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Holistic Rehabilitation for Severe Multi-Trauma: A Case Study of Comprehensive Physiotherapy Interventions in Complex Injuries

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Abstract

In this case report we are presenting a 37 year old patient having multiple fractures post road traffic accident caused by bike collision which has led to grade III B supracondylar femur fracture, fracture of proximal phalanx, hemopneumothorax on the left side along with rib fracture and brachial plexus injury.
After surgical correction of the femur fracture physiotherapy intervention was started for the patient which focused on regaining range of motion and strength of hip and phalanx, gentle breathing exercises for the hemopneumothorax and rib fracture, education regarding the dyspnoea relieving position. The primary focus of the intervention was application of cryotherapy, myofascial release, passive and active range of motion exercises. Neuromuscular re-education. The follow up was taken after 31 days showing significant improvement in functionality and improved sensorium. This case report emphasises on the integrated rehabilitation approach for optimizing the recovery of the individual.

Keywords: *polytrauma, physiotherapy, rehabilitation, case report*

1. Introduction

Distal femoral fractures represent 7% of all femoral fractures[1]. These fractures are frequently observed in the older population as well as in high-energy injuries[2]. Femur fractures that occur supracondylar are exceedingly challenging to treat. These fractures always show a lot of comminutions, frequently with exposed wounds and bone loss. Many a time there will be accompanied proximal tibial fractures along with floating injuries. Since these fractures occur near or involve the knee joint, achieving a full knee Range of Motion (ROM) is challenging. Distal femoral fractures also have a high risk of complications such as infection, non-union, and malunion, leading

to significant disability[3]. It has been shown that therapeutic approaches are helpful in these kinds of situations[4].

The most frequent foot fractures are phalanx fractures[5]. The most frequent ways that injuries occur are from axial loading and crush or "stubbing" injuries[6]. Injury to the phalanx can happen at the distal, middle, or proximal portions of the bone[7]. The majority of the time, emergency departments can handle them entirely without the need for an orthopaedic referral. Restoring alignment and range of motion, avoiding complications, and managing discomfort are among the management's objectives[8]. The foot is a crucial functional component. Therefore, for daily tasks, post-immobilization therapy for phalangeal fractures is crucial[5,7].

Traumatic brachial plexus injury (BPI) is one of the most incapacitating injuries to the upper limb. It is a serious neurological disorder caused by trauma. Motorcycle accidents are the most common cause of brain damage in young males[9]. A number of variables, including the extent of the nerve damage, the site of the injury, the trauma's underlying mechanism, and the circumstances specific to each individual influence how the injury functions[9,10]. Impaired muscle strength, sensitivity, and deficiencies in upper limb movements are common post-BPI symptoms. Furthermore, BPI may make it more difficult for the patient to carry out tasks associated with their job and everyday living, which could have an impact on their quality of life and emotional and psychological well-being as well as have a major socioeconomic impact[9,11]. Recovery from trauma requires rehabilitation, and in most cases, early intervention is necessary to reduce the likelihood of secondary consequences[12,13].

Thorax injuries rank third in terms of severity, after head, neck, and extremities injuries, according to an analysis of all trauma cases[14]. Thorax traumas account for 20–25% of trauma-related mortality[15]. About 9–10% of patients with trauma have rib fractures[16,17], and are indicators of serious physical injury and solid organ damage. Rib fractures are associated with the head, extremities, abdomen, and traumatic cardiac injuries other than concurrent thoracic injuries[18]. It has been determined that physiotherapists are essential in helping patients establish coping mechanisms and accelerating their recovery following severe trauma[19]. In many people, this leads to such fatal complications as hemopneumothorax, pneumothorax, and haemothorax where the bones of the chest are broken. The most frequently involved ribs are the middle and upper ribs after blunt thoracic injury and this can lead to pneumothorax and Haemothorax[20].

2. Case Presentation:

A 37-year-old male worker from Agargaon, Maharashtra, was admitted to the hospital on 9th July 2024. He presented with a history of pain and swelling in his left leg following a two-wheeler collision on 8th June 2024, which also caused injuries to his chest, face, left thigh, and back. Upon arrival at the hospital, he was unconscious, and further examination revealed a head injury. His symptoms included sudden, non-radiating pain, which was moderate in intensity, aggravated by movement, but relieved by rest.
A patient underwent extensive investigations, which confirmed multiple diagnoses: a Compound Grade III B Supracondylar Femur fracture on the left side, a Fifth proximal phalanx fracture of the left foot, left-sided hemopneumothorax, fractures of the first to eighth ribs on the right side, a fracture of the first rib on the left side, and a brachial plexus injury on the left side. The individuals underwent surgery for supracondylar femur fracture on 24th July 2025. Retrograde femoral nails in open reduction and internal fixation. The patient does not have any known allergy which will worsen the condition

