



# Treatment of Mallet Finger Deformity with Ring Splint

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## ABSTRACT

Mallet finger deformity is the loss of active extension on distal interphalangeal joint and possessing hyperextension deformity on PIP joint. Although there are several treatment alternatives for mallet finger deformity, optimal treatment is unclear. In this paper, we discuss Mallet finger deformity caused by blunt injuries in the late term in a 7-year-old patient, who underwent second surgery. We also discuss the results of subsequent physiotherapy program.

**Keywords:** Mallet finger, splint, tendon

## Introduction

The Mallet Finger deformity develops due to the avulsion of the central slip of the extensor tendon at the distal phalanx floor or due to extensor zone I laceration (1). Active extension loss in the DIP (Distal Interphalangeal) joint leads to flexion deformity, which causes functional and aesthetic problems.

Later in the process, hyperextension deformity in PIP (Proximal Interphalangeal) joint accompanies extension loss in the DIP joint (2).

There are surgical and conservative treatment options in Mallet Finger deformity in accordance with the shape, degree and place of the damage (3). Although there are various treatment options for Mallet Finger deformity, optimal treatment is still unclear. The first option for conservative treatment is splinting and exercise (3, 4). Surgical treatment options for primary bone fragment ruptures include open or closed reduction and K-wire fixation; if there is a long enough tendon part in the distal, tenorrhaphy or fixation of the tendon with pull-out techniques in avulsions close to the bone is also preferred. Secondary interventions are tendon plication or arthrodesis (5). Although primary treatment

is satisfactory, secondary treatment approaches are not evenly successful in neglected cases (6).

In this study, we present the successful results of secondary surgery, splinting and exercise application in our case who was admitted in the late period due to Mallet Finger deformity.

## Case Report

A seven-year-old male patient was admitted to an external center after a desk fell on his hand; D2-D3 proximal phalanx fracture was detected in his right hand in the X-ray and finger splint was applied (Figure 1). In his follow-up, he had motion limitation in the 3<sup>rd</sup> finger and had mallet finger deformity. Because no bone pathology was found; the patient, who was admitted 6 weeks after the injury, was diagnosed with extensor tendon central slip elongation. Tendon plication was performed and the DIP joint was fixed with K-wire at hyperextension. K wire was removed after 4 weeks (Figure 2).

Upon the continuation of the disability of extension, he was referred to the Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Hand Physiotherapy Unit. Informed consent was received from his family. The MCP, PIP

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and DIP joint flexion and extension angles of the 3<sup>rd</sup> finger before and after the ring splint were evaluated with goniometer according to neutral zero method.



**Figure 1a-b.** (a) Preoperative radiography of the patient (Lateral view). (b) Preoperative radiography of the patient (Front view)



**Figure 2.** The first view of the patient after surgery

### Physiotherapy

The use of a splint in mallet finger deformity is an indispensable part of the treatment. The most important problem encountered in the use of a splint is the skin problems related to splint usage and the prevention of the use of finger. Ring splint is preferred because it does not cause skin problems and allows the use of the hand in daily life activities. DIP and PIP joints are measured circumferentially for ring splint application and it is prepared specific to the patient by adjusting so as to correct the deformity.

The patient underwent fixation with K-wire after surgery, and PIP joint flexion exercises were given (4 times a day with 10 repetitions) after applying ring splint in the 6<sup>th</sup> week, which kept the DIP joint at extension; the exercises were also taught to the family to be performed as a home program (Figure 3). The joint range of motion measurements of the patient before physiotherapy is shown in Table 1.



