. Right crural radiograph, lateral and AP projections, after the traffic accident on 13 June 2025. The radiographic record describes a comminuted middle-third tibia-fibula fracture with soft-tissue swelling before fixation. Source: patient medical record, 2025.



Figure 2. Right crural radiograph, lateral and AP projections, after conversion to internal fixation on 31 July 2025. The radiographic record describes flexible intramedullary fixation with persistent fracture discontinuity at the middle third. Source: patient medical record, 2025.

Across the four outpatient visits, movement pain decreased from 2 to 1 on the Visual Analogue Scale, while pain at rest remained 0 and tenderness remained 1. Ankle range of motion increased in both reported planes. Hip and ankle muscle strength remained 4/5. Limb circumferences and measured limb length were unchanged. The HRS-A score decreased from 21, classified as moderate in the source manuscript, to 17, classified as mild. LEFS was measured only at the first visit and was not repeated. These findings are summarized in Table 2.

Table 2. Physiotherapy outcomes before and after four outpatient visits

Variable	Parameter	Before	After
Pain (VAS)	Rest	0	0
Pain (VAS)	Movement	2	1
Pain (VAS)	Tenderness	1	1
Ankle ROM, right	Dorsiflexion to plantarflexion	S 10°-0°-10°	S 40°-0°-21°
Ankle ROM, right	Inversion to eversion	T 18°-0°-30°	T 43°-0°-35°
Muscle strength (MMT)*	Hip flexors, extensors, abductors, adductors; ankle plantarflexors and dorsiflexors	4/5	4/5
Circumference*	Thigh	37 cm (R) / 41 cm (L)	37 cm (R) / 41 cm (L)
Circumference*	Calf	27 cm (R) / 28 cm (L)	27 cm (R) / 28 cm (L)
Limb length*	Right / left	89 cm / 90 cm	89 cm / 90 cm
Anxiety (HRS-A)	Total score	21 (moderate)	17 (mild)
Functional ability (LEFS)**	Total score	22/80 (severe)	Not repeated

*MMT and limb measurements were compared with the contralateral limb. Thigh circumference was measured 15 cm above the patella, calf circumference 10 cm below the patella, and limb length from the anterior superior iliac spine to the medial malleolus.

**LEFS was measured only at the first visit and therefore does not provide a quantitative follow-up comparison.

Functional mobility also changed descriptively during the observation period. At the third visit, the patient was able to perform a squat during toileting while still using both upper limbs for support. At the fourth visit, the record documented progression from two crutches toward one crutch, although the clinical basis for this progression was not available. No adverse events were reported during the four physiotherapy visits. No intermediate quantitative outcome data were available for the second and third visits; therefore, the report does not infer the trajectory or consistency of change between the first and final assessments.

Discussion

This case describes a young adult with an open middle-third tibia-fibula fracture and concomitant TBI who underwent staged orthopedic and neurosurgical management before beginning structured outpatient physiotherapy. During four visits, movement pain decreased, ankle range of motion increased, anxiety decreased, muscle strength remained 4/5, and observed mobility progressed from two crutches toward one. These findings are descriptive and cannot establish that physiotherapy caused the observed changes.

The coexistence of TBI and long-bone fracture is clinically important because neurologic stabilization, impaired consciousness, prolonged immobilization, and orthopedic restrictions may interact with rehabilitation planning.⁴ In the present case, the period of reduced consciousness and multiple operations formed a prolonged and complex pathway to outpatient rehabilitation. However, specific neurologic findings during the physiotherapy period were not assessed, so the contribution of residual TBI-related impairment cannot be determined.

The orthopedic course included initial external fixation, implant failure requiring revision, negative-pressure wound therapy, and subsequent conversion to flexible intramedullary internal fixation on day 48 after injury. Evidence indicates that infection risk after conversion may vary with the duration of external fixation, although conversion decisions are influenced by injury severity, soft-tissue status, infection, and other clinical factors.² The 48-day interval in this case should therefore not be interpreted as an independent cause of infection. The available record does not explicitly document a confirmed fracture-related infection.

Soft-tissue management is particularly relevant in open fractures because tissue damage and contamination can influence wound and bone recovery.¹⁶ Negative-pressure wound therapy was used for a crural soft-tissue defect, but the source record does not provide comparative wound outcomes. Its role should therefore be understood as part of the broader clinical management rather than evidence of a specific treatment effect.⁷ The risk of tibial nonunion remains relevant to follow-up, but nonunion cannot be diagnosed from the available data because serial radiographic union assessment was not reported.¹⁷

Movement pain decreased from 2 to 1 while resting pain and tenderness remained unchanged. Ankle dorsiflexion to plantarflexion changed from S 10°-0°-10° to S 40°-0°-21°, and inversion to eversion changed from T 18°-0°-30° to T 43°-0°-35°. These changes occurred while the patient received a multimodal program including education, infrared, ankle pump exercise, range-of-motion exercise, resisted exercise, balance training, transfer practice, and non-weight-bearing gait training. The individual contribution of each component cannot be separated, and spontaneous recovery, time since surgery, wound recovery, and general recovery from trauma may also explain some or all observed changes.

