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Customizable Hyperextension Splint for Mallet Finger

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Learning Point of the Article:

The use of a customizable hyperextension splint made using easily accessible materials will empower medical professionals to treat mallet finger injuries effectively.

Abstract

Introduction: Mallet finger is a common deformity occurring due to the traumatic detachment of the extensor tendon at its insertion in the distal phalanx. Despite several different methods of splinting being available, residual extensor lag remains one of the most common complications of conservative treatment.

Technique Report: We demonstrate a novel technique to make a hyperextension splint which can be customized as per the individual. The pictorial demonstration depicts every step in the preparation, application, and maintenance of the splint.

Conclusion: We believe that the use of such easily accessible materials and visual demonstration of each step, with pointers along the way to verify the correct technique, will empower any medical professional, to satisfactorily treat such injuries at the primary point of contact, without necessitating the services of a hand surgeon.

Keywords: Mallet finger, splint, thermoplastic.

Introduction

Mallet finger is a deformity occurring due to the detachment of the extensor tendon at its insertion in the distal phalanx. As a result of this, the distal interphalangeal joint (DIPJ) of the affected digit is held in flexion, with the inability to extend the DIPJ actively. It occurs most often due to sports injuries or minor trauma [1]. Despite being a common injury, there remains controversy regarding its treatment, with little consensus among surgeons regarding the indications for surgery [2]. Several studies have explored the decision between the non-surgical and surgical management, with a larger number of studies favoring non-surgical methods in the absence of any fractures or open wounds [3, 4]. Inappropriate treatment, can however, lead to chronic functional loss and stiffness of the digit [5]. Despite several different methods of

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Author's Photo Gallery


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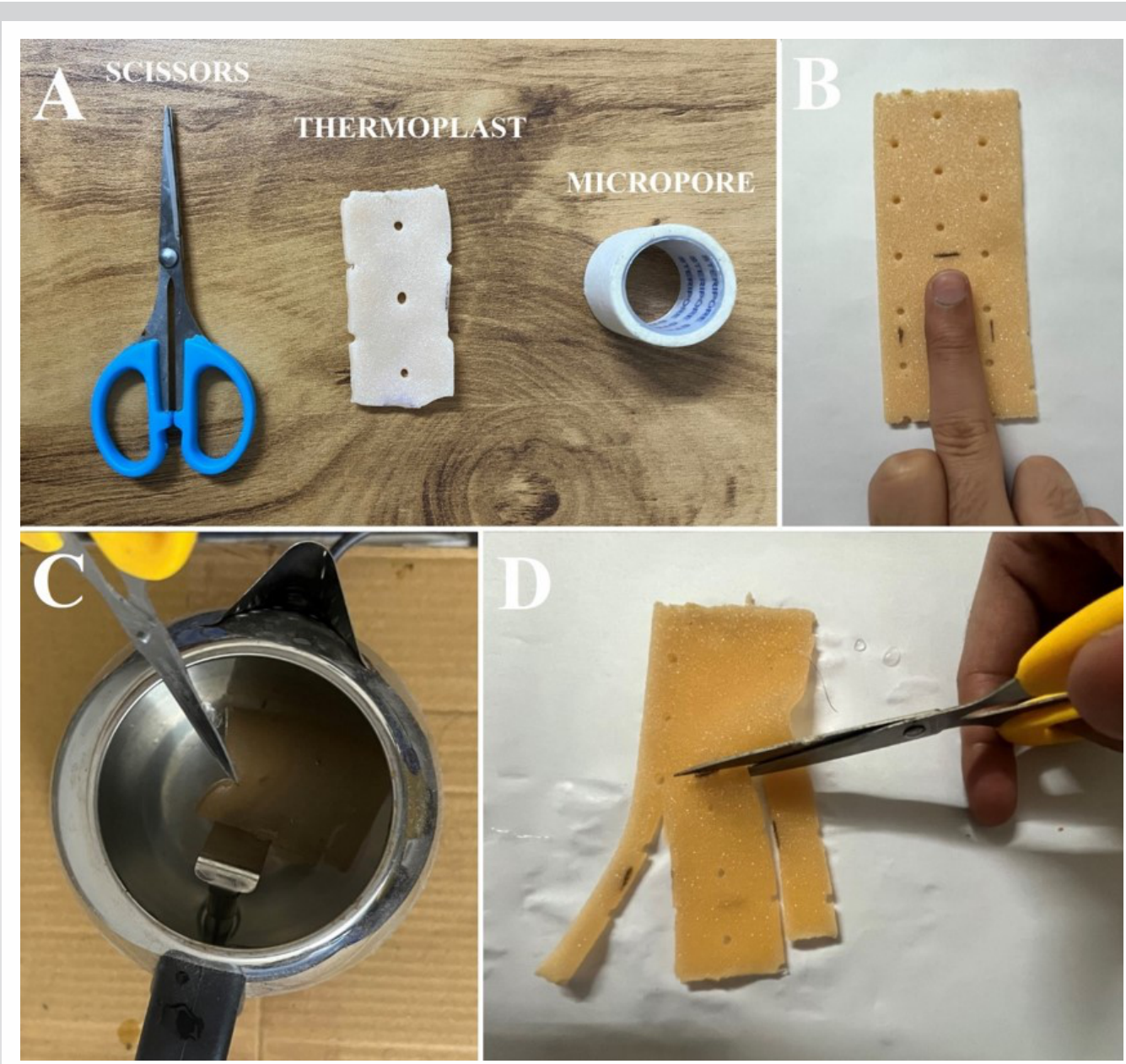


