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Functional recovery following structured physiotherapy rehabilitation in a post-operative polytrauma patient: A case report

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Abstract
Background: Polytrauma is a major cause of long-term functional disability due to the combined effects of musculoskeletal injury, surgical intervention, prolonged immobilization, and physical deconditioning. Early and structured physiotherapy rehabilitation plays a crucial role in restoring joint mobility, muscle strength, functional independence, and quality of life. However, evidence highlighting the functional outcomes of structured rehabilitation in post-operative polytrauma patients at an individual level remains clinically valuable.
Case Presentation: A 45-year-old female sustained multiple fractures following a fall from a moving train, including right olecranon, right radial head, right proximal tibia, right fifth metacarpal, and left thumb proximal phalanx fractures. Following surgical fixation and an initial period of home-based exercises, she presented to the Musculoskeletal Physiotherapy Outpatient Department at Navi Mumbai Municipal Corporation with persistent pain, restricted right elbow and knee range of motion, muscle weakness, and difficulty with weight-bearing and functional activities. Assessment included pain measurement using the Visual Analogue Scale (VAS), goniometric range of motion assessment, manual muscle testing, and quality-of-life assessment using the Short Form-36 (SF-36).
Intervention: The patient underwent a structured, phase-wise physiotherapy rehabilitation program for 12 weeks, focusing on pain management, progressive joint mobilization, muscle strengthening, proprioceptive training, gait training, and functional task-specific training. A home exercise program and patient education were also incorporated to improve treatment adherence and functional outcomes.
Results: Following rehabilitation, the patient demonstrated reduction in pain levels, improvement in joint range of motion, increased muscle strength, improved gait pattern, and enhanced functional independence. Outcome measures showed improvement in functional ability and physical health domains of quality-of-life assessment.
Conclusion: This case highlights the importance of early, structured, and individualized physiotherapy rehabilitation in improving functional recovery and quality of life in post-operative polytrauma patients. Physiotherapy plays an essential role as part of multidisciplinary trauma management. Further research involving larger sample sizes is recommended to develop standardized rehabilitation protocols for polytrauma patients.

Keywords: Polytrauma, physiotherapy rehabilitation, post-operative rehabilitation, functional recovery, orthopedic trauma, case report

Introduction

Polytrauma refers to an injury where more than one traumatic injury occurs to different parts or organ systems of the body. Polytrauma injuries usually occur due to high energy injuries such as road traffic accidents, falls from height, and train accidents. Despite the advances in the field of emergency care, surgery, and intensive care units that have helped improve the survival rate of patients after major trauma, patients still suffer from long term disabilities and limited functional ability. The challenge with musculoskeletal injuries is usually when there is more than one fracture of the extremities of both upper and lower limbs as this can affect the joints' range of motion, muscle function, weight-bearing capability, walking, and the ability to perform day-to-day activities. Therefore, management of polytrauma involves not only surgery but also comprehensive rehabilitation to regain functional ability [1].

In cases where there is surgical management of multiple fractures, one of the secondary impairments that occur may be due to pain, edema, immobility, lack of muscle contraction, stiff joints, and deconditioning. Upper extremity injuries including fractures of the elbow joint may limit the movement of the elbow joint in flexion and extension, forearm rotation, and activities like reaching, lifting, and self-care. The same applies to lower extremity injuries where the fractures are in the proximal tibia. Knee joint movements, strength of the quadriceps, balance, standing, and walking ability will be impaired. In case both upper and lower extremity injuries coexist, then they may interact to cause more impairment [1].

Physiotherapy serves an important purpose in facilitating postoperative recovery through pain management, improvement in joint flexibility, strengthening of the muscles, improvement in neuromuscular coordination, and gradual resumption of functional activities. Individualized rehabilitation can consist of pain and swelling management, active-assisted and active joint movement exercises, isometric and resistance exercises, balance and

proprioception exercises, walking retraining, and functional task-specific training. The timing and progression of such measures need to be based on the stability of the fracture, surgical stabilization, tissue healing, weight bearing status, and the overall clinical condition of the patient. According to Agarwal *et al*. [2], early mobilization after surgery for hip fractures has been found to reduce mortality and complications after 30 days from the procedure as compared to delayed mobilization although a causal link between the two cannot be establishe [2].

