



JHT READ FOR CREDIT ARTICLE #648.

Practice Forum

## Short functional dynamic orthosis for proximal interphalangeal joint extension deficit. Crest design

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This author provides instruction in the fabrication of a cost-effective dynamic proximal interphalangeal (PIP) extension orthosis. The device allows PIP flexion for activities of daily living and promotes PIP extension—Kristin Valdes, OTD, OT, CHT, Practice Forum Editor

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### Introduction

Proximal interphalangeal (PIP) joint active extensor lag is a frequent complication after finger fracture or extensor tendon lesions that can cause significant impairment of the hand and its function.<sup>1</sup> Active extensor lag is defined as a loss of full active extension of a joint when passive extension of a joint exceeds the active motion. A low-profile extension orthosis can be fabricated to assist in gaining active extension of the PIP joint while still permitting composite finger flexion with a dorsal block design.<sup>2,3</sup>

### Purpose of the orthosis

We combined the orthosis design by Bracks<sup>3</sup> used for PIP joint extension lag and the original idea of Arnold and Janson,<sup>4</sup> which is a dinosaur design to improve wrist range of motion. The orthosis described by Bracks<sup>3</sup> has a main dorsal component and does not allow observation of the PIP joint in cases where edema or skin conditions warrant monitoring. In addition, the design we propose is more stable during the day-to-day activities as it covers the entire phalanx. This device is a low-cost option that can be used by therapists in countries that have limited access to commercially available devices. The main objective of the PIP joint crest design is to allow free PIP flexion while the elastic bands aid extension. The device should not be used if the finger fracture is not healed. The device should be used in the daytime

for up to 6 hours per day. A static finger gutter orthosis can be used during the nighttime.

### Materials

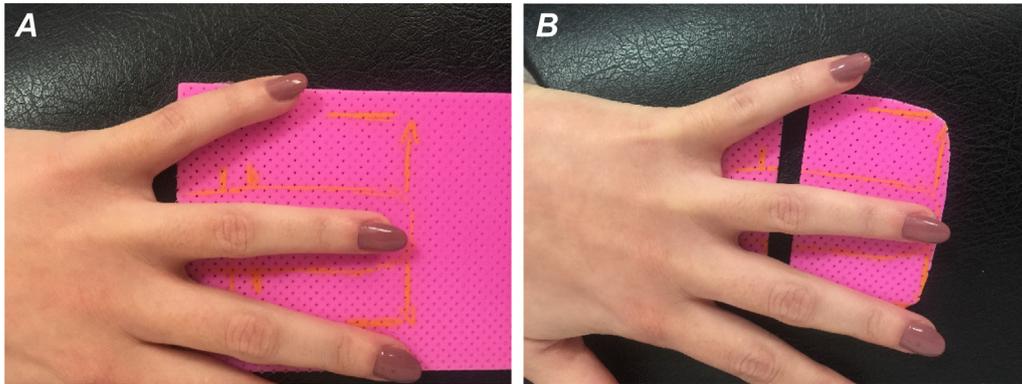
- Low-temperature thermoplastic material from 1.6 to 2.0 mm
- Orficast material
- Elastic bands

