

Multi level Injury from High-energy Trauma in Sports: Case Report

Seppi S*, Vecchi S, Agnetti S, Ghezzi I and Pajardi G

Hand Surgery Department, S. Giuseppe Hospital, Plastic Surgery School, Milan, Italy

Abstract

Objective: Verify the efficacy of rehabilitative treatment according with splinting and early mobilization on a patient with joint and tendon injury after sport activity.

Methods: The patient is a 39 years old caucasian man, he arrived at the emergency department for high-impact trauma during sport activity. The diagnosis was avulsion of the volar plate at the proximal phalanx and extensor tendon rupture at the distal phalanx. The surgical approach has been reinsertion of the volar plate at the base of the middle phalanx with 2 micromytec anchors and extensor tendon tenorraphy after stabilization with transarticular Kirschner wire. He was subsequently subjected to early and protected mobilization program. The patient was assessed with the PRWHE, VAS and ROM every 7 days after surgery.

Results: The results obtained following the settled clinical protocol are encouraging for the VAS, that improved from 8 to 2 points from the first to the last evaluation. Also the PRWHE index gave excellent results going from an initial value of 88/100 to a ending value of 3/100.

Conclusions: The patient reached an excellent recovery of flexion-extension of the proximal interphalangeal joint and distal interphalangeal joint, he reintegrated gesture and functionality of the finger and hand in ADL and sport activities, thanks to an early mobilization protocol and to a continuous adaptation of the splinting.

Keywords: Interphalangeal joint; Sports trauma; Joint injuries; Mallet finger

Introduction

The activities of daily living (ADL) demand that the joints of the hand be both stable and allow for mobility. The hand requires stability to intricately transmit power from the forearm musculature to the fingertips. At the same time, the hand requires mobility to position the digits for countless tasks. However the joints are vulnerable to damaging forces that may injure the supporting joint capsules and ligament complexes [1].

The complexity of a joint injury ranges from stable dislocation to contracture. An unstable dislocated joint indicates a joint that does not maintain stability following anatomic reduction. In a joint contracture, the soft tissue around the joint becomes tight in the shortened position, thus limiting range of motion (ROM). The soft tissue structures affected in a joint injury progresses through three phases of healing to produce and remodel scar. The inflammation phase occurs from 0 to 5 days; followed by the proliferative fibroplasia phase, lasting 5 days to 4 to 6 weeks; and the scar-remodelling phase, which begins approximately 6 weeks after the injury and continues for years. Tendon healing to bone without operative intervention requires 6 to 8 weeks before placing unrestricted tension on the tendon (e.g., soft tissue mallet and central tendon injuries) [1-3].

PIP (Proximal Interphalangeal) and DIP (Distal Interphalangeal) joint injuries and tendon lesions often occur during sport activities. If DIP is flexed, the impact on the longitudinal axis causes a hyper flexion of more than 45°. This condition can bring to an extensor tendon avulsion from the distal phalanx, known as “mallet finger” [3-8].

If the impact is significant, it also causes a PIP hyperextension and stresses the volar plate. A subluxation of PIP occurs if the intensity of the impact is stronger than the volar plate resistance. In 85% of cases there is a dorsal dislocation with a volar plate avulsion from the middle phalanx base [1,5,9].

This case report shows the efficacy of rehabilitative treatment according to splinting and early mobilization on a patient with this

kind of joint and tendon injury. Evidence-based literature is lacking, clinical studies recommend an early motion program even following potentially unstable injuries [1,5,10]. The benefits include the potential to improve the quality and rate of fracture healing through the use of intermittent and limited loads, improved connective tissue healing due to physiologic stress applied early on it, and improved soft tissue mobility (tendon excursion) around the injury site. These benefits are negated if the motion contributes to fracture malunion or nonunion or joint instability. On the other hand, prolonged immobilization leads to pain, degenerative changes, arthrofibrosis and joint stiffness. Immobilization beyond 4 weeks for hand fracture generally has long-term detrimental effects [1-6].