**Figure 3a-b.** (a) The appearance of the patient with a ring splint in the 10th week after surgery. (b) The appearance of the patient without ring splint in the postoperative 10th week



**Figure 4a-c.** (a) The appearance of the patient with a splint on the PIP joint in the postoperative 16th week. (b) Finger extension of the patient in the 16th week after surgery. (c) Finger flexion of the patient in the 16th week after surgery

**Table 1: Joint range of motion measurements before physiotherapy**

3 <sup>rd</sup> Finger	Extension/Flexion (Degree)
MCP	0/90
PIP	+30/90
DIP	-50/60

MCP: Metacarpophalangeal, PIP: Proximal Interphalangeal, DIP: Distal Interphalangeal

**Table 2: Joint range of motion measurements after physiotherapy**

3 <sup>rd</sup> Finger	Extension/Flexion (Degree)
MCP	0/85
PIP	+10/100
DIP	-20/60

MCP: Metacarpophalangeal, PIP: Proximal Interphalangeal, DIP: Distal Interphalangeal



In the 12<sup>th</sup> week, the DIP extension angle was improved and the PIP joint tended towards hyperextension; therefore, the ring splint was modified and used in a way to avoid PIP joint hyperextension. Because there was a 10-degree hyperextension in the PIP joint of the patient in the end of the 16<sup>th</sup> week, the use of the ring splint for the PIP joint was continued (Figure 4). The splint did not prevent the upper extremity to be used in daily life activities.

The functional outcome of the patient in the 16<sup>th</sup> week was considered to be good according to Crawford Criteria (Figure 4).

The last joint range of motion measurements in the 16<sup>th</sup> week is shown in Table 2.

## Discussion

Childhood hand injuries are most often caused by household accidents. The development of mallet finger deformity as a result of zone I extensor tendon cuts is a common type of injury (5).

Injuries leading to mallet finger deformity are the rupture of the central slip of the extensor tendon at the zone I level, its avulsion from the bone or rupture with a piece of bone from the region where it sticks to the bone. In addition to open surgery and interventional minimal invasive methods; although there are conservative treatment options such as splinting for mallet finger deformity in parallel to how it occurs, there is also a high rate of negligence (7-9).

In the surgical treatment, the distal end of the tendon is fixed to the bone through pull-out techniques when there is not a distal part long enough to perform a primary tenorrhaphy. In all cases, the K-wire is used to fix the DIP joint at hyperextension. The K wire should remain in the mid phalanx and should not extend to the PIP joint. Secondary surgical treatments, although less satisfactory, can be applied in cases where the primary treatment has failed or in neglected cases; these are the interventions of stretching the elongated tendon by folding over itself and shortening it, and fixation of the tendon to the distal phalanx by being separated from the proximal region through pull-out techniques, or arthrodesis interventions.

Valdes et al. (3) have stated in their systematic reviews on conservative treatment in mallet finger that there are immobilization methods with different orthoses in conservative treatment of the mallet finger, and that the immobilization duration should be continued for 6-8 weeks and it should be applied for 4 more weeks later.

In our study, we applied exercise with ring splint for 6 weeks after full immobilization and continued immobilization at night. In the literature, many studies state that the splints used in mallet finger treatment cause skin problems (6). The advantage of ring splint is that it does not cause skin problems and allows the use of hand in daily life activities.

In the evaluation of the results of the mallet finger deformity, the Crawford classification is preferred (7, 8). We also used the Crawford classification in our study. Bloom et al. (9) have stated that patient training and regular follow-up play an important role in both conservative and surgical treatment of mallet finger. The active participation of the family in the treatment process and the compliance of the patient with the rehabilitation program also affect the success of the treatment (5). Ring splint and exercise therapy do not have any restrictions except for mentally disabled people (10).

## Conclusion

In a 7-year-old boy who underwent an unsuccessful secondary surgery because of a neglected mallet finger deformity, the deformity was corrected as well as the use of hand in daily living activities was increased thanks to the use of a ring splint and regular physiotherapy. We think that good results can be obtained in neglected cases along with detailed evaluation, appropriate splint and regular follow-up.

**Informed Consent:** Written informed consent was obtained from

patients' parents who participated in this study.

**Peer-review:** Externally peer-reviewed.

## Author Contributions:

Concept - E.G.; Design - Z.H.; Supervision - E.G.; Resources - Z.H.; Data Collection and/or Processing - Z.H.; Analysis and/or Interpretation - Z.H., E.G.; Literature Search - Z.H.; Writing Manuscript - Z.H., E.G.; Critical Review - E.G.; Other - Z.H.

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