### Fabrication steps

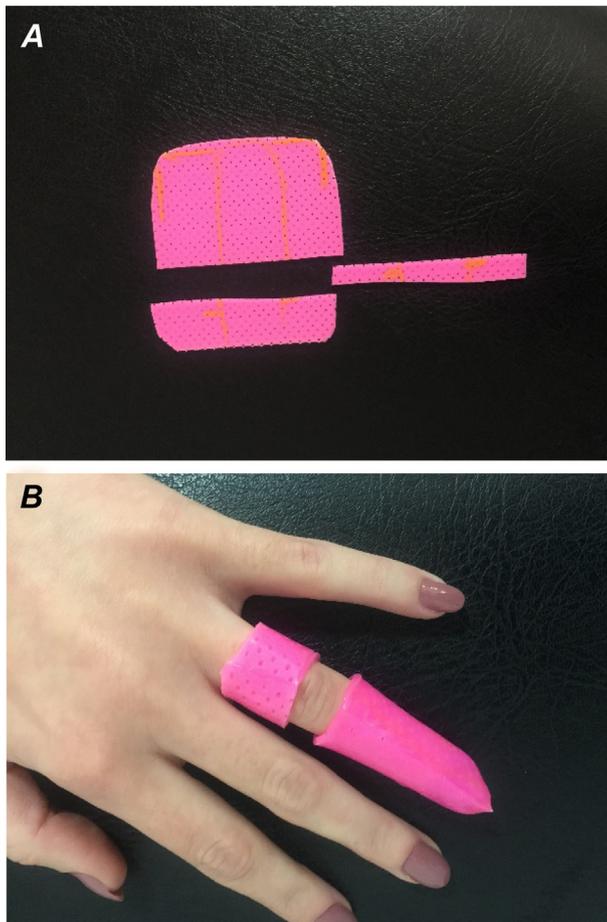
1. Measure the thermoplastic material as follows: the length for part 1 is the distance from metacarpophalangeal joint to PIP joint. The length for part 2 is the distance from PIP joint to the top of the finger. The width of the orthosis pattern will be equal to 3 times the thickness of the patient's finger (Figs. 1A and 1B).
2. Cut the material and activate by heating. Working quickly, while the material is still warm, place material on the digit and mold to the desired position (pay attention that there is no thermoplastic material in the volar part of the PIP joint to allow free flexion of this joint) (Figs. 2A and 2B).
3. Once you have determined that the PIP is free to flex, you must ensure the stability of the parts to avoid their displacement during finger movement. To accomplish this, you will use 2 orficast strips that you activate with hot water (Fig. 3). Once the material is activated, roll them to form a narrow tube (Fig. 4). Due to the elastic capacity of the material in only 1 direction, the tube is flexible laterally but not to traction and compression (Figs. 5A and 5B).
4. Once the tubes are dry and have hardened, proceed to heat the corners of them with a heat gun to activate the material (Fig. 6)

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**Fig. 1.** Pattern of the orthosis.



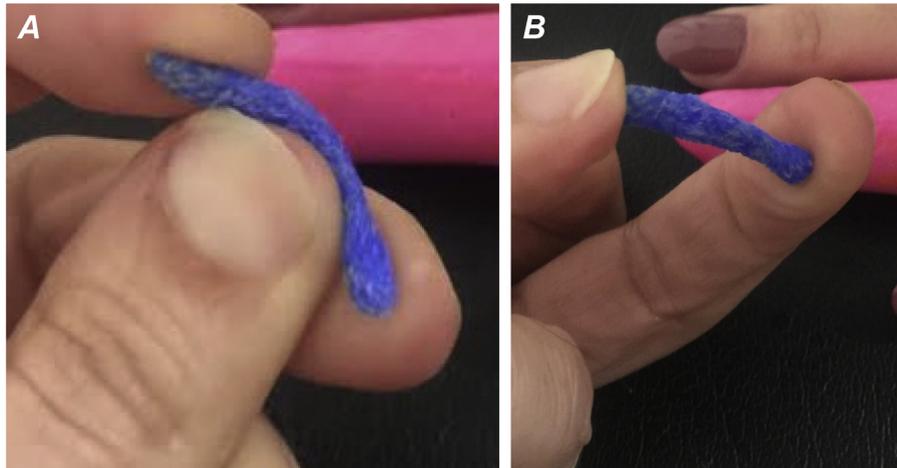
**Fig. 2.** (A) Cutting the material. (B) Molding the material on the digit.