3. Clinical Finding:

An oral consent was obtained before initiating the treatment the assessment of pain was taken using numerical pain rating scale the NPRS was 8/10 at left thigh, 6/10 over the chest which has reduced to 3/10. On observation the left thigh was presented with swelling and bruising indicating of compound grade III B supracondylar femur fracture. On palpation grade 3 tenderness was presented at the site of the injury i.e left thigh. The NPRS score for left foot was 5/10 and tenderness grade I was present. Chest

examination showed reduced breath sound and dull notes on percussion and patient complaints of pain upon deep breathing and crepitus was heard. Neurological assessment revealed that the patient had left upper limb weakness, which was measured to be 2/5 on Manual muscle testing. The sensory examination showed that the patient had decreased sensation in the left upper limb in the C5-T1 dermatomal distribution, indicative of brachial plexus damage. The patient had a limited ROM in the left shoulder, elbow, and wrist, with the patient unable to flex, extend, or abduct fully due to pain and weakness. The patient's vitals include tachycardia and a slightly low oxygen level, which could be attributed to the hemopneumothorax and multiple rib fractures.

4. Radiological Findings

The radiographic examinations were carried out to observe:

1) How the impants were fixed in compound Grade III B supracondylar femur fracture (figure.1)
2) Rib fracture with Left-Sided Hemopneumothorax (figure 2)
3) Left sided brachial plexus injury (figure3)

Figure 1: Grade III B Supracondylar Femur Fracture

Figure 2: Rib Fracture and left sided hemopneumothorax

Figure 3: Brachial Plexus Injury

5. Therapeutic Intervention:

The objectives were pain reduction, increase upper limb and lower limb range of motion (ROM) and strength, to relieve dyspnoea, to improve lung expansion, etc. as shown in (table 1).

Injury	Goals	Intervention	Duration	Progression	Dosage
1. Compound Grade 3B Supracondylar Femur Fracture (Left Side)	To educate the patient and his family about the patient's condition	NA	NA	If the patient or family member has any questions regarding his condition, they will be answered	NA
	To manage pain and inflammation	cryotherapy	For 10 minutes	NA	Twice daily
	To reduce the tightness of hamstring and quadricep muscle	Myofascial release	For 10 minutes	Week 1: 3 sessions alternately, week 2 to 4: 3 sessions were given continuously	Alternate days
	To increase the ROM of the hip and knee joint	A] Muscle energy technique	3 sets of gradually progressing repetitions	Week 1: 1 set (4 repetitions), week 2: 1 set (6 repetitions), week 3 and week 4: 1 set (8 repetitions)	Once a day

		B] Passive range of motion exercises	2 sets of 10 repetitions	In week 3 and week 4 progress to active range of motion exercises	Twice daily
	To increase the strength of the lower extremity	Resisted exercises	2 sets of 10 repetitions	Week 1 and week 2: with 5 RM (Repetition maximum), week 3 and week 4: with 10 RM	Twice daily
2. 5th Proximal Phalanx Fracture (Left Side)	To reduce pain; to relax the muscle and tissue surrounding the injured area	Hydrocollator pack	For 10 minutes	NA	Twice daily
	To improve ROM; to prevent stiffness	Passive ROM to all the joints around the affected foot	2 sets of 10 repetitions	Week 1 and week 2: with 5 RM (Repetition maximum), week 3 and week 4: with 10 RM	Twice daily
	To restore normal joint function	Mulligan's movement with mobilization	2 sets of gradually progressing repetitions	Week 1: 1 set (4 repetitions), week 2: 1 set (6 repetitions), week 3 and week 4: 1 set (8 repetitions)	3 times a week
	To improve flexibility	Percussion massage gun therapy	10 minutes per session	NA	3 times a week
	To improve strength				Twice daily
3. Left-Sided Hemopneumothorax	To reduce pain	A] Breathing exercises (diaphragmatic breathing, deep breathing)	10-15 repetitions	Gradually increase the depth of breathing as tolerated	Thrice daily
		B] Relaxation techniques (guided imagery)	15 minutes	NA	Twice daily
	To Improve Lung Expansion	A] Incentive spirometry	7-8 breaths	Increase volume goal as tolerated	Every 4 hours