Though the significance of rehabilitation after a traumatic event is widely acknowledged, there are limited guidelines available on how to choose and sequence specific physiotherapy procedures in cases of poly-trauma with a number of musculoskeletal injuries. According to the systematic literature review conducted by Klingebiel *et al*. and published in International Orthopaedics journal, there is insufficient evidence for standard rehabilitation protocols in poly-trauma patients [1].

This case report aims to describe the physiotherapy assessment, clinical reasoning, and rehabilitation management of a surgically treated orthopedics Polytrauma patient, highlighting the importance of early, structured, and goal-oriented physiotherapy intervention in optimizing functional recovery and quality of life.

Case Presentation

Patient information- The patient is a 45-year-old female who sustained multiple injuries following a fall from a running train at Sanpada railway station on 19/07/2024. The incident resulted in a high-energy impact, following which the patient experienced immediate pain, swelling, and inability to move the right upper limb and right lower limb. She was initially taken to a nearby private hospital for emergency care and later referred to a tertiary care center and was admitted to the hospital on 20/7/2024 for definitive diagnosis and management for the same. X-ray examination was done which showed right olecrenon with 5th metacarpal fracture, left thumb proximal phalanx fracture and with right proximal tibia fracture. Following the injury, the patient complained of Severe pain and swelling over the right elbow, right hand and pain and swelling with inability to bear weight on the right knee. There was no history of loss of consciousness, vomiting, seizures, ENT bleed, chest pain, abdominal pain, or breathlessness, indicating the absence of associated head, thoracic, or abdominal injury. Based on the mechanism of injury, radiological findings, and involvement of multiple skeletal regions, the patient was diagnosed as a case of orthopedic Polytrauma.

Operative details - Following clinical and radiological evaluation, the patient was diagnosed with displaced fractures of the right olecranon and right proximal tibia, along with a right radial head fracture. Staged surgical management was undertaken. On 29 July 2024, the patient underwent open reduction and internal fixation (ORIF) of the right olecranon and right proximal tibia under general anaesthesia with a supraclavicular block. ORIF of the right radial head was performed on 30 July 2024 under general anesthesia with a supraclavicular block. On 23 August 2024, definitive fixation of the right proximal tibial fracture was performed using medial and lateral proximal tibial plates (bicondylar tibial plating) secured with multiple locking and cortical screws. General anesthesia with epidural anesthesia was documented for this procedure. The postoperative course was uneventful, with healthy surgical wounds and stable fixation, as reported in the available records.

Following surgical management and stabilization, the patient was prescribed a basic home exercise program at the time of discharge, which included gentle range-of-motion exercises for the uninvolved joints, isometric muscle strengthening, ankle pump exercises, and breathing exercises, as per post-operative precautions. The patient reported that she regularly performed these exercises at home for a duration of approximately two months, which helped in maintaining joint mobility and preventing secondary complications.

After completing the initial home-based rehabilitation phase, the patient continued to experience residual pain, stiffness, muscle weakness, and functional limitations, particularly involving the right upper and lower limb. Consequently, she presented to the Musculoskeletal Physiotherapy Outpatient Department (MSK OPD) at tertiary health care sector for further supervised physiotherapy rehabilitation aimed at improving joint mobility, muscle strength, gait, and functional independence.

Radiological findings



Clinical examination

Pain assessment- The patient complained of pain predominantly over the right elbow, particularly around the olecranon and surgical site, and over the right knee in the region of the surgical scar. The pain was described as a dull, aching sensation with intermittent pricking, localized to the affected areas without radiation to the distal segments. The onset of pain was sudden, following the initial injury, and the symptoms persisted for approximately two months after surgery. At the time of assessment, the pain was intermittent

and occurred mainly during movement and functional activities involving the affected limbs.

Pain Intensity: Pain intensity was assessed using the Visual Analogue Scale (VAS). The patient reported pain intensity of 3/10 at rest and 7/10 during activity, indicating relatively mild pain at rest and substantial pain during activity.

Aggravating Factors: Pain was aggravated by active movements of the right elbow and right knee, weight-bearing on the right lower limb, prolonged standing and walking, functional activities involving the right upper limb, end-range joint movements, and maintaining sustained postures.