**Fig. 3.** Orficast strips.



**Fig. 4.** Narrow tube of orficast material after activation.



**Fig. 5.** The tube is flexible laterally but not to traction and compression.



**Fig. 6.** Heat the corners of the tube.



**Fig. 8.** Static part of the orthosis.

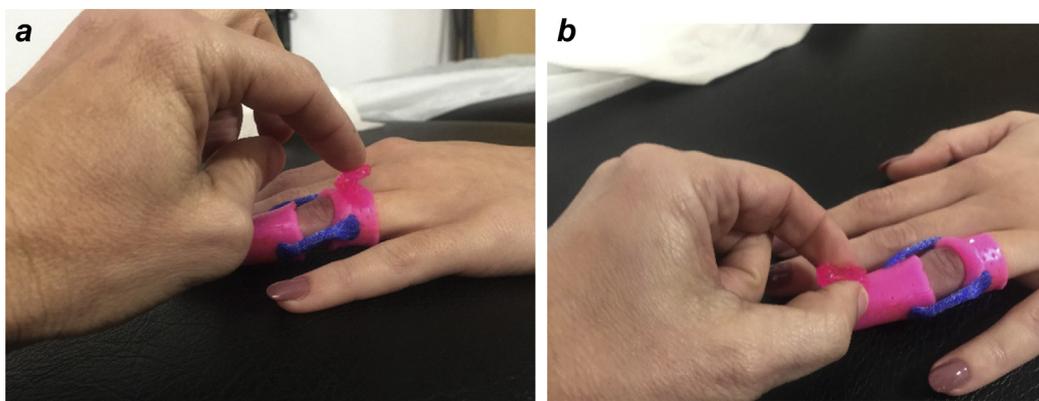


**Fig. 7.** Paste tube after activation with heat on the sides of the orthosis.

and paste it on the sides of the orthosis keeping the tubes parallel to the middle of the axis of movement (Fig. 7). At this point, you have a finger orthosis with 2 fixed parts joined together with thermoplastic material that allows the PIP movement (Fig. 8)

#### *Dynamic component fabrication*

1. With thermoplastic material, fabricate 2 hooks that you attach to the dorsal part of the P1 and P2 components, parallel to the phalanx (Figs. 9A and 9B).
2. Loop the elastic across the 2 hooks (Fig. 10), and measure the tension with a dynamometer (Fig. 11).
3. The grams of traction depend on each patient, the length and thickness of the elastic band, and the separation distance of the hooks. So it must be calculated in each case on the patient's hand.