Deciding on how early motion should be applied involves determining the number of joints moved at a time, the type (active or passive) of motion, the duration of motion, and the safe arc of motion. The goal of an early motion program is to provide the minimum amount of stress to healing tissues while allowing for the right amount of excursion of soft tissues to prevent motion-limiting adhesions. “Minimum” and “right” amounts are different for each patient and injury [1,3].

Methods

The patient is a 39 years old Caucasian man. He comes to the emergency department for high impact trauma (middle finger) occurred during boxing training. The diagnosis is volar plate avulsion

***Corresponding author:** Simone Seppi, Hand Surgery Department, S. Giuseppe Hospital, Plastic Surgery School, Milan, Italy; Tel: +393388279828; E-mail: simone.seppi@gmail.com

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at PIP (2° group cl. Eaton and Littler) and “mallet finger” lesion. He is treated surgically. Volar plate is reinserted at the base of the middle phalanx with 2 micromytek anchors and extensor tendon is repaired after stabilization with transarticular Kirschner wire. In the immediate post-op, the hand therapist applies a removable digital splint that immobilizes PIP at -15° of extension and DIP at 0° and the rehabilitative treatment starts. The patient was assessed with the PRWHE [11], VAS and ROM every 7 days after surgery.

PRWHE is the Patient Rated Wrist and Hand Evaluation. The PRWHE is a 15-item questionnaire designed to measure wrist pain and disability in activities of daily living. Developed in 1998 for clinical assessment and is used for specific wrist problems. It is one of the reliable upper extremity outcome instrument.

ROM was assessed with specific finger goniometer after the session of physical therapy. We have considered for both joints the Active Range of Motion (AROM) for evaluate stiffness and tendons adhesions.

According to the surgeons we have managed the patient with following protocol:

0-3 days

RICE (resting, ice, compression, elevation)

3 days to 6th week

Edema and pain control: PIP AROM: the therapist works in order to achieve a painless AROM of 90° of flexion and -15° of extension. A target splint at 90° of flexion is used during exercises, while extension is limited by the dorsal digital splint (Figures 1 and 2). DIP movement is protected by a digital splint that the patient wears during PIP flexion (Figure 3).

Scar management: The hand therapist shows the patient an exercises program that he should do at home 4 times per day. Every exercise should be repeated 10 times.

The home program consists in:

- ✓ Intrinsic muscles activation
- ✓ PIP active flexion until target (90°), keeping wrist, MP and DIP extended
- ✓ PIP active extension until 15°.

7th to 9th week

At the end of the 6th week, the k-wire is removed.

PIP: the patient is allowed to do exercises without AROM limitation both in flexion and extension. The therapist gradually stretches volar plate. DIP: the patient flexes DIP with a target volar splint starting with 15°/20°. AROM in flexion increasing 10°/20° every week only if DIP extension is kept. Initially, PIP joint is maintained flexed during DIP flexion in order to avoid stress on LRO. After 9 weeks the patient flexes DIP keeping PIP at 0° (Figure 4).

Scar management: the therapist massages the apical scar that usually presents an altered sensibility.

The home program consists in:

- ✓ Isometric and concentric activation of extensor tendon at distal phalanx level
- ✓ Intrinsic muscles activation (Figures 5-7)
- ✓ PIP active flexion without target



Figures 1: Removable Static Dorsal Splint.

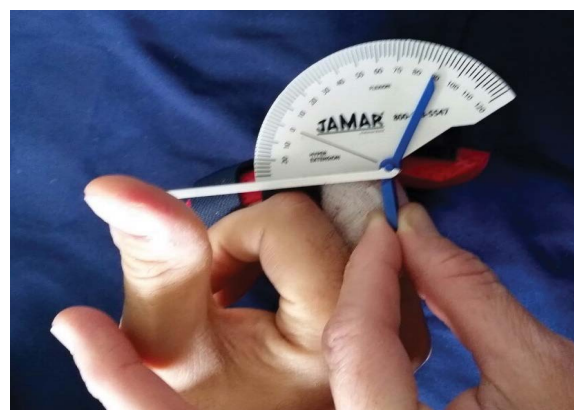


Figure 2: 90° PIP flexion in the first 6 weeks.

