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Percutaneous fixation of mallet finger by screw – A review of 18 patients

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Abstract:-

Introduction:- As such, they are challenging fractures to treat. Proponents of non-operative management report good results even with joint subluxation. Those favoring surgery, generally do so when greater than 30% of the articular surface is involved on the basis that this will lead to joint subluxation, extensor lag, and premature osteoarthritis. Controversy exists regarding the preferred method of operative treatment, and there are a wide variety of published operative techniques, including closed reduction and percutaneous fixation, open reduction and internal fixation, and external fixation. The aim of the present study was to compare the functional and radiological outcome in patients with mallet finger. **Materilas and Methods:-**Eighteen patients with mallet fractures treated by percutaneous reduction and internal fixation with small screws were reviewed at six months. The indication for surgery was a Fracture involving the distal phalanx articular surface or with subluxation ofthe distal interphalangeal joint. **Observation and Results:-** Almost all of the patients had good results regarding function and radiological union. Three patients had early removal or irregular usage of the splint had led to some degree of extensor lag. No other major complication was noted. **Conclusion:-** Percutaneous reduction and screw fixation with small screwscan lead to satisfactory outcome in appropriate patients.

Keywords:-Mallet Finger, Percutaneous screw fixation.

INTRODUCTION

The definition of mallet fracture includes both the deformity secondary to extensor tendon rupture and due to distal phalangeal fracture pull off of the tendon.[1,2] The latter has been defined as mallet fracture. The mallet finger deformity with bone involvement is determined by an intraarticular fracture of the dorsal lip of the distal phalanx, in which the traumatic mechanism is an axial load on the extended distal interphalangeal joint(DIPJ), as occurs, for example, in sport injuries.The fracture may involve a significant large area of the articular surface and may sometimes also be associated with volar subluxation of the distal phalanx.[3]

Classification:-

Doyle classification of Mallet Fracture Injuries[4].(fig-1)

Type I – Closed injury +/- small dorsal avulsion fracture

Type II –Open laceration

Type III – Open abrasion Involving skin Loss and tendon substance

Type VI – Mallet Fracture:-

A. Distal Phalanx Physeal Injury
B. Fragment involving 20-50% of articular surface
C. Fragment involving >50%b of articular surface.

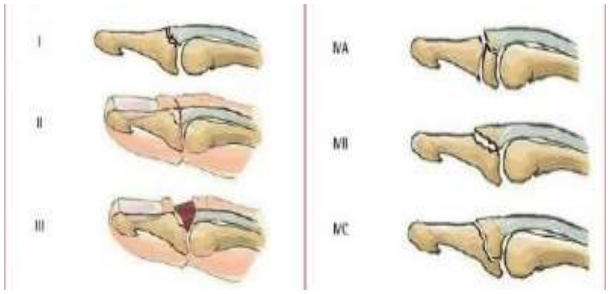

Figure 1:-Doyle classification

Wehbé and Schneider classification of Mallet Fracture Injuries[4].(fig-2)

Type I – No DIP joint subluxation

Type II – DIP joint subluxation

Type III – Epiphyseal and Physeal injury

Subtype:-

A. <1/3 Articular surface
B. 1/3 – 2/3 Articular surface
C. >2/3 Articular surface

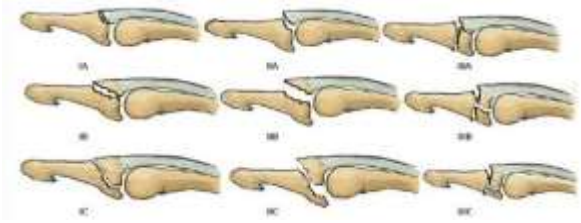

Figure 2:-Wehbé and Schneider classification

Tubiana (Left) and ModifiedTubiana (Right) Classification (fig – 3):-

Epidemiology:-Mallet finger lesions are common, with a prevalence of 9.3% of all tendon and ligament lesions in the body and an incidence of 5.6% of all tendinous lesions in the hand and wrist. Globally there is no gender difference is present in the affected population, although high-energy mechanisms of injury are more common in young males and low-energy mechanisms of injury are common in elderly females.[5]

All authors say that the index and thumb fingers are the least frequently affected. However, some researchers have described the middle finger as the most affected, whereas others have identified the ring finger to be the most affected, and still others the little finger. The dominant hand is more often affected.[1,2,4] Tendinous mallet finger is however more common than bony mallet finger. Some authors have also proposed that a family predisposition may contribute to mallet finger[3,4,5,6].