**Fig. 9.** Fabricate two "hooks" and attach them to the dorsal part of the P1 and P2 components.



**Fig. 10.** Loop the elastic across the two hooks.

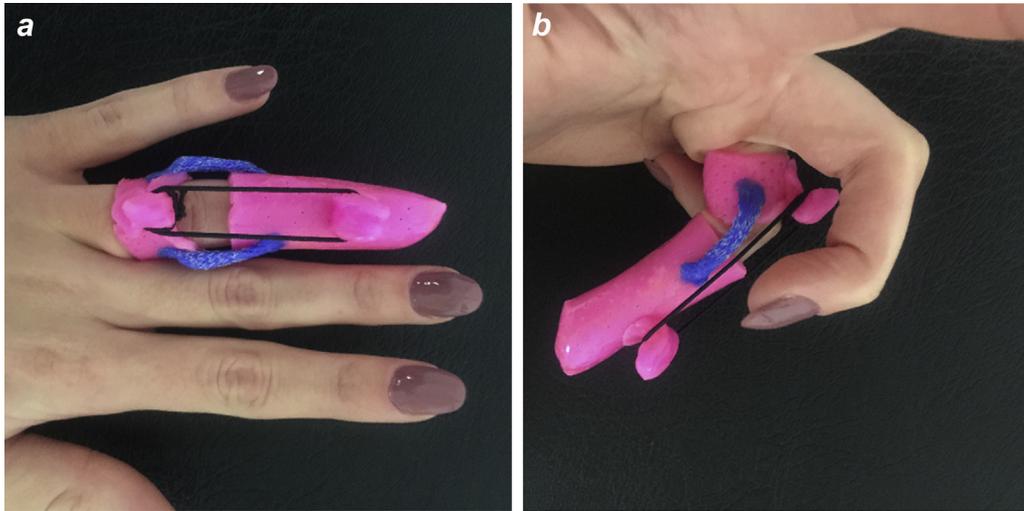


**Fig. 11.** Measure the tension of the elastic.

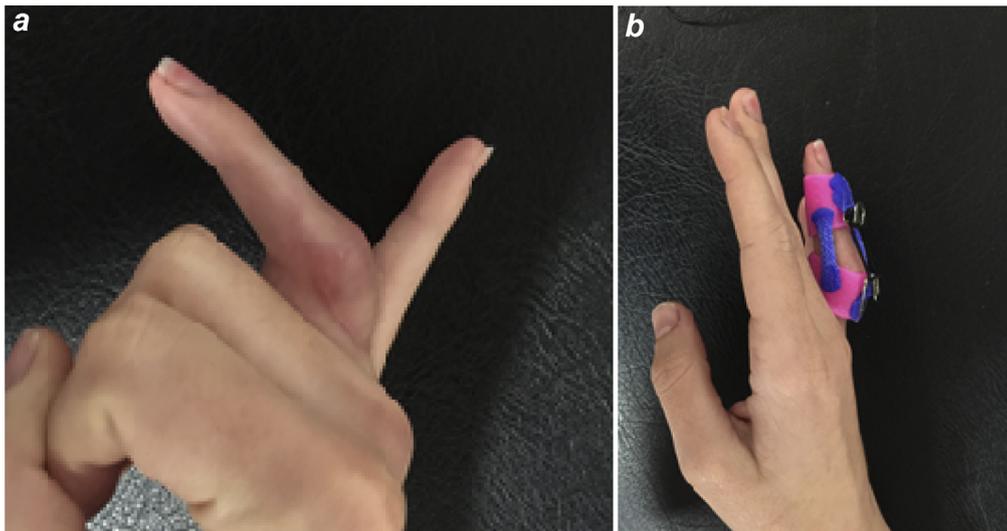
4. Elastic tension must be just enough for the pulling force to keep the PIP joint at full extension but allow active PIP flexion (Figs. 12A and 12B).
5. If, in specific cases, a tendency toward hyperextension of the PIP joint is observed, a stop of thermoplastic material can be added to 1 of the mobile parts on the dorsal side.

#### Case example

A patient with a 35° PIP extension lag was provided with the device after confirmation of healing of a proximal phalanx fracture. The device was worn 6 hours per day. After wearing the device for 6 weeks, the patient regained full active finger extension (Figs. 13A and 13B).



**Fig. 12.** Elastic tension keep the PIP joint at full extension and allows active PIP flexion.



**Fig. 13.** Case example.

**References**

1. Tocco S, Boccolari P, Landi A, et al. Effectiveness of cast immobilization in comparison to the gold-standard self-removal orthotic intervention for closed mallet fingers: a randomized clinical trial. *J Hand Ther.* 2013;26:191–201.
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3. Bracks C. Low profile extension splint for active extensor lag of the proximal interphalangeal joint. *J Hand Ther.* 2007;20:274–276.
4. Arnold S, Janson R. Wrist extension or flexion mobilization orthosis: the dinosaur design. *J Hand Ther.* 2017;30:109–112.

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## Quiz: # 648

**Record your answers on the Return Answer Form found on the tear-out coupon at the back of this issue or to complete online and use a credit card, go to [JHTReadforCredit.com](http://JHTReadforCredit.com). There is only one best answer for each question.**

# 1. The primary indication for use of the device is

- a. PIP DJD
- b. PIP flexion contracture
- c. PIP extension lag
- d. PIP flexion lag

# 2. The blue lateral tubes are made of

- a. orficast
- b. rubber
- c. leather
- d. composite plastic beads

# 3. The device allows

- a. full active PIP flexion
- b. full passive PIP extension

c. freedom for most ADL

d. all of the above

# 4. The tension is set with

- a. a rubber band gauge
- b. a tensiometer
- c. a dynamometer
- d. an iPhone app

# 5. The case example called for wearing the device 6 hours per day for 6 weeks after which the patient had regained full active PIP extension

- a. false
- b. true

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