Figure 1: Pictorial demonstration of the technique for making of the splint. (a) Items required for making of splint. (b) Making markings on the thermoplast with a pen, leaving a gap of 0.5 cm around the finger. (c) Placing the thermoplast strip in a pan or kettle with water. Then using scissors to remove the thermoplast strip from the water. (d) Cutting the thermoplast along the markings previously made, using a regular pair of scissors.

splinting being available, residual extensor lag remains one of the most common complications of conservative treatment [6]. We demonstrate a novel technique to make a hyperextension splint which can be customized as per the individual. The pictorial demonstration depicts every step in the preparation, application, and maintenance of the splint. The focus is on the use of easily accessible materials, simple steps employable by any medical professional, pointers to ensure the correct technique is employed, and

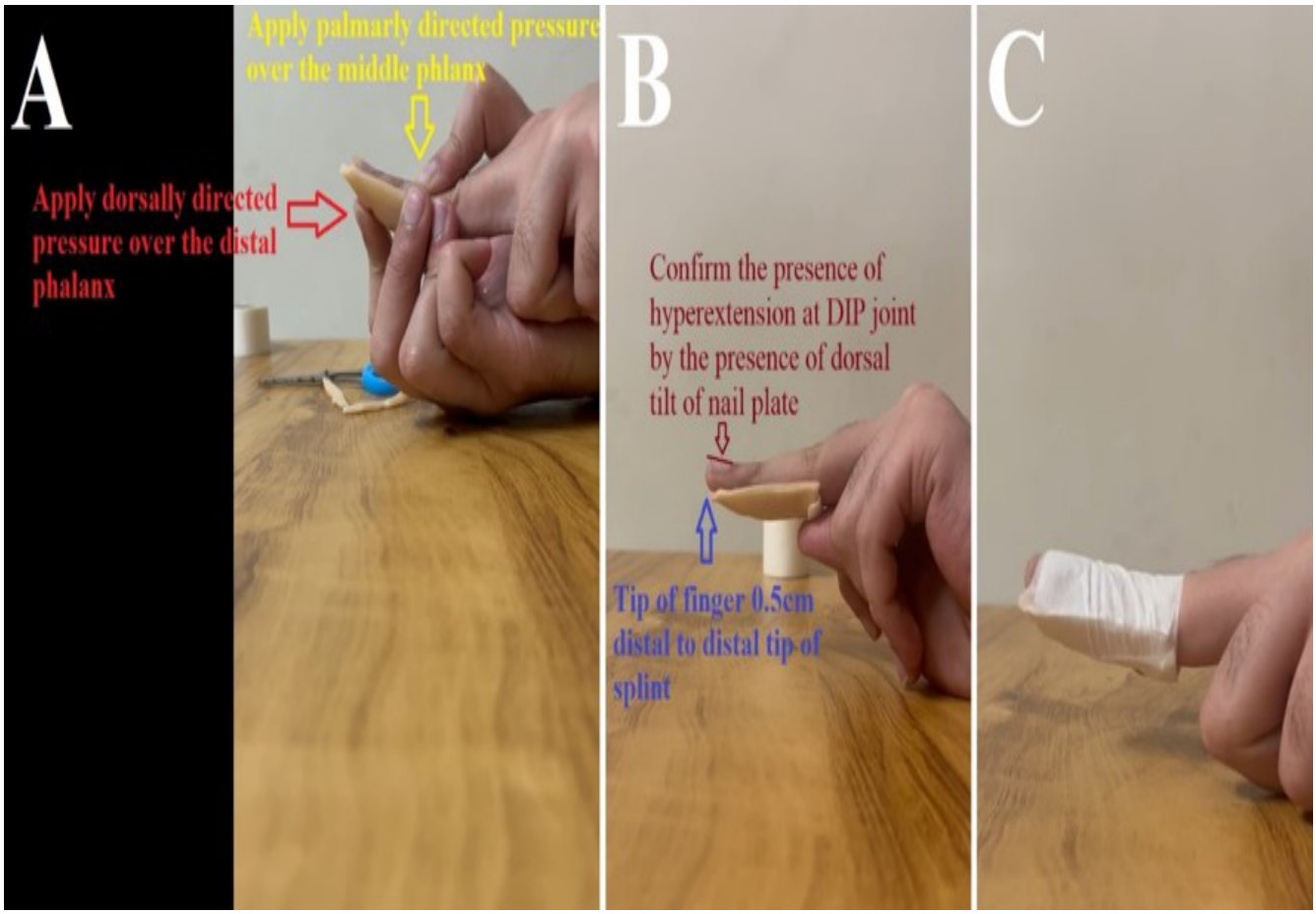


Figure 2: Pictorial demonstration of the technique for molding and strapping of splint. (a) The portion of the thermoplast distal to the DIPJ should be tilted dorsally. To achieve this, apply a dorsally directed force over the palmar aspect of the distal phalanx. Apply a counter palmarly directed force to the dorsal aspect of the middle phalanx. This maneuver will hyperextend the DIPJ. Hyperextend the DIPJ as much as tolerated (approximately 10°–20°). (b) Place the injured finger on the splint, such that the distal tip of the finger lies 0.5 cm distal to the distal end of the splint. This ensures the DIPJ will remain in the maximum possible hyperextension. (c) Roll the micropore around the finger and splint. Three layers of micropore can be put to ensure it remains fairly tight. Keep the distal tip of the phalanx exposed to observe for any discoloration in case the strapping is put too tight. DIPJ: Distal interphalangeal joint.

education of the patient for adherence and maintenance of the splint.

Technique Report

The only items required for this are a regular pair of scissors, adhesive surgical tape (micropore), and a small strip of thermoplastic material (Fig. 1a). For the purpose of measuring and molding the splint do not use the injured finger, as it may cause discomfort. Use the same finger of the uninjured hand.

Step 1: Measurement and cutting of appropriate-sized strip of thermoplast

- Place the finger over the edge of the available thermoplast sheet such that the sheet is just distal to the proximal interphalangeal joint (PIPJ).
- Make markings on the thermoplast with a pen, leaving a gap of 0.5 cm around the finger (Fig. 1b).
- Place the thermoplast strip in a pan or kettle with water. Heat until the water begins to boil. Then use scissors to remove the thermoplast