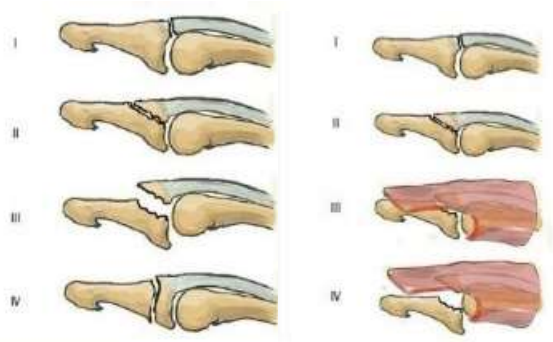

Figure 3:-Tubiana (Left) and ModifiedTubiana (Right) Classification

Mechanism of injury: -Specific biomechanical studies have not elucidated the exact mechanism of injury in the mallet finger, several theories have been proposed (Fig. 4).[7,8]

The process is divided into two major steps by all researchers. The very first step is the application of an axial force to the distal end of a straight finger involved. The second step varies among authors.[8]

None of these theories have been proven. The amount of energy involved depends on the patient's age. In younger individuals, mallet finger is most often the result of a highenergy injury during sports, involving the impact of a ball onto the hand.[8,9]

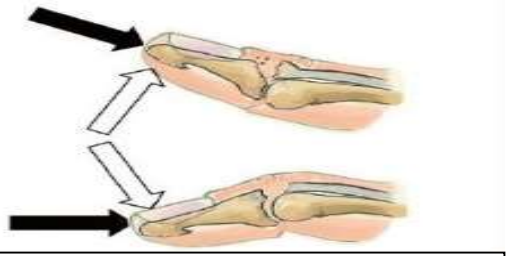

Figure 4:- Mechanism of injury

Multiple-digit injuries have been described. In patients of older age, the mechanism of injury is more often a low energy sedentary activity. Examples include injuries sustained while making a bed or putting socks on. In children it is more often a direct impact with a crushing mechanism in a door.[10,11]

Most fractures are intraarticular with instability caused by flexor/extensor tendon imbalance, which if left untreated, may lead to a secondary swan neck deformity of the finger and premature osteoarthritis, pain, and stiffness.[1,12,13]

Fig 5:- Conservative management[4]

Indication for operation:- The size of the fracture fragment involved, the percentage(%) of joint surface involvement and the association with joint subluxation have all been offered as indications for operative intervention in mallet finger fracture.[3,5,12]

There still remains no clear consensus regarding the indications for operative intervention in the literature. Once the decision to intervene surgically has been made, the surgeon is confronted with a litany of options. Usually the operative fixation is indicated when more than 30% of the articular surface is involved with or without subluxation of the joint rest conservative.[1,3,4,5,12,13]

Controversy exists regarding the preferred method of operative treatment, and there are a wide variety of published operative techniques, including closed reduction and percutaneous fixation[5] (fig-6&7), open reduction and internal fixation[6] (fig-8), and external fixation.

Fig 6:-Closed reduction and percutaneous fixation

Complications: - Reported with both non-operative and operative treatment modalities, although infection and wound breakdown are the worry with surgical intervention.[5,9,10]

The wide variety of reported operative techniques suggests that treatment is determined primarily by individual experience rather than by an established evidence base. King et al. reported that about 41% of patients with surgically-treated mallet fractures developed postoperative complications.[2] Problems with open operations include formation of soft tissue scars with subsequent stiffness of joints, risk of fragmentation of the fracture, infection at the site of the pin, deformity of the nail, and skin necrosis.[10,11,13]

A large number of surgical techniques have been described in literature, with variable results. Distal interphalangeal joint fractures have been fixed by various different methods including screw, plate and suture techniques. The treatment options for mallet fractures of the distal phalanx range from splinting, to surgical fixation using percutaneous pins, pull-out wires, microscrews, interosseous wires, tension band wiring, screw fixation.

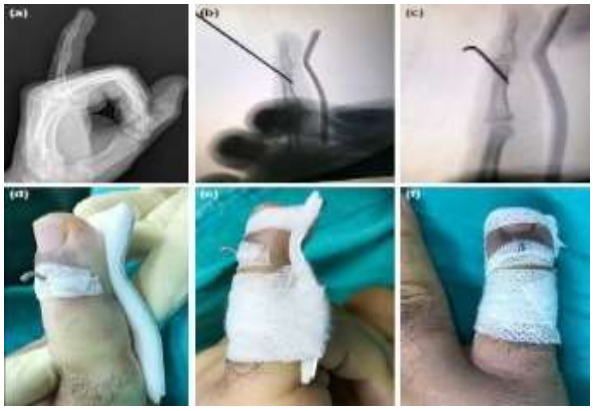

Fig 7:- Closed reduction and percutaneous fixation

AIMS and OBJECTIVES:-

The aim of surgery is:-

1. To reduce the fracture fragments anatomically
2. Osseous stability
3. Minimization of extensor lag
4. To commence early active movement of the joint
5. To prevent stiffness.