Relieving Factors: Pain was relieved by rest, supporting the affected limbs, avoiding strenuous activities, taking prescribed analgesics, adopting comfortable positions, and discontinuing movements that provoked symptoms.

On observation

On observation, the patient demonstrated mild postural asymmetry, with the right shoulder appearing slightly depressed compared with the left. The right upper limb was maintained close to the body, with reduced elbow extension. The right knee was held in slight flexion. Surgical scars were present over the right elbow and right knee, consistent with the history of operative management.

On palpation

Mild increase in local temperature was noted around the right knee and elbow. Tenderness was graded as Grade II over the right olecrenon and radial head and right proximal tibia. On scar examination length of scar was 10cm and width 3.5cm. post-operative scars over the right elbow and right knee were Healed, slightly adherent to underlying tissues and no signs of infection were noted.

On examination

Active and passive range of motion of affected elbow and knee given in (Table 1).

Region	Movement	Active ROM	Passive ROM right
Right elbow	Flexion	20°–100°	15° to 105°.
	Extension	Extension lag of 20°	Extension lag of 15°
Right forearm	Pronation	30°	35°
	Supination	35°	42°
Right knee	Flexion	10° to 70°	5° to 85°
	Extension	Extension lag of 10°	Extension lag of 5°

Manual muscle testing- (Table 2)

Muscle Group	Right Side Strength	Left Side Strength
Elbow Flexors	3/5	5/5
Elbow Extensors	3/5	5/5
Pronators	3/5	5/5
Supinator	3/5	5/5
Quadriceps	3/5	5/5
Hamstrings	3+/5	5/5



Outcome measures

SF 36 Questionnaire grading reveals score 36 which is predominately low domain score.

Physiotherapy intervention [1, 3, 4, 5]

The patient underwent a structured, individualized physiotherapy rehabilitation programme aimed at reducing pain, restoring joint mobility, improving muscle strength, facilitating weight-bearing, and enhancing functional independence following multiple fractures and surgical fixation. The intervention included pain management, therapeutic exercises, progressive strengthening, balance training, gait re-education, and functional training. Rehabilitation was progressed according to the patient's pain, movement tolerance, muscle strength, and functional ability.

The treatment was started with week wise protocol for patient –

Phase 1: Pain management, mobility, and muscle activation (Weeks 1–2) Table 3.

Intervention	Procedure dosage	Purpose
Pain and swelling management	Comfortable limb positioning; elevation as needed. If appropriate, cryotherapy for 10–15 minutes with skin protection and regular skin checks.	Reduce discomfort and help manage swelling.
Scar mobilization	Circular longitudinal skin lifting and gliding massage technique given	To improve scar mobility, reduce superficial tissue adherence, improve skin gliding over underlying tissues, and facilitate comfortable movement of the elbow and knee
Elbow AAROM/AROM	Supported elbow flexion-extension within the permitted range; 1–2 sets × 10 repetitions, 2–3 times/day.	Improve elbow mobility and limit stiffness.
Forearm rotation	Supported pronation-supination with elbow positioned as instructed; 1–2 sets × 10 repetitions, 2–3 times/day.	Improve forearm rotation for functional reaching and hand positioning.
Knee ROM	Heel slides and active-assisted knee flexion-extension; 1–2 sets × 10 repetitions, 2–3 times/day.	Improve knee mobility and reduce movement-related stiffness.
Quadriceps setting	Contract quadriceps while keeping the knee supported; hold 5 seconds × 10 repetitions, 2–3 times/day.	Improve quadriceps recruitment and extension control.
Hamstring isometrics	Gentle hamstring contraction without joint movement; hold 5 seconds × 10 repetitions, if permitted.	Maintain muscle activation.
Ankle pumps	20 repetitions per set, several times daily while relatively inactive.	Maintain ankle mobility and support circulation; not a substitute for prescribed thrombosis prevention.