		B] Positioning (upright sitting, leaning forward)	Maintain position for 15-30 minutes	NA	Thrice daily
4. 1st to 8th Rib Fractures (Right Side	To reduce pain	A] Splinting	NA	NA	NA
		B] Transcutaneous electrical nerve stimulator	For 8 minutes	NA	Once daily
	To improve bed mobility	Log rolling, side-lying to sitting bedside, sit to stand.	NA	NA	Thrice daily
	To avoid Secondary complications such as venous thrombosis, bed sores, etc.	Ankle-toe movement	10 repetitions	Gradually progress repetitions	Every 2 hours
	To maintain chest mobility	Gentle thoracic mobility exercises	10 repetitions of 1 set	Week 1 and week 2: 2 sets daily, week 3 and week 4: 4 sets daily	Twice daily
5. 1st Rib Fracture (Left Side)	To reduce pain	A] splinting	NA	NA	NA
		B] Transcutaneous electrical nerve stimulator	For 8 minutes	NA	Once daily
	To improve bed mobility	Log rolling, side-lying to sitting bedside, sit to stand.	NA	NA	Thrice daily
	To avoid Secondary complications such as venous thrombosis, and bed sores.	Ankle-toe movement	10 repetitions	Gradually progress repetitions	Every 2 hours
	To maintain chest mobility	Gentle thoracic mobility exercises	10 repetitions of 1 set	Week 1 and week 2: 2 sets daily, week 3 and week 4: 4 sets daily	Twice daily
6. Brachial Plexus Injury (Left Side)	To relieve dyspnoea	The Semi-Fowler's position, head end elevated to 45 degrees	NA	NA	NA

	To enhance breathing and facilitate mobilization	Diaphragmatic breathing	10 repetitions of 1 set	Diaphragmatic breathing with 3-sec hold	Every 4 hours
	To reduce inflammation and edema and to facilitate nerve regeneration	Low-intensity laser therapy over nerve roots C5, C6, C7, and T1	For 10 minutes	NA	Alternate day
	To regain neuromuscular control	A] Lateralization training	5 to 10 minutes	NA	Twice daily
		B] Rood's facilitatory technique by using cotton balls (slow-light touch) and rotatory brush (fast brushing) on respective	3 to 5 times followed by a 30-second break		Once daily
		C] Sensory re-education with different textures such as sandpaper, silk, and net	3 to 5 times followed by a 30-second break		Once daily
		D] Motor re-education through PNF rhythmic initiation technique (active assisted D1 –D2 flexion/extension) and range of motion exercises of left upper extremity	2 sets of 10-repetition	Progress to active and then to resisted PNF training	Twice daily

Table 1: Physiotherapy Intervention

6. Follow -up and Outcome Measures:

The patient's physiotherapist performed a follow-up after the patient had 31 days of physical treatment. (Table 2) displays the values of several parameters of examination done on the same day of patient admission and after the 31 days of the physiotherapy regime.

Range Of Motion	**On the day of examination (in degrees) [actively]**	**After 31 days of physiotherapy (in degrees) [actively]**
Hip Flexion	0 to 85	0 to 100
Hip Extension	0 to 25	0 to 30
Knee Flexion	0 to 50	0 to 90

Knee Extension	50 to 0	90 to 0
Ankle Plantarflexion	0 to 30	0 to 35
Ankle Dorsiflexion	0 to 30	0 to 35
Manual Muscle Testing	**On the day of the examination**	**After 31 days of physiotherapy**
Hip Flexors	2/5	4/5
Hip Extensors	2/5	4/5
Knee Flexors	3/5	5/5
Knee Extensors	3/5	5/5
Ankle Plantarflexors	3/5	5/5
Ankle Dorsiflexors	3/5	5/5
Shoulder Flexors	1/5	4/5
Shoulder Extensors	1/5	4/5
Elbow Flexors	2/5	4/5
Elbow Extensors	2/5	5/5
Wrist Flexors	2/5	5/5
Gait Parameters	**On the day of the examination**	**After 31 days of physiotherapy**
Stride Length	42 cm	52 cm
Step Width	12.5 cm	16 cm
Step Length	19 cm	23 cm
Cadence	75 steps/ min	83 steps/min
Muscle Tone	**On the day of the examination**	**After 31 days of physiotherapy**
Upper Extremity	1+	2+
Reflex	**Nerve**	**Left side**
Biceps (C5-C6)	Musculocutaneous	Diminished
Supinator (C7-C8)	Radial	Diminished
Triceps (C7-C8)	Radial	Diminished
Finger Flexors (C7-C8)	Median and Ulnar	Diminished

Table 2: Pre and Post comparison of the range of motion and strength.