Fig 8:- Open reduction andfixation[7,8,9]

MATERILAS and METHODS:-

All the patients coming to Patna Bone and Spine Hospital from March 2018 to Feb 2020 within 7 days of injury giving written consent for the trial, fit for anaesthesia, without any associated fracture in the same finger was taken for study. Patients of age group 18 to 55 years were included in the study. Open injury or lacerated wounds at the site of fracture were not included in the study. Patients having head injury and any serious co-morbid condition were excluded from the study.

Eighteen cases were included in this study. All the cases were operated under local anaesthesia by ring block. Records were made about the sex, mode of injury, time since injury, degree of deformity, size of the fragment, side involved, number of fingers involved, name of the finger involved.(**Table 1**)

Pre-operatively regular radiograph and routine blood investigations needed were carried out and pre-anesthetic checkup was done.

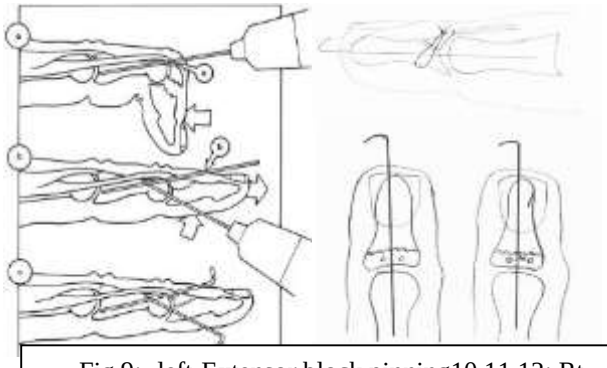

Fig 9:- left-Extensor block pinning10,11,12; Rt-Intraosseous Suture Technique13

Operative Procedure: -Under adequate aseptic precaution painting draping of the part done. Local anesthetic as ring block to the desired finger was given. After the complete effect of local anaesthesia closed reduction was done and checked in the image intensifier.

The site of incision was confirmed by the image intensifier and then with eleven no knife 2-3 mm incision was made. Under image intensifier control the drilling was done and 1.5mm screw of adequate length was applied keeping the fracture reduced.

After screw application the reduction was checked in the image intensifier again and correction in deformity was noted. Single stitch was sufficient for wound closure. Dressing with handiplast done. Frog splint was applied without any hyperextension.

Post-op Management: -Immediate post op X-ray was done. Limb was kept in elevation and normal movement of the hand allowed with the splint.

After 3-4 weeks the splint was removed and the involved DIPJ was mobilized. At the end of 6 weeks repeat x-ray done and any complication was noted. Final follow-up was done at the end of 6 months and x-ray done and function of the fingers in the form of Range of motion and grip strength was noted clinically.(**Table 2**)

OBSERVATIONS and RESULTS:-

Table 1:-Patient statistics and Pre-op findings

S. No.	Sex	Age in yrs	Mode of injury	Time since injury	Side	Degree of deformity	Size of the fragment	Name of the finger
1.	M	19	Cricket ball	6 Hrs.	Left	30^0	<1/3	Ring
2.	F	18	Cricket ball	12 Hrs.	Right	30^0	1/3 – 2/3	Middle
3.	M	25	Cricket ball	12 Hrs.	Left	30^0	<1/3	Middle
4.	M	35	RTA	6 Hrs.	Left	30^0	1/3 – 2/3	Ring and Index
5.	M	22	Cricket ball	2 days	Left	20^0	1/3 – 2/3	Ring
6.	M	50	House hold	4days	Right	30^0	1/3 – 2/3	Middle
7.	F	42	RTA	1 day	Left	20^0	<1/3	Index
8.	M	21	RTA	3days	Right	20^0	1/3 – 2/3	Index and Middle
9.	M	44	House hold	5days	Right	30^0	<1/3	Ring
10.	M	37	Cricket ball	1 day	Left	30^0	1/3 – 2/3	Ring
11.	F	36	RTA	12 hrs.	Left	30^0	1/3 – 2/3	Middle
12.	F	26	RTA	6 hrs.	Left	30^0	<1/3	Middle
13.	M	55	House hold	1 day	Left	20^0	<1/3	Ring
14.	M	18	RTA	1 day	Left	30^0	1/3 – 2/3	Middle
15.	M	24	Cricket ball	5 days	Left	20^0	<1/3	Ring
16.	M	25	Cricket ball	3 days	Right	40^0	1/3 – 2/3	Ring
17.	M	31	RTA	2 days	Left	30^0	1/3 – 2/3	Middle
18.	M	48	RTA	12 Hrs.	Right	30^0	1/3 – 2/3	Middle