Phase 2: Weeks 3–4 — Mobility and Muscle Activation Table 4

Intervention	Procedure dosage	Purpose
Knee ROM	Heel slides and active-assisted knee flexion-extension, 2 sets × 10–15 repetitions.	Improve knee flexion and extension.
Straight-leg raise	2 sets × 8–10 repetitions, only if the patient can maintain knee extension and is cleared.	Improve quadriceps and hip muscle control.
Elbow ROM exercises	Elbow flexion, extension, pronation and supination 10 reps 2 sets	Improve elbow mobility and limit stiffness.
Transfer training	Practice bed mobility and sit-to-stand with appropriate assistance and prescribed weight-bearing restrictions.	Improve functional independence.
Ankle pumps	20 repetitions per set, several times daily while relatively inactive.	Maintain ankle mobility and support circulation; not a substitute for prescribed thrombosis prevention.

Phase 3: Weeks 4–6 — Progressive Strengthening and Functional Mobility Table 5

Intervention	Procedure dosage	Purpose
Quadriceps strengthening	Quadriceps setting and straight-leg raises, 2–3 sets × 10 repetitions, as tolerated.	Improve quadriceps strength and extension control.
Hip strengthening	Supine hip abduction and extension, 2 sets × 10–12 repetitions.	Improve proximal lower-limb strength.
Elbow strengthening	Gentle resisted elbow flexion; add triceps resistance only after surgical clearance. Start with 1–2 sets × 10 repetitions.	Restore upper-limb strength.
Weight-shifting exercises	Supported weight shifts, 10 repetitions in each direction, only at the permitted loading level.	Improve postural control and weight transfer.
Gait training	Walking with the prescribed assistive device, in short intervals according to tolerance and weight-bearing status.	Improve gait safety and mobility.

Phase 4: Weeks 6–8 — Strength, Balance, and Gait Re-education

Intervention	Procedure dosage	Purpose
Progressive resistance exercises	2–3 sets × 8–12 repetitions, 2–3 days/week, for cleared muscle groups that is elbow flexors extensors knee flexors extensors and hip muscles.	Improve strength and muscular endurance.
Sit-to-stand	2 sets × 8–10 repetitions, using support as needed.	Improve transfer ability and functional strength.
Mini-squats	Shallow, supported mini-squats, 1–2 sets × 8–10 repetitions, only when weight-bearing is permitted.	Improve lower-limb loading control.
Static and dynamic balance	Supported standing, controlled weight shifts, and stepping practice for 10–15 minutes.	Improve postural stability.
Gait re-education	Practice step sequencing, controlled weight transfer, turning, and walking-aid use.	Improve gait quality and safety.
Functional reaching	Graded reaching and light object handling within restrictions, 2 sets × 8–10 repetitions.	Improve upper-limb functional performance.

Phase 5: Weeks 8–12 — Advanced Functional Rehabilitation

Intervention	Procedure dosage	Purpose
Advanced knee exercises	Sit-to-stand, controlled squats, and step-ups, 1–3 sets × 8–12 repetitions, if permitted.	Improve lower-limb control during daily activities.
Advanced elbow strengthening	Progressive resistance for elbow flexors, extensors, and forearm muscles, subject to surgical restrictions.	Improve lifting, reaching, and handling ability.
Dynamic balance	Multidirectional stepping, reaching, and reduced hand support when safe; 10–15 minutes.	Improve balance during functional mobility.
Gait endurance	Gradually increase walking duration and distance, with rest breaks and the appropriate walking aid.	Improve walking tolerance and independence
Stair training	Practice stair ascent and descent with rails and appropriate assistance, once safe and cleared.	Improve stair-negotiation ability.

Result

Over the rehabilitation period the patient showed gradual, progressive improvement. In weeks 1–2, treatment focused on pain, oedema control and gentle mobility. Resting pain reduced, assisted movements were better tolerated, right knee swelling decreased, and bed mobility and assisted transfers became less uncomfortable. In weeks 3–4, active mobility and muscle activation improved, with less end-range pain. Sit-to-stand needed only minimal assistance, partial weight-bearing walking began, and the patient used the right upper limb more in light activities. By the end of week 6, gait was more symmetrical, with better weight acceptance on the right leg and fewer compensations. Balance and proprioception had improved, and the patient could manage stairs with support and needed minimal assistance for most daily activities.

Pain (VAS)

Pain on activity fell from 7/10 to 2/10, a 5-point reduction. This is well beyond the commonly cited minimal clinically important difference of roughly 2 points on the VAS. Pain at rest fell from 3/10 to 0/10, so the patient was pain-free at rest.

