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## Research Article

# SIMPLE MODIFIED TRACTION DEVICE FOR PHALANGEAL FRACTURES-A PROSPECTIVE STUDY

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### ABSTRACT

**Background:** Phalangeal fractures are the most common fractures of the hand & are difficult to treat. They may result in long lasting deformity irrespective of mode of management. Surgical management and internal fixation devices results in adhesions of soft tissues, hindering tendon gliding and resulting in stiffness & reduction in range of movements. On the other hand conservative management using customised splints may not be able to hold the fractured fragment in proper alignment resulting in delayed union or malunion in addition to time taken for making and availability of these splints. Thus the need of a technique which is non invasive, easily available, cost effective and which holds the fractured fragment in proper alignment resulting in achieving excellent functional outcome.

**Materials and methods:** All acute patients of closed displaced proximal or middle phalangeal fractures were included (n=30). Patients were evaluated clinicoradiologically for confirmation of fractures and rotational or scissoring deformity. They were applied splintage & traction with aluminium hanger and rubber band followed by check x-ray for reduction of fracture. After 3 weeks of application, the hanger and rubber band were removed followed by radiological evaluation and initiation of physiotherapy. All patients were evaluated at 6 months for TAM scoring.

**Results:** Total 30 patients were included in the study. 18 were proximal phalangeal fractures and 12 were middle phalangeal fractures which were managed by this technique. All patients post procedure had acceptable alignment confirmed radiologically. 02 patients developed superficial cuticular necrosis at the volar aspect of head of metacarpal of involved finger after one week which was managed conservatively and in subsequent patients additional padding was applied to prevent this complication. All patients at end of 6 months achieved satisfactory finger movement with Total active motion grading ranging from 240-270 degrees.

**Conclusion:** The technique used for the management is a simple OPD procedure and easy to learn. Aluminium hanger and rubber bands are easily available and are inexpensive. This non invasive modality prevents the tendon adhesions and offers good functional outcome in phalangeal fractures.

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## INTRODUCTION

Fracture of phalanges are common in hand injuries<sup>1,2</sup>. Various treatment options like closed reduction and internal fixation, open reduction and internal fixation, splinting and traction have been described. There is no widely accepted consensus on the treatment modality.

Surgical management and internal fixation devices results in adhesions of soft tissues, hindering tendon gliding and resulting in reduction of range of movement of interphalangeal joints. Conservative management using splints may not be able to hold the fractured fragment in proper alignment resulting in delayed union or malunion. The most important aspect of

management of hand fractures is to achieve an acceptable alignment of fracture for proper union. Undisplaced fractures are managed with volar splint but displaced fractures of proximal and middle phalanx which are functionally unstable need acceptable alignment for their management. Customized aluminium splints are a mode of treatment for conservative management of these fractures but are not easily available in a developing country like India apart from the added cost & time required for making such customized splints resulting in delayed management. Thus we used an aluminium hanger and a rubber band modified as a splint with finger nail traction for management of displaced proximal and middle phalangeal fractures of hand. The traction can be gradually increased due to elastic property of rubber band and alignment of fracture

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segment can be achieved with hand in functional position due to malleable property of aluminium. The above treatment restores anatomy, minimizes soft tissue injury, and enables early mobilization of the injured digit.

**MATERIAL AND METHODS**

Our's is a prospective study done at a tertiary care centre between November 2016 and August 2018. All patients with trauma to hand were evaluated. All patients underwent Xrays- Antero Posterior (AP), oblique and lateral views of involved hand.

All closed proximal or middle phalangeal comminuted, intraarticular, oblique or transverse fractures involving a single digit with radiological evidence of angulation greater than 15 degrees in either coronal or sagittal plane were included. Patients having proximal or middle phalangeal fractures with rotational or scissoring deformity were also included. All Open fractures were excluded.