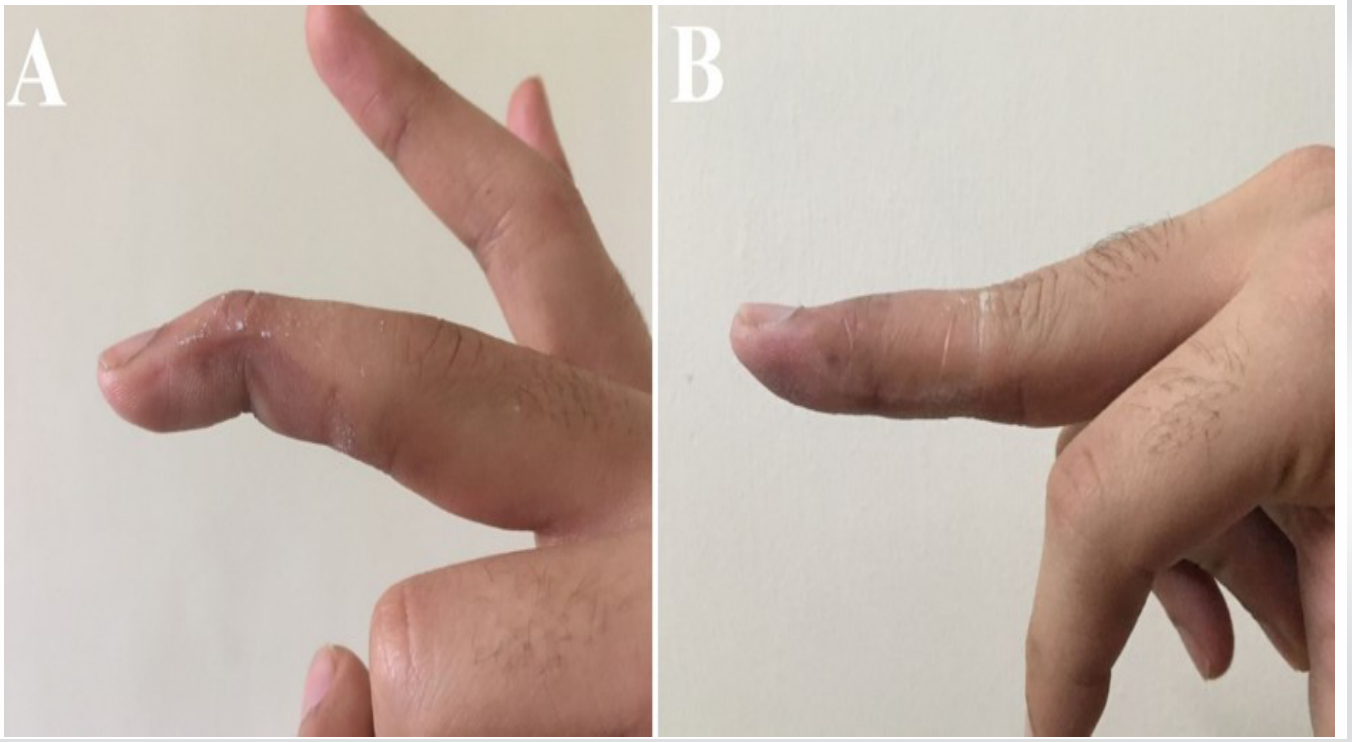


Figure 3: Clinical images of mallet finger injury the first author treated by this method of splinting. (a) Mallet finger injury of the middle finger showing fixed flexion deformity of distal interphalangeal joint. (b) After 8 weeks of splinting using the described technique. Complete extension noted, without any flexion deformity, and extensor lag.

strip from the water (Fig. 1c).

• Cut the thermoplast along the markings previously made, using a regular pair of scissors (Fig. 1d).

• You will then obtain a small strip of thermoplast (approximately 5×3 cm) which will be a little larger than the finger.

• Fold a strip of micropore on itself, which can later be used for cushioning any sharp edges around the splint. Alternatively, any small piece of cloth or cotton can be used instead.

• The thermoplast hardens within about 45 s. So we recommend reinserting this small strip of thermoplast in the heated water before the next step of molding the thermoplast.

Step 2: Molding the splint

• Place the thermoplast over the palmar aspect of the finger, starting 0.5 cm distal to the PIPJ.

• Mold the thermoplast around the finger. Cut of any extrathermoplast with the scissors. The splint should only cover the palmar aspect of the digit and the palmar half of the digit on the lateral aspects of the finger.

• The portion of the thermoplast distal to the DIPJ should be tilted dorsally. To achieve this, apply a dorsally directed force over the palmar aspect of the distal phalanx. Apply a counter palmarly directed force to the dorsal aspect of the middle phalanx. This maneuver will hyperextend the DIPJ. Hyperextend the

DIPJ as much as tolerated (approximately 10°–20°) (Fig. 2a)

• Hold the position till the thermoplast hardens, which will take approximately 45 s.

• Place the folded strip of micropore/folded strip of cloth/cotton at the proximal edge of the splint for cushioning and avoiding pressure on the skin at the proximal margin of the splint.

• The hardened splint should thus be semicircular, proximally padded, and dorsally tilted in the distal 1/3rd of the splint.

• If the splint is not molded adequately at the first attempt, reinsert the splint in the heated water. The splint can then be removed and remolded as prescribed.