Outcome Parameters by using Scales	**On the day of the examination**	**After 31 days of physiotherapy**
Numerical Pain Rating Scale	- Left Thigh: 8/10 (during movement) - Chest: 6/10 (during movement) - Left Foot: 5/10 (during movement)	- Left Thigh: 3/10 - Chest: 2/10 - Left Foot: 2/10
Upper Extremity Functional Scale	34/100	58/100
Brachial Plexus Outcome Measure	11/55	36/55
Lower Extremity Functional Scale	25/85	65/85
Functional Independence Measure	25/126	110/126
Pain, Inspiratory Capacity, and Cough (PIC Score)	6/10	9/10

Table 3: Pre and post Comparison of outcome measures

7. Discussion:

Compound Grade 3B Supracondylar Femur Fracture: The management of a compound Grade 3B supracondylar femur fracture involves surgical intervention followed by a structured rehabilitation program to optimize recovery. According to Karekar et al., (2024) and Aprisunadi et al., (2023), early mobilization and a progressive weight-bearing regimen are essential for reducing complications such as joint stiffness and muscle atrophy. The author emphasizes that early physiotherapy can facilitate better alignment, reduce inflammation, and improve functional outcomes[21,22].

Carneiro et, al. conducted a study which proves the postural correction is plays a crucial role in correction of the posture and improve the overall gait and posture of the patient. [23]. Progressive strength training post supracondylar fracture of femur plays a crucial role in recovery of the patient, improve long term outcome and prevent secondary complication caused by immobilization, karekar, et, al. [21]. Application of manual therapy for soft tissue stiffness help reduce stiff and improve functionality by improving range of motion [24].

Additional studies by Gliga et al., (2022)support the use of proprioceptive training to enhance balance and prevent falls, which is crucial for patients recovering from such severe fractures[25].

Proximal Phalanx Fracture: the prime focus of rehabilitation in case of phalangeal fracture is achieving range of motion and improving dexterity of the hang Gashaw et al., (2022) emphasis on early mobilization leads to optimal recovery [26]. Range of motion exercises active and passive help maintain flexibility of the joint and soft tissue and reducing selling and prevent contracture formation [27].

According to Althoff et al., Splinting and prevention of re-injury, avoid in- growing nails along with proper alignment and function functional activities like toe curls, fanning of toes calf raises, gait training are required for successful rehabilitation [28][29].

Hemopneumothorax: To enhance respiratory functions and avoid complication various exercises such as chest expansion, deep breathing exercises, diaphragmatic exercises, segmental breathing varous techniques such as proprioceptive neuromuscular inhibition technique help improve respiratory function [30,31]. Techniques like chest percussion and postural drainage are used to facilitate pulmonary secretion clearance[32].

In the early stages, pain treatment and mild range-of-motion exercises are essential to prevent further respiratory impairment[33]. More rigorous respiratory rehabilitation techniques, such as respiratory muscle strengthening exercises, are added as recovery advances[34].

Rib Fractures: Deep breathing exercise like active cycle of breathing technique (ACBT) airway clearance technique such as huffing and coughing plays a crucial role in improving lunch function whereas in case if fracture associated with first rib pain and altered respiratory function are the main complains associated with rib fracture breathing exercises are prescribed to prevent atelectasis [35]. Deep breathing exercises and coughing techniques are crucial for preventing respiratory complications[36].

Battle et al.,(2023) found out early mobilization and lung function training and pain management plays a vital role in maintain lung function [37]. Particular focus is placed on treating concomitant shoulder and cervical discomfort, particularly in instances of first rib fractures[38,39].

Brachial Plexus Injury: Neuromuscular rehabilitation, functional re-education and avoiding activity putting stress on the neural structures are avoided to promote recovery of the neuromuscular junction and improve functionality and co-ordination of the individual [40]. Strengthening exercises for the shoulder girdle, arm, and hand are essential for enhancing muscle strength and limb function[41]. Utilization of new technologies like AR, VR help simulate daily tasks which assist the patient to indulge more in the rehabilitation regimen and improved functionality [41]. Occupational therapy is part of a multidisciplinary approach that tackles the injury's wider functional effects and guarantees a full recovery[42].

8. Conclusion:

We conclude that a tailored rehabilitation regimen with progressive loading and rehabilitation help assist the patient for healthy recovery. A well planned physical therapy regimen help in reduction of pain improve mobility of the hip knee joint along with phalangeal joint, along this this deep breathing

exercises, segmental breathing and neuromuscular rehabilitation plays a plays a significant role in recovery of brachial plexus injury, ultimately making the individual functionally independent. A comprehensive approach help assist the patient in regaining function.

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