Table 2:-Final Post-op results

S.No.	Degree of Deformity	Grip strength	Malunion
1.	0^0	Comparable	No
2.	10^0	Comparable	No
3.	10^0	Comparable	No
4.	0^0 in Ring and 5^0 in Index	Comparable	No
5.	0^0	Comparable	No
6.	15^0	Reduced	Yes
7.	10^0	Comparable	No
8.	10^0 in both fingers	Reduced	No
9.	0^0	Comparable	No
10.	0^0	Comparable	No
11.	10^0	Comparable	No
12.	10^0	Comparable	No
13.	15^0	Reduced	Yes
14.	10^0	Comparable	No
15.	0^0	Comparable	No
16.	0^0	Comparable	No
17.	0^0	Comparable	No
18.	15^0	Reduced	Yes

Complications:-None of the screw had prominence clinically as well as radiologically. All the wounds healed well. There were no nail deformities. None patient had a second procedure related to the mallet injury or surgery. Three of the patients had early splint removal / irregularity of splint usage has caused some degree of deformity clinically.

Radiographic data:-Radiographic union was documented within 10-12 weeks inall patients. Articular incongruity was less than 1mm in17 patients and was >1<2mm in one patient. None of the patients had evidence of degenerative arthritis at this short time period.

DISCUSSION:-

Some surgeons feel that the risks of operative treatment of mallet fractures are not justifiable given the good results of non-operative treatment. Others also believe articular incongruity will lead to eventual symptomatic arthritis, extensor lag or deformity and thus recommend operative intervention to restore the integrity of the joint. Non-operative treatment has proved effective in mallet finger deformity due to disruption of the extensor tendon, but mallet fractures should be considered as a different entity. These patients usually have a fracture of the distal phalanx articular surface and they often occur in young individuals.

They usually result from axial loading on the tip of the extended finger as occurs when trying to catch a ball. Few authorsdocumented satisfactory results after splint treatment, even in cases in which the fracture involved more than one-third of the articular surface or there was joint subluxation. They contended that the only problems encountered were cosmetic problem and that patients achieved a satisfactory range of motion as a result of articular remodeling.

However, within their relatively short follow-up time of just over three years, half of their patients haddegenerative changes on radiographs (joint space narrowing, osteophyte formation, and subchondral sclerosis). They found that decreased range of motion and degenerative changes were common in the presence of subluxation or significant fracture displacement preoperatively.Others have also recommended accurate reduction of the articular surface, especially in those fractures involving more than one-third of the joint surface. This is done in the belief that restoration of the joint surface will prevent secondary degenerative osteoarthritis, loss of motion, and cosmetic deformity.

Various operative procedures have been described, ranging from percutaneous fixation to open reduction with internal fixation with screws. Adverse outcomes of operative treatment include nail deformity, wound dehiscence, pulp scarring, pulp pain, and non-union or mal-union,infections including pyoarthritis or osteomyelitis. Operative complications were most commonly reported with Kirschner wire fixation and may be due to technical errors.

This technique has the theoretical advantage ofnot requiring pinning of the distal interphalangeal joint,may reduce the likelihood of injury to the distalinterphalangeal joint(DIPJ). Even though these fractures canconstitute a large portion of the articular surface, theycan still be quite very small and usually require treatment with smallscrews with small heads.

The screws used in this studyrequired only a 1mm drill bit, which reduced the risk offracture fragmentation. The smallest AO screw is1.0mm in size and it has a much larger head. We used 1.5 mm screws with head having cross serration for better hold of the screw with screw driver while applying, thus we were able to pass the screw in single shot.

CONCLUSION:-

Although the technicality of the procedure quiet demanding our method of fixation of mallet finger shows promising results in short time period. This method needs lots of patience while operating to ensure single shot insertion of drill and screw.

LIMITATION:-

A very small number of patients were included in the study and only one center was involved follow up was for relatively small duration. Further study with larger group of patients and longer follow up is needed.

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