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Physiotherapeutic rehabilitation following JESS Fixator-treated proximal phalanx fracture along with isolated medial malleolar fracture - A case report

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ABSTRACT

Compared to other fractures, for instance, the tri-, bi-, and lateral malleolar fractures, isolated medial malleolar fractures are rare. Their annual incidence varies from 107 to 187 per 100,000 persons. One of the most prevalent forms of upper extremity fractures is phalangeal fractures, with the proximal phalanx being the most commonly affected. Here we present an instance of a 28-year-old man, who gives a road traffic accident history which was a collision with a two-wheeler while riding his bike. On the left leg and hand, the patient complained of pain and couldn't put weight on his lower limbs or use his left hand to grip an object. X-ray showed a fracture of medial malleolus of left side and Compound grade II proximal phalanx fracture 4th and 5th digit on the left side. The patient was managed with operative measures along with Physiotherapy. The physiotherapy rehabilitation regimen conducted in this case study reduced pain, enhanced joint mobility, muscular strength, and endurance, and greatly benefited the patient's functional independence.

Keywords: Medial Malleolus fracture, Proximal Phalanx fracture, Physiotherapy

1. INTRODUCTION

The medial malleolar isolated fractures are rare as compared to other fractures of the ankle including the tri-, bi, and lateral malleolar fractures (Jaffe et al., 2017). Their yearly incidence ranges from 107 to 187 instances per 100,000 people, and this figure is rising every year (Kusnezov et al., 2017). Only around seven percent are of this type. The medial malleolus' resistance in isolated fracture has been linked to deltoid ligament complex stability. When a fracture becomes displaced, it is important to restore it to maintain normal and pain-free ankle biomechanics (Bulut and Gursoy, 2018). Built on the anteroposterior (AP) radiograph, Labronici et al., (2016) simplified the system

of Müller classification into four different categories: type-A avulsion fractures arises at the tip of malleolus; type-B fractures arises betwixt the tip and the plafond; type-C fractures arises at the level of plafond's; type-D fractures extend into oblique-vertical manner from the plafond. Fracture of medial malleolar which is nondisplaced can be conservatively treated; nevertheless, the great majority of fractures are displaced and need surgery. K-wires, tension bands, small precontoured plates and Lag screws, are some of the therapeutic options for fracture fixation of medial malleolar.

Phalangeal fractures, are one of the preponderance types of fractures in upper extremity, with proximal phalanx being almost often damaged (Gaspar et al., 2019). These are often seen in emergency departments as a result of several causes, including road traffic accidents, machine or crush injuries, explosion-related or assault injuries. Hand injuries are typically conservatively managed with plaster and splints, although surgical process is necessary for communited, unstable, intraarticular fractures (Mishra et al., 2019). In comminuted and intra-articular fractures, open reduction with internal or external fixation is used. Cerclage wires, Kirschner's wire, plating, intramedullary nails, tension band wires, lag screws, and/or external fixators are some fixation techniques that have been employed. Joshi's External Stabilization System, a device of external fixation used for a wide range of fractures. Distraction histoneogenesis is the principle on which the JESS operates, which ensures a stable fixation while preventing injury to the previously injured tissue, lowering the risk of infection, allowing mobility of adjacent joints and secondary procedures without disturbing the fracture, lowering the occurrence of joint stiffness and resulting in early functional outcome (Shah et al., 2019). Following various upper limb and lower limb fractures, specialized exercise programs regardless of the fracture type or treatment plan, physical therapy (PT) is considered a critical component of treatment (Bruder et al., 2011).