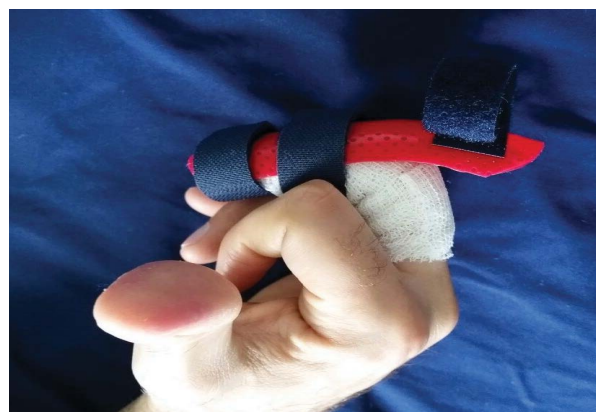


Figure 3: Flexion of PIP keeping DIP in extension.

- ✓ PIP stretching
- ✓ Gradual mobilization of DIP joint with PIP kept in flexion

10th to 12th week

PIP and DIP AROM and PROM improvement: the therapist realizes two static progressive splints: one in extension of PIP (Figure 8) and the other one in flexion of both PIP and DIP joint (Figures 9-10). The



Figure 4: After 9 weeks the patient flexes DIP keeping PIP at 0°.

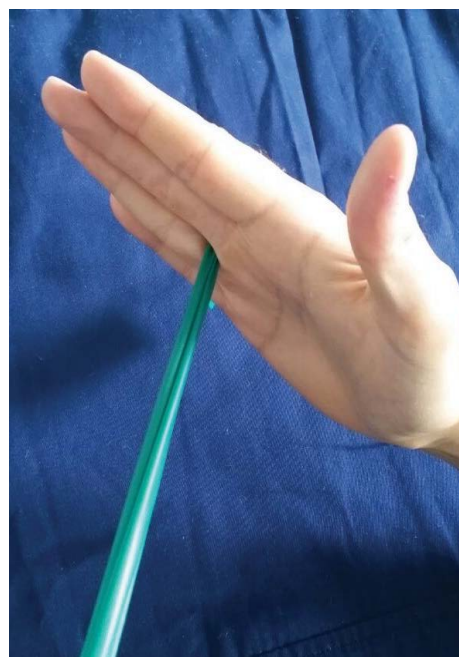


Figure 7: Strengthening of intrinsic muscles.



Figure 5: Strengthening of intrinsic muscles.

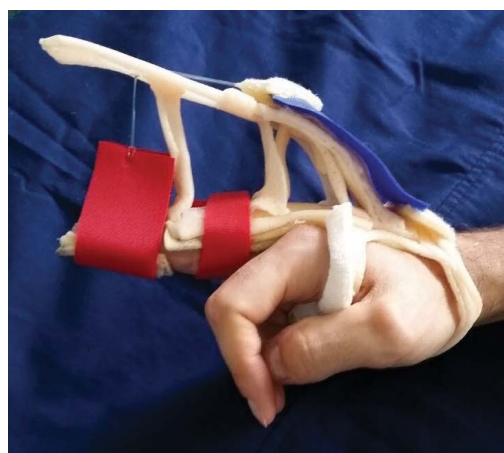


Figure 8: Extension Static Progressive splint for PIP Joint.

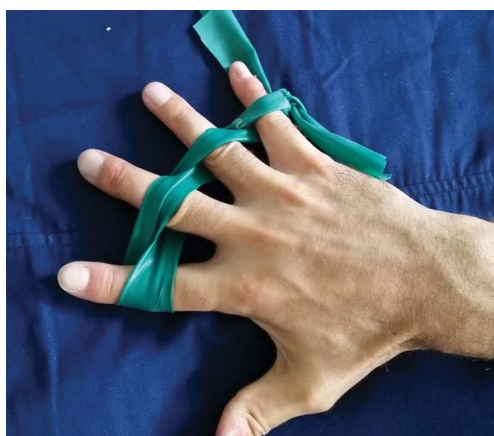


Figure 6: Strengthening of intrinsic muscles.



Figure 9: Static Progressive splint for flexion of both PIP and DIP joint.