After taking informed consent, under aseptic conditions digital block with 2% Lignocaine was given. Aluminium hanger splint was pre bent - 90 degrees at Metacarpophalangeal (MP) joint & second dorsal bend of 30 degrees at wrist joint. In this way a single aluminium hanger can be used for two patients by dividing it in exactly two halves. Thereafter using a cutting needle suture of 2-0 nylon, a bite taken from distal one third of nailplate and finger tip. Two sets of plaster of paris(POP) each 12 layers in thickness is made extending from MP joint to mid forearm level. Aluminium splint is sandwiched between the two layer of POP. After proper alignment and padding at MP joint, a knot is also given midway between the nail and the hook of the hanger. Now MP joint of involved digit is flexed at 90 degrees and holding the nylon thread with one hand optimum traction is given and fracture is reduced with other hand. Nylon thread is then tied to hanger with optimum tensioning. This is followed by rubber band tied to midway knot of nylon thread and then to distal part of hanger with multiple rounds till tensioning and alignment is achieved. The hanger and tensioning is oriented in the direction of scaphoid. (Fig-1)

After the procedure check X-ray (AP, lateral and oblique views) is taken confirming the alignment and reduction. If reduction is inadequate then the tensioning is released, realignment of hanger and retensioning is done after proper reduction. It is again confirmed radiologically. The aluminium hanger splint traction is maintained for 03 weeks. The rubber bands are used to optimize the tensioning as and when required. The patients are followed up weekly on OPD basis. After 03 weeks, splintage and traction is removed and patients are initiated upon active range of motion exercises under supervision of hand therapist. Night splintage of involved digit was continued for 02 weeks. The post reduction X-Rays were classified as good (< 10 degree malalignment), satisfactory (10-20 degree malalignment) and poor (Greater than 20 degree malalignment)

The patients were followed up at 01 month, 03 month and 06 months after traction removal. They were evaluated for range of movements with total active motion (TAM) scores at metacarpophalangeal and Interphalangeal joints, fracture segment alignment and grip strength was compared with opposite hand measured with dynamometer.

**RESULTS**

The study group consisted of 26 male and 04 female patients. Patients age ranged from 17 to 62 years with average age of 28 years. Rt hand was involved in 23, all were right hand dominant and Lt hand in 07 cases out of which 2 were left hand dominant individuals. The cause of injury were RTA in 18, sports related injuries in 10 and alleged assault in 02 cases. The location of fracture is depicted in Table 1 with most common location being shaft of proximal phalanx. Middle finger (12) was most commonly involved followed by Index (08), Thumb(04), Ring(04) and little fingers(02). The post reduction X-Ray was good in 24 cases, satisfactory in 06 cases and poor in nil. The average total active motion(TAM) achieved at 06 months was 260(range 230 to 270). According to the TAM classification,<sup>3</sup> 25 (83%) patients attained excellent, 5 (17%) attained good, and none attained poor results. (Table 2). The average grip strength at 06 months was 90% (Range 80 to 96%). Younger patients (Age <45 yrs) had better outcomes. We did not find contracture in any of the patients. There were no cases of malunion or non union. Fig 2. All patients returned to work and remained pain free at end of 6 months. 02 patient had superficial pressure ulcer over palm at MP joint which was managed conservatively and they recovered without any sequelae.

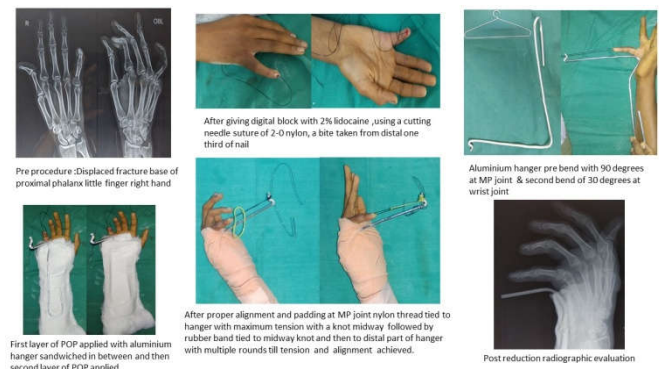


Fig 1



Fig 2

Table 1

Fracture Location	No.
Shaft of proximal phalanx(Transverse)	07
Shaft of proximal phalanx(oblique)	05
Head of proximal phalanx	02
Shaft of Middle phalanx(Transverse)	02
Shaft of Middle phalanx(oblique)	05
Comminuted fracture shaft Middle phalanx	02
Comminuted fracture Shaft Proximal phalanx	04
Intraarticular fracture base of Middle phalanx	03