Step 3: Strapping

• Place the injured finger on the splint, such that the distal tip of the finger lies 0.5 cm distal to the distal end of the splint. We found that this ensures the DIPJ will remain in the maximum possible hyperextension (Fig. 2b).

• Then roll micropore around the finger and splint. Three layers of micropore can be put to ensure it remains fairly tight. Keep the distal tip of the phalanx exposed to observe for any discoloration in case the strapping is put too tight (Fig. 2c).

• Once strapped, ensure the PIPJ is free of any strapping, allowing for full flexion and extension of the PIPJ.

Step 4: Changing of strapping/cleaning of finger

• Remove the micropore.

• Keep the distal portion of the splint pressed over a hard surface. Elevate the palm, while the distal portion of the splint remains pressed over the hard surface, thus hyperextending the DIPJ.

• Using the other hand, gradually pull the splint proximally. The distal phalanx should remain pressed against the hard surface. This ensures the DIPJ never loses the hyperextension.

• Clean the finger with a cloth. Clean the splint if required. Dry the finger and the splint. Then slide the splint under the finger from proximal to distal. Do not change the position of the hand, with the DIPJ remaining in hyperextension.

• Roll a clean micropore over the finger and splint.

Discussion

Several different methods of splinting have been attempted for mallet finger injury, including stack splints, thermoplastic splints, and aluminum splints [7-9]. However, none of the splints have conclusively been proven to be superior over the other [10]. There are several hurdles encountered during conservative management with splinting. First, maintaining hyperextension of the DIPJ

using a splint is a challenge [11]. Simple stack splints and those relying on straps/tape to hold the DIPJ in hyperextension often fail to maintain the hyperextension [12]. Second, the splint needs to be worn continuously for 6–8 weeks, with any loss of hyperextension requiring the course of splinting to be restarted [13]. Continuous splinting for this duration, if hindering their ability to carry out their vocation, is not acceptable to many individuals, especially certain professionals such as surgeons and musicians [14]. Continuous splinting also leads to skin problems, which are often encountered with non-perforated splints [15]. The use of custom-made splints has shown to decrease the incidence of skin problems [16] and also improve patient satisfaction and compliance [17]. This has led to advanced, customizable, patient-specific splints being introduced, but these are often expensive and not easily accessible [18]. Third, the availability and access to such splints designed specifically for mallet finger deformities are a practical hurdle, especially in developing countries. Fourth, despite the various designs of splints, an aspect which is often overlooked is health literacy among the patients regarding the adherence to splinting. Poor adherence to splinting has proven to be a major factor in poor outcomes, resulting in extensor lag [19].

Our technique and demonstration of splinting does not utilize any novel materials or concepts of splinting. It employs the already proven concept of molded thermoplastic splints with hyperextension of the DIP joint. It simply demonstrates every step in the making of such a molded splint with proper methodology. In addition, it contains several practical tips we discovered through our experience with mallet fingers. These were the result of the first author of the article himself suffering from a mallet finger injury of his right hand, which was splinted using this design for 8 weeks (Fig. 3a and b). Thus, the technique addresses every small aspect that the patient may face during the course of splinting. The method requires minimal items, all of which are easily accessible. This we believe will make it employable even in more remote areas with poor access to medical facilities. The pictorial representation has demonstrated every step of the preparation of the splint so that if required, it can even be made by non-medical professionals. We have also demonstrated the method for changing of the splint strapping and cleaning of the finger. We believe this to the most important step, as it is required to be performed by the patient themselves and is often when the hyperextension of the DIPJ is lost. We have used micropore rather than any velcro straps or materials, as it is cheap, easily available, and extremely easy to use. This would enable the patient to themselves change the splint, multiple times a day, without ever losing the

hyperextension. This frequent changing/ cleaning is not possible in most other splinting methods. It, therefore, would also help to decrease skin problems and improve compliance. The entire demonstration is performed by the first author alone, without requiring the assistance of any other individual.

Conclusion

We believe that the use of such easily accessible materials and visual demonstration of each step, with pointers along the way to verify the correct technique, will empower any medical professional, to satisfactorily treat such injuries at the primary point of contact, and without necessitating the services of a hand surgeon.

Clinical Message

1. A customizable splint for mallet finger helps to ensure that the splint truly maintains the DIP joint in hyperextension.
2. The fact that the splint can be made from easily available materials will make it more affordable and accessible.
3. The success of the splint depends on strict compliance to splinting for the duration of treatment.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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