



JHT READ FOR CREDIT ARTICLE #630.

Practice Forum

An alternative static progressive orthosis for forearm pronation and supination



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These authors have provided instruction for a low cost forearm rotation orthosis that is easily adjusted and holds the tissue at the end range of motion to gain either supination or pronation. – Kristin Valdes OTD, OT, CHT, Practice Forum Editor, Journal of Hand Therapy

Introduction

To prevent the limitation of forearm rotation after injuries, the rehabilitation management includes edema control, scar management, early active exercises, appropriate passive stretch, and orthosis provision. When patients have experienced joint stiffness or limitations of passive range of motion due to scar formation or adaptive shortening following injuries or surgery, static progressive orthoses can be prescribed.¹ There have been a few designs of static progressive orthoses developed for forearm rotation.² These orthoses apply torque to the forearm in order to statically position the forearm at the maximal end range of supination or pronation over a long period of total end range time.^{1,3} Commonly, the elbow joint is fixed at 90°, whereas Lee et al.⁴ argued that these orthoses may limit the functional use of the involved hands. No comparative study is available to assess the orthosis effectiveness in improving the rotation arc, patients' compliance, cost-effectiveness, or to determine which design is more suitable.

We designed an alternative orthosis to improve patients