2. PATIENT INFORMATION

Here, we report the instance of a 28-year-old man, who gives a history of a road traffic accident on 16/01/2022. The accident was a collision with a two-wheeler while riding his bike. He was immediately taken to a local hospital in Chandrapur. The patient complained of swelling besides the pain on the left leg and the hand on arrival. He was bleeding from his left ankle and left hand. Following the accident, the patient was unable to withstand weight on lower limb and hold an object with his left hand. The patient felt excruciating pain rating it 9/10 on the Numeric Pain Rating Scale (NPRS) which was gradually increasing in nature. He had no history of a head injury, loss of consciousness, or ENT bleeding, and no history of vomiting or seizures. The patient had received primary care in a government hospital and was suggested to take further management in AVBRH. Following consultation with the orthopedic surgeon, the requisite investigations were carried out, during which the patient was diagnosed with Medial Malleolus fracture on the left lower limb (supination and abduction injury) and a compound grade II proximal phalanx fracture of the 4th and 5th digit without any neurovascular injury. The patient was operated on the next day for the medial malleolus fracture with closed reduction - internal fixation with the CC screw and a below-knee slab was applied. The compound grade II proximal phalanx fracture of the 4th and 5th digit was operated by closed reduction and JESS fixator with an application of a cock-up slab. The incidences of all the circumstances are mentioned in the table of the timeline (Table 1). When the patient was stable after the surgery, he was transferred to the ward for further recovery and was then recommended for physiotherapy for post-operative rehabilitation. The physical examination and treatment regimen were delineated to him after he signed a written consent form. He was engaged, calm, and oriented during the examination.

Table 1 Shows all the incidences taken place in the case report.

Occurrences	Dates
Date of admission	17/01/2022
Date of examination	18/01/2022
Date of accident	16/01/2022
Date of X-ray	18/01/2022
Date of operation 1st for medial malleolus fracture	19/01/2022
Date of operation 2nd for medial malleolus fracture	19/01/2022

3. CLINICAL FINDINGS

The physical examination and investigations were explained to the patient after he signed a written consent form. While evaluating, he was conscious and a well orient of the time, place, and person. On observation, he was evaluated in the supine position, with the ASIS and shoulders both at the same level. The left hand was kept elevated, with the Jess fixator applied. The left lower limb was kept on the wedge, which was used to elevate the left lower limb with a below-knee cast. On examination of the left leg and ankle, a

sutured contused lacerated wound (CLW) of 4 x 1 cm was found on the anterior aspect of the left ankle and distal leg. There was diffuse swelling but no deformities. On palpation, the local temperature was raised with a tenderness of grade 2 over the left leg on medial malleolus. Active ankle toe movements are present. The dorsalis pedis artery and the posterior tibial artery were not palpable. The movements around the ankle were painful and the range of motion of the lower extremity is mentioned in (Table 2). Muscle strength was evaluated based on Resisted Isometric Contraction as mentioned in (Table 3).

On examination of the left hand, over the fourth and fifth digits, a 1 x 1 cm sutured contused lacerated wound (CLW) was present. Non-pitting edema was seen over the dorsum of the hand. On palpation, the local temperature was raised with grade 3 tenderness present over the 4^{th} and 5^{th} digit of the proximal phalanx. Abnormal mobility was seen in fourth and fifth digits along with crepitus with Active finger movement. The radial artery was palpable. Movements around the wrist and the phalanges were painful. Ranges of the upper extremity have been mentioned in (Table 2). Muscle strength was evaluated based on Resisted Isometric Contraction as mentioned in (Table 3).

Table 2 Range of motion taken on day one

	Joint movement	Left		Right	
		Active	Passive	Active	Passive
Hip joint	Flexion	20^0	90^0	120^0	125^0
	Extension	25^0	30^0	20^0	30^0
	Abduction	25^0	30^0	45^0	48^0
	Adduction	30^0-0	35^0-0	40^0-0	45^0-0
	Internal rotation	30^0	40^0	40^0	45^0
	External rotation	30^0	40^0	40^0	45^0
Knee joint	Flexion	20	60^0	130^0	140^0
	Extension	110^0-0	125^0-0	145^0-0	150^0-0
Ankle joint	Plantar flexion	Not evaluated	Not evaluated	45^0	50^0
	Dorsiflexion	Not evaluated	Not evaluated	15^0	20^0
	Inversion	Not evaluated	Not evaluated	30^0	35^0
	Eversion	Not evaluated	Not evaluated	20^0	25^0
Shoulder joint	Flexion	150^0	155^0	175^0	180^0
	Extension	20^0	25^0	30^0	30^0
	Abduction	170^0	175^0	175^0	180^0
	Adduction	30^0-0	35^0-0	40^0-0	45^0-0
	Internal rotation	30^0	40^0	50^0	55^0
	External rotation	30^0	40^0	60^0	65^0
Elbow Joint	Flexion	120	125^0	140^0	150^0
	Extension	130^0-0	135^0-0	145^0-0	150^0-0
Wrist Joint	Flexion	135^0	140^0	145^0	150^0
	Extension	5-0^0	5-0^0	5-0^0	5-0^0
	Pronation	75^0	80^0	85^0	90^0
	Supination	75^0	80^0	85^0	90^0
Proximal interphalangeal joint	Flexion	Not assessed	Not assessed	95^0	100^0
	Extension	Not assessed	Not assessed	5^0	7^0
Distal interphalangeal joint	Flexion	Not assessed	Not assessed	65^0	70^0
	Extension	Not assessed	Not assessed	5^0	8^0

Table 3 Shows findings of resisted isometric contraction

MUSCLES	GRADING	MUSCLES	GRADING
Hip flexors	Strong and painless contraction	Shoulder extensors	Strong and painless contraction

Hip extensors	Strong and painless contraction	Shoulder abductors	Strong and painless contraction
Hip abductors	Strong and painless contraction	Shoulder adductors	Strong and painless contraction
Hip adductors	Strong and painless contraction	Shoulder internal rotators	Strong and painless contraction
Hip internal rotators	Strong and painless contraction	Shoulder external rotators	Strong and painless contraction
Hip external rotators	Strong and painless contraction	Elbow flexors	Strong and painful contraction
Knee flexors	Strong and painless contraction	Elbow extensors	Strong and painful contraction
Knee Extensors	Strong and painless contraction	Wrist flexors	Weak and painful contraction
Ankle dorsiflexors	Weak and painful contraction	Wrist extensors	Weak and painful contraction
Ankle plantarflexors	Weak and painful contraction	Finger flexors	Weak and painful contraction
Shoulder flexors	Strong and painless contraction	Finger extensors	Weak and painful contraction

Diagnostic assessment

An X-Ray was done on 18/01/2022 as shown in (Fig 1.) and mentioned in (Table 1).

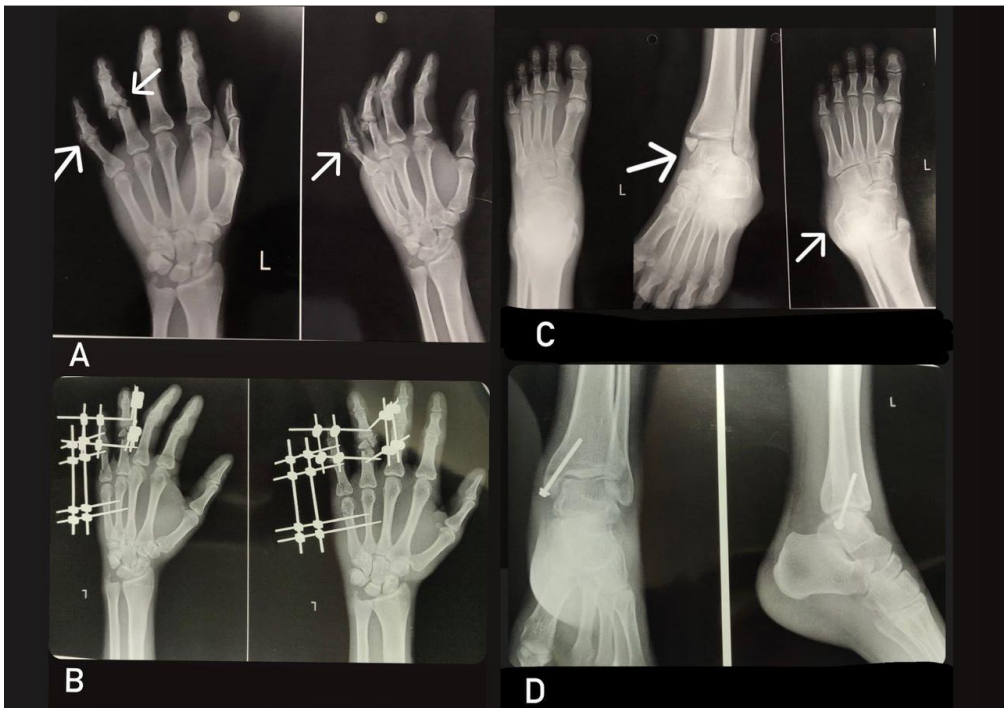

Figure 1 X-ray showing A: fourth and fifth proximal phalanx fracture, B: Closed reduction with JESS fixator application C: medial malleolus fracture, D: after the surgical procedure of closed reduction with internal fixation with the CC screw on the medial malleolus.

Diagnosis

Left side Medial malleolus fracture (supination and abduction injury) and Compound grade II proximal phalanx fracture 4th and 5th left hand without neurovascular injury.

Therapeutic intervention

Physiotherapy rehabilitation began on the first day of examination, and the patient was addressed for four weeks. We assessed the patient's pain, range of movement along with strength on day one of therapy. Before beginning treatment, the patient was taught and instructed about the necessity of exercise for his recovery and an early return to his everyday activities. The pretreatment pictures are in (Fig 2).

Figure 2 patient on the first day of the physiotherapy treatment

Short term goals

The intervention aimed to alleviate the pain, swelling to be reduced, prevent from going into any deformity, to prevent stiffness of joints, enhancing the wrist; proximal interphalangeal; distal interphalangeal; hip; knee and ankle joint functional range of motions and strength of muscles around these joints, to reinstate the afflicted hand's power grip, grasp, pincer grip, and key pinch.

Long term goals

it is aimed at enhancing the full range of motions of wrist; proximal interphalangeal; distal interphalangeal; hip; knee and ankle joints, maintaining strength muscles around these joints, to encourage independent walking and enhancing both balances in static and dynamic, to improving the endurance and assisting the patient in gradually returning to functional activities.

Phase I – (day one – one week)

It is critical to reduce swelling at the earliest possible time to avoid adhesion formation and subsequent stiffness. The mobility of the unaffected extremity is maintained. It's crucial to keep unaffected joints mobile and to make sure that all joints of the extremities of upper and the lower move through their complete range of motion to prevent any deformities or stiffness. For the upper limb, the unaffected digits are given active range of motion exercises. The patient was advised to use the uninvolved hand for self-care, hygiene, eating, grooming, and clothing. For the lower extremity, active toe movements were started in as much range as the slab

allowed him to move. Limb in the cast is given exercises of range of motion actively for flexion of hip - knee. Exercises isometrically to quadriceps as well as hamstrings, and glutes were begun with a five-second hold followed by ten repetitions, as tolerated by the patients. Unilateral pelvic bridging was done for 10 repetitions with 3 seconds of hold. Every exercise was completed twice a day. By the first week's end, the patient began with toe touch weight-bearing.

Phase II (Week 2 – Week 3)

This stage is managed by focusing on encouraging joint mobility and strengthening by isometrics along with improving the functional independence of the patient. In the wrist, elbow, and shoulder, an active full range of motion was promoted in the affected limb. As much as endured by the patient, the affected digit might gradually begin to bear weight and move the digits in the cast as much as movement is allowed by the cast. Resisted exercises to the unaffected and affected shoulder, elbow, and wrist joints were started. The rehabilitation for the lower limb was started with the exercises of range of motion to hip-knee flexion done actively. Isometric exercise for the quadriceps, hamstrings, and glutes was continued which was progressed to 10 seconds of hold and ten repetitions, as tolerated by the patients. 10 repetitions of unilateral pelvic bridging with a 5-second hold were performed.

Phase III (Week 4)

Management at this phase focuses on restoring the functional range of the affected upper and lower extremity mobility and strengthening the muscles supporting them. For the upper limb, exercises in complete range of motion were performed actively was fostered in the affected limb at the wrist, elbow, and shoulder joint. Resisted exercises were initiated on the unaffected and affected shoulder, elbow, and wrist with the use of weight cuffs and resistance bands. Partial weight-bearing was initiated on the hands. The cast of the upper limb was still present although, by the end of the 4th week, the below-knee slab was removed. Active ankle-toe movements were started with twenty repetitions of one set. Isometric exercises of the hamstrings, quadriceps, and glutes were continued with an increase of the hold to 15 seconds for ten repetitions. Resisted exercises for the lower limb were begun for strengthening of the muscles. Pelvic bridging was initiated for ten repetitions. Sit-to-stand activities were taught to the patient and were begun. The patient was started with partial weight-bearing ambulation. The improvement of the range of motion and the rehabilitation can be seen in (Fig. 3).

Figure 3 Improvement in the ranges during treatment

After a week, when the patient visited the Hospital for the removal of the below-elbow slab, he was referred to physiotherapy for further management. Since the affected digits were out of the slab, now the rehabilitation was focused on restoring the power grip, grasp, pincer grip, and key pinch of the affected hand. All fingers were encouraged to have an active progressed to active-assisted followed by passive exercises of range of motion. Exercises for the digits that are isometric as well as isotonic exercises for the intrinsic musculature, flexors, and extensors of the fingers and wrist were done to ameliorate ranges of movement. Prehension training was taught and started for the patient. To enhance grip strength, the patient was begun with the ball-squeezing exercises. The patient was asked to hold variously sized and shaped objects in their hand like a mobile, water bottle, pen, key, etc., and maintain the grip for ten seconds. For the development of strength, the patient used his uninvolved hand to provide resistance to flexion, extension, abduction, and adduction. The use of a rubber band is resistance to the finger for building up strength in the lateral prehension. Pad to pad, tip to tip, and pad to side prehension exercises were taught and begun. This exercise protocol was performed twice a day by the patient. The improved ranges after the treatment are mentioned in (Table 4).

Table 4 range of motion after the rehabilitation

	Joint movement	Left		Right	
		Active	Passive	Active	Passive
Hip joint	Flexion	120^0	125^0	120^0	125^0
	Extension	25^0	30^0	20^0	30^0
	Abduction	25^0	30^0	45^0	48^0
	Adduction	30^0-0	35^0-0	40^0-0	45^0-0
	Internal rotation	30^0	40^0	40^0	45^0
	External rotation	30^0	40^0	40^0	45^0
Knee joint	Flexion	95^0	100^0	130^0	140^0
	Extension	110^0-0	125^0-0	145^0-0	150^0-0
Ankle joint	Plantar flexion	40^0	50^0	45^0	50^0
	Dorsiflexion	10^0	20^0	15^0	20^0
	Inversion	30^0	35^0	30^0	35^0
	Eversion	20^0	25^0	20^0	25^0
Shoulder joint	Flexion	150^0	155^0	175^0	180^0
	Extension	20^0	25^0	30^0	30^0
	Abduction	170^0	175^0	175^0	180^0
	Adduction	30^0-0	35^0-0	40^0-0	45^0-0
	Internal rotation	30^0	40^0	50^0	55^0
	External rotation	30^0	40^0	60^0	65^0
Elbow Joint	Flexion	120	125^0	140^0	150^0
	Extension	130^0-0	135^0-0	145^0-0	150^0-0
Wrist Joint	Flexion	135^0	140^0	145^0	150^0
	Extension	5-0^0	5-0^0	5-0^0	5-0^0
	Pronation	75^0	80^0	85^0	90^0
	Supination	75^0	80^0	85^0	90^0
Proximal interphalangeal joint	Flexion	95^0	100^0	95^0	100^0
	Extension	5^0	7^0	5^0	7^0
Distal interphalangeal joint	Flexion	65^0	70^0	65^0	70^0
	Extension	5^0	8^0	5^0	8^0

Follow up and outcome of interventions

Disabilities of the Arm, Shoulder, and Hand Scale: Pre-treatment score – 50/100; Post-treatment score -15 /100

4. DISCUSSION

The medial and lateral structures serve as key stabilizers of ankle (Kusnezov et al., 2017). In a study of ankle fracture outcomes after surgical process, isolated fractures of medial malleolar were linked to long-term poor function when in comparison to other types which makes it important for medial malleolus's anatomic reduction and internal fixation along with timely physiotherapeutic rehabilitation for fracture healing and function restoration along with the independent restoration of functional efficiency (Vajapey and Harrison, 2020).