Figure 10: Static Progressive splint for flexion of both PIP and DIP joint.

tension applied on the finger by the flexion splint should be moderate to avoid excessive stress.

After 12 weeks

PIP and DIP AROM and PROM improvement: the direction of traction in flexion splint is modified by the therapist in order to apply a more intense and selective force. MP joint is kept at 0°: this is the best position for intrinsic muscle stretching.

Recovery of selectivity, fluency and speed of movements during ADL: Muscle strengthening program: The therapist works in order to strengthen fingers flexors and extensors, wrist extensors, interosseal and lumbrical, elbow flexors, shoulder flexors and external rotator muscles.

Results

The results obtained following the set clinical protocol are encouraging for the VAS (Table 1), that improved from 8 to 2 points from the first to the last evaluation. Also the PRHWE index (Table 2) gave excellent results going from an initial value of 88/100 to an ending value of 3/100.

The goniometric measure, detected every week, shows a progressive increase of the range of motion of the PIP and DIP Joint (Tables 3 and 4).

Conclusion

Injury to the joints of the hand may result in intra-articular fracture of the bones or damage the supporting joint capsule and ligament systems. Absolute respect for the principles of bone and soft tissue healing is paramount in providing safe, yet progressive rehabilitation [1].

Essentials for goal achievement are:

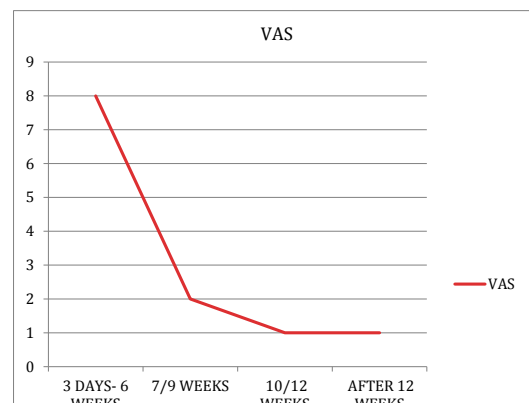


Table 1: Pain decrease from the first to the last week.

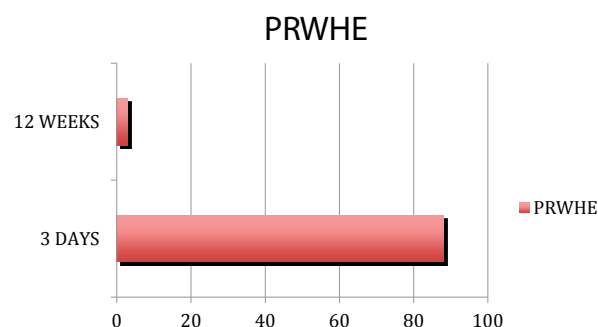


Table 2: At the last week of treatment the patient can do every AVQ and Sport activity.

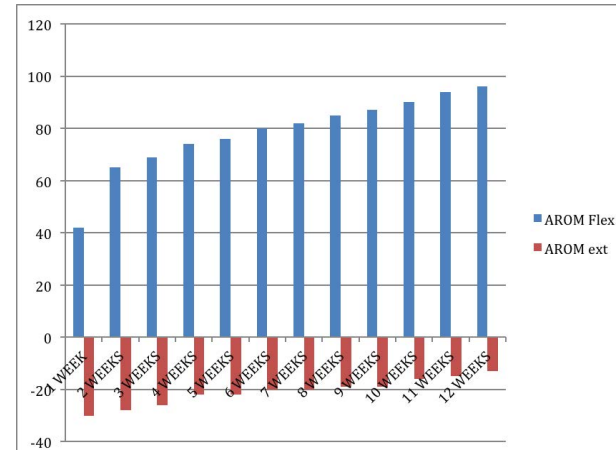


Table 3: AROM PIP Joint.