Range of motion

The active elbow and knee ROM improved from baseline: elbow flexion 20°–100° to 5- 130°, elbow extension lag 20° to5°, pronation 30° to 60°, supination 35° to 65°, knee flexion 10°–70° to 110°, knee extension lag 10° to 0°**.** The improvement allowed better performance of activities of daily living.

Muscle strength (MMT)

Strength improved progressively, from 3/5 (hamstrings 3+/5) at baseline, to about 3+/5 by weeks 3–4, to approximately 4/5 by week 6 in the major elbow and knee muscle groups. This is a gain of one full grade. The uninvolved left side remained 5/5.

Quality of life (SF-36)

The physical domains improved, specifically physical functioning and bodily pain, from a baseline of predominantly low scores. The mental and emotional domains stayed stable at the preserved baseline.

Discussion

This case describes functional recovery in a 45-year-old woman after staged fixation of right olecranon, radial head and bicondylar proximal tibial fractures, together with hand injuries, who began supervised physiotherapy about two months after surgery. Activity pain on the VAS fell from 7/10 to 2/10 (rest 3/10 to 0/10), elbow and knee range of motion improved, strength rose from 3/5 to about 4/5, gait and independence improved, and the SF-36 physical domains improved. Polytrauma rehabilitation is usually described as a staged process, and there is little high-quality evidence on how to sequence it in patients with multiple limb fractures [1].

Pain

The 5-point (50 mm) fall in activity pain is far above the minimum clinically significant VAS difference of about 12 mm (about 1 point) reported by Kelly [6]. The gain is therefore clinically important, not just statistical. It fits the early programme of elevation, cryotherapy, scar mobilisation and pain-limited movement. The report can't say how much of the change came from physiotherapy and how much from natural healing.

Elbow range of motion and strength

After stable fixation of olecranon and radial head fractures, the elbow should not be immobilised for long, because it stiffens easily, and regaining motion is the priority in the first phase. Verstuyft *et al*. suggest light isotonic work from about 3–4 weeks, strengthening once healing is confirmed (about 6 weeks), and advanced strengthening once motion is complete and painless, usually between 6 weeks and 3 months [4]. This matches the present programme, which moved from supported motion to gentle resisted elbow work, then progressive strengthening and functional reaching. Most daily activities need an elbow arc of roughly 30°–130°. [7, 8] This patient began at about 20°–100° with an extension lag, so state the final flexion–extension arc and whether it reached the functional range.

Knee range of motion, weight-bearing and strength

After tibial plateau fixation, Iliopoulos and Galanis found the strongest consensus for early range-of-motion exercise, and noted that weight-bearing protocols remain controversial. They reported that delaying full weight-bearing beyond 12 weeks was associated with poorer function, and recommended continued quadriceps strengthening and proprioceptive training because patients often have lasting activity limitations and gait asymmetry [5]. Progression here from supported weight-shifting to sit-to-stand, balance work and gait re-education matches that approach, and the better weight acceptance and stair ability are consistent with it. Weight-bearing followed the surgeon's restrictions for the bicondylar plating.

Quality of life

SF-36 is a widely used generic health-status measure with physical and mental components [ ]. Improved physical

domains with stable mental domains suggest the gains came from physical recovery. Reporting the actual domain and summary scores would strengthen this point.

Limitations

This is a single case without a control, so the gains can't be attributed to the programme alone. Final range-of-motion, SF-36 and strength values are described only in general terms, and no validated functional scale was used. Follow-up was short, and the patient had completed about 1 month of home exercises before supervised therapy began. Larger controlled studies with standardised outcome measures are needed.

Conclusion

The study concludes that structured, phase-wise physiotherapy rehabilitation improved pain, range of motion, muscle strength, gait, functional independence and SF-36 physical health in a post-operative polytrauma patient. It also concludes that early, individualized physiotherapy is an essential part of multidisciplinary trauma care, and that larger studies are needed to develop standardized protocols. These findings emphasize the importance of early initiation of rehabilitation and individualized exercise prescription based on surgical precautions, tissue healing principles, and patient tolerance.

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