The movement-related pain score was already low at baseline. The one-point reduction should therefore be interpreted as an observed within-patient change rather than proof of a clinically important treatment response. Likewise, the increase in ankle range of motion is an observed functional finding, but this case report does not establish whether the magnitude exceeded a validated minimal clinically important difference for this postoperative population.

Muscle strength remained 4/5 in the assessed hip and ankle muscle groups. The absence of short-term numerical change is compatible with the limited observation window. Disuse-related muscle loss can develop during reduced activity.^{18,19} In this case, the four-visit physiotherapy period may have been insufficient to observe substantial recovery of muscle function. The source documents did not identify the prescribing source of weight-bearing restrictions or explicit criteria for progression from two crutches toward one, so their effect on strengthening and gait cannot be estimated.

The right-to-left thigh circumference difference was 4 cm, whereas the calf difference was 1 cm, and neither changed during the four visits. Because thigh and calf measurements were recorded at defined distances from the patella, the anatomical landmarks are now specified. However, tissue composition, edema, and other factors that might explain the asymmetry were not assessed. The findings should therefore be reported as observed limb asymmetry rather than evidence of a specific pattern of muscle loss.

HRS-A decreased from 21 to 17, moving from moderate to mild anxiety according to the categories reported in the source manuscript. Psychological symptoms may change during recovery from traumatic injury, and anxiety has been reported among patients recovering from extremity fractures.²⁰ Nevertheless, the present case had no control condition, no long-term psychological follow-up, and no systematic assessment of other psychosocial factors. The change cannot be attributed specifically to physiotherapy. It nevertheless highlights the presence of psychological symptoms following extremity fractures, suggesting that psychological outcomes may also warrant consideration during physical rehabilitation after severe trauma.²⁰

The clinical timeline records cranioplasty on 3 October 2025, after the fourth physiotherapy visit on 22 September 2025. Because no subsequent rehabilitation data were available and the effect of cranioplasty was not assessed, its influence on neurologic status, loading, treatment planning, or longer-term recovery cannot be interpreted.

A strength of this report is the chronological integration of major orthopedic, soft-tissue, neurosurgical, and outpatient physiotherapy events. The report also combines physical, functional, and psychological observations and explicitly reports the absence of adverse events during the four visits. The available data now provide specific parameters for several intervention components and anatomical landmarks for limb measurements.

The principal limitations are the single-patient design, short observation period, absence of a comparator, lack of intermediate quantitative data, and baseline-only LEFS measurement. Session duration, resistance intensity, home-program frequency, total treatment exposure, and explicit criteria for increasing, maintaining, or stopping exercise were not available. Specific neurologic findings after TBI were not assessed, and the source of the weight-bearing prescription and the clinical basis for progression from two crutches toward one were not documented. A formal patient perspective and adherence assessment were also unavailable. No serial radiographic follow-up was available to determine union status. These limitations prevent causal attribution, limit intervention reproducibility, and restrict generalizability.

Conclusion

During four outpatient physiotherapy visits, this patient with an open middle-third tibia-fibula fracture and concomitant TBI showed descriptive improvements in movement pain, ankle range of motion, anxiety, and observed mobility, while assessed muscle strength remained 4/5 and LEFS was not reassessed. The case illustrates the complexity of rehabilitation after staged orthopedic and neurosurgical care and supports comprehensive documentation of intervention parameters, weight-bearing instructions, neurologic findings, functional outcomes, and follow-up. Because this was a single case with short observation and no comparator, the observed changes should not be interpreted as evidence of physiotherapy effectiveness or generalized to other patients. Future case reporting and clinical follow-up should incorporate standardized reassessment and clearer documentation of rehabilitation progression when such information is available.

Author Contribution

Andi Khoffiah Chaerani: Conceptualization; Methodology; Investigation; Data curation; Writing, original draft; Writing, review and editing; Approval of the final manuscript.

Rijal: Conceptualization; Methodology; Investigation; Data curation; Writing, original draft; Writing, review and editing; Approval of the final manuscript.

Hermansyah: Conceptualization; Methodology; Investigation; Data curation; Writing, original draft; Writing, review and editing; Approval of the final manuscript.

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Conflict of Interest Statement

Conflict of interest information was not available in the source documents.

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Ethics Statement

Written informed consent for publication and use of anonymized clinical information was reported as having been obtained from the patient. The available source documents did not provide an ethics committee name, ethical approval number, waiver number, or institutional policy regarding whether ethical approval was required.

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