- ✓ Consistent communication between the surgeon and therapist
- ✓ Patient compliance
- ✓ Proper use of splints (protective or static progressive)
- ✓ Proper use of exercises and mobilization

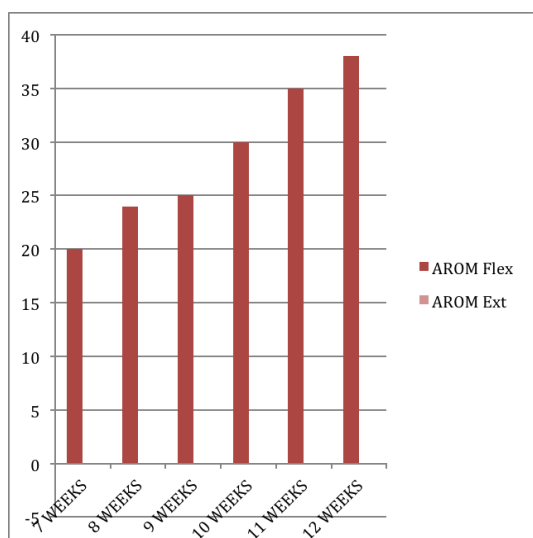


Table 4: AROM DIP Joint.

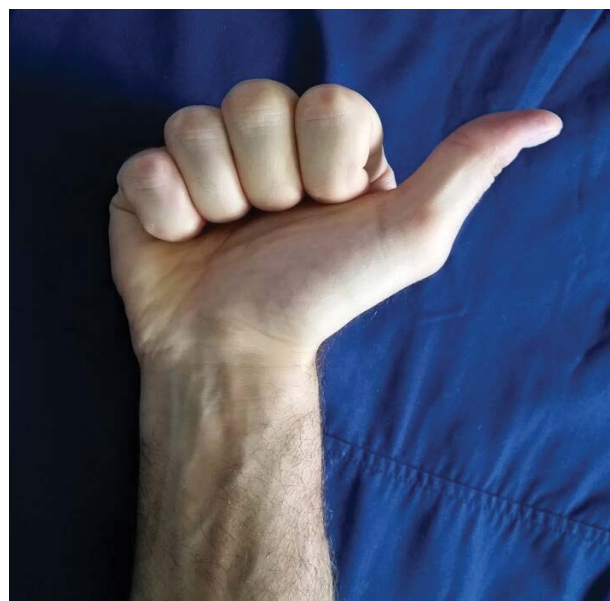


Figure 12: 12 weeks follow up.



Figure 11: 12 weeks follow up.

The communication between surgeon and therapist is useful to understand when and how is possible to mobilize the structures involved by the trauma, patient compliance is necessary to optimize and maintain results achieved with session of rehabilitation. The patient has to do several sessions of ROM and strengthening exercises during the day and session of splinting specific depending on the post-operative phase.

Concerning splinting we used static protective splint for the first 6 weeks after surgery as described by the literature and static progressive splints that improve range of motion and increase tendon gliding starting from 10 weeks. We decided to use static progressive splints instead of dynamic because this kind of traction is better tolerate and therefore more used by the patients.

The evaluation scales used in this case report show improvements in the clinical situation. AROM and strength recovery has been achieved successfully (Figures 11-14). Also the general functionality of the hand during ADL and SPORT activity has improved.

This case report proves that an early mobilization protocol is the way to achieve the best functional result in less time when we approach this kind of sport injury.

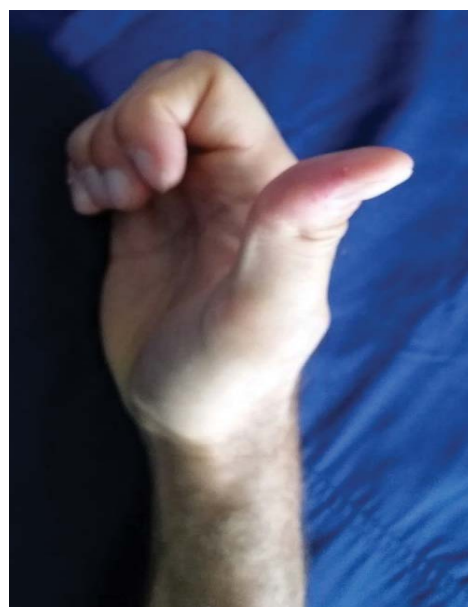


Figure 13: 12 weeks follow up.



Figure 14: 12 weeks follow up.

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