Fractures of Phalanges are most prevalent ones in fractures of upper limbs, with the PIP usually affected. While there are several surgical treatments for treating proximal phalanx fractures, the outcomes are frequently suboptimal. Early physiotherapy rehabilitation allows free mobility. The rehabilitative approach was performed by the patients actively for proximal along with distal joints the inter-phalanx, which helps in preventing limited mobility, swelling, and rotational and axial abnormalities increasing the functional ability of patients for a better outcome (Figl et al., 2011).

5. CONCLUSION

After five weeks of rehabilitation and a home exercise routine, there was a gain in joint range of motion, muscle strength, and functional independence markedly employing physical therapy approaches. This case study emphasizes the significance of thorough physical therapy following a Medial malleolus and Compound grade II proximal phalanx fracture of fourth and fifth digit with operative management to assure the patient's successful recovery.

Author's contribution

SP evaluated the patient. SP and ML did assessment in documentation and formatting of the manuscript, SP ML and PP gave approval to manuscript.

Informed Consent

The patient provided informed oral consent.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Bruder A, Taylor NF, Dodd KJ, Shields N. Exercise reduces impairment and improves the activity in people after some upper limb fractures: a systematic review. J Physiother 2011; 57(2):71–82. doi:10.1016/S1836-9553(11)70017-0.
2. Bulut T, Gursoy M. Isolated Medial Malleolus Fractures: Conventional Techniques Versus Headless Compression Screw Fixation. J Foot Ankle Surg 2018; 57(3):552–556. doi:10.1053/j.jfas.2017.12.005.j
3. Figl M, Weninger P, Hofbauer M, Pezzei C, Schauer J, Leixnering M. Results of dynamic treatment of fractures of the proximal phalanx of the hand. J Trauma 2011; 70(4): 852–856. doi:10.1097/TA.0b013e3181e51149.
4. Gaspar MP, Gandhi SD, Culp RW, Kane PM. Dual Antegrade Intramedullary Headless Screw Fixation for Treatment of Unstable Proximal Phalanx Fractures. Hand (N Y) 2019; 14(4):494–499. doi:10.1177/1558944717750919.
5. Jaffe D, Christian MW, Weber A, Henn RF. Incarceration of the Posterior Tibial Tendon in an Isolated Comminuted Medial Malleolus Fracture. J Foot Ankle Surg 2017; 56(6):1312–1315. doi:10.1053/j.jfas.2017.05.016.
6. Kusnezov NA, Eisenstein ED, Diab N, Thabet AM, Abdelgawad A. Medial Malleolar Fractures and Associated Deltoid Ligament Disruptions: Current Management Controversies. Orthopedics 2017; 40(2):e216–e222. doi: 10.3928/01477447-20161213-02.

7. Labronici P, Pires R, Franco M, Freitas R, Araújo G, Pires e Albuquerque R, Gameiro V, Jeray K. Medial Malleolar Fractures: An Anatomic Survey Determining the Ideal Screw Length. Ann Med Health Sci Res 2016; 6(5):308–310. doi:10.4103/amhsr.amhsr_41_16.
8. Mishra AK, Adhikari V, Chalise P, Shrestha P, Singh R. Jess Fixator for Metacarpal and Phalangeal Fracture. Nep Med Coll J 2019; 21(1):48–52. doi:10.3126/nmcj.v21i1.24853.
9. Shah D, Shetty S, Shetty M, Hegde RM, Nbsp SS. Functional Outcome Of Fracture Of Metacarpals And Phalanges Managed With Jess. IJOTSS 2019; 5(1):176–182. doi:10.47618/IJOTSS/v5i1.42.
10. Vajapey SP, Harrison RK. Hook Plate Fixation of Medial Malleolar Fractures: A Comparative Study of Clinical Outcomes. J Foot Ankle Surg 2020; 59(5):969–971. doi:10.1053/j.jfas.2018.12.048.