**Table 2**

Fracture location	Number	TAM score		
		Good	Fair	Poor
Shaft of proximal phalanx	12	10	02	00
Head of proximal phalanx	02	01	01	00
Shaft of Middle phalanx	07	07	00	00
Comminuted fracture	06	05	01	00
Intraarticular fracture base of Middle phalanx	03	02	01	00
Total	30	25	05	Nil

## DISCUSSION

The incidence of phalangeal fractures is common in males and peaks in the age group of 10-40 years<sup>4</sup> which was also seen in our series. The proximal phalanx (PP) of the fingers is fractured more frequently than the middle or distal phalanges. The deformity with considerable displacement is typical when the Proximal phalanx is fractured.<sup>5,6</sup> Fractures of the phalanges in the hand are difficult to treat because of the presence of an important joint on either end of this bone.<sup>7,8</sup>

The aim of the treating surgeon is not only to achieve timely union with good alignment but also to preserve the gliding mechanisms of tendons. Usually in the sagittal plane, the fracture adapts a palmar apical configuration with the proximal fragment in flexion and the distal fragment in extension. This is because the intrinsic muscles flex the MP joint, hence the proximal fragment is in flexion. The distal fragment goes into extension due to the short excursion of the extensor tendon hood and lateral bands.<sup>9</sup> When reduced optimally, the fracture can be held by using a splint with traction and the stabilizing effect of tense soft tissues.<sup>10</sup>

The treatment options include open reduction and internal fixation, closed reduction and internal fixation, external fixators and conservative modalities. Open reduction and internal fixation may cause further soft tissue damage which can result in impairment of the tendon gliding.<sup>8,11,12</sup> Conservative management on the other hand avoid additional soft tissue damage and is associated with less loss of range of motion in the adjacent joints.<sup>9,13</sup> To the best of our knowledge none of the available literature at present makes use of an aluminium hanger and rubber band as splint for management of proximal and middle phalangeal fractures of hand. The collateral ligaments of the MP joint in flexed position are taut with minimal chances of stiffness due to contracture. The extension of proximal interphalangeal (PIP) joints prevents volar plate contracture.<sup>13</sup> The longitudinal traction applied in this position makes the extensor and flexor tendons tense, which provides dorsal and volar stability.

There have been previous studies on management of proximal phalangeal fractures with traction splints but very few on middle phalangeal fractures. In our series overall 83% patients achieved good results based on evaluation by TAM and hand grip. This compares favorably better with reported series using both traction splints and internal fixation. Pun *et al.*<sup>14</sup> have reported 35.7% good results with internal fixation whereas Thomine *et al.*<sup>9</sup> have reported 55% good results with functional splint application. Rajesh *et al.*<sup>8</sup> used a thermoplastic MP block splint for proximal phalangeal fractures in 32 cases without traction on the finger. In their series they reported excellent

results in 72%, good in 22% and fair to poor in 6% of the cases, similar to Koul *et al.*<sup>10</sup> Their results for younger patients were comparable to our series and showed a better outcome. Koul *et al.*<sup>10</sup> reported the results of 39 proximal phalangeal fractures treated with a custom made traction splint. They used adhesive glue to fix the traction to the nail plate and reported excellent results in 72% , good in 22% and poor results in 6%. None of the patients in this group with transverse fractures were treated by traction splint; they suggested that internal fixation is more favourable for transverse fractures, however in Jehan *et al.* series<sup>16</sup> 18(42%) cases of transverse fractures treated by digital splint and nail traction showed favourable outcome. In our series also 9(30%) cases of transverse fractures treated showed comparable results. This shows that if good reduction is achieved under digital block and then maintained with longitudinal traction and proper splinting, then transverse fractures can be treated successfully with traction splints. Similar complications of cuticular necrosis was also seen in Jehan *et al.* series<sup>16</sup> at volar aspect of MP joint which may have been avoided with proper padding.

## CONCLUSION

The results from our series show that aluminium hanger and rubber band can be efficiently used for management of closed Proximal and Middle phalangeal fractures of hand. It is a simple and easy procedure which can be done on OPD basis. It has a short learning curve and is cost effective. This non invasive modality prevents tendon adhesions and also the uninjured digits remain free for movement. The results were stable over the study period balancing the goals of fracture healing, soft tissue preservation and early recovery of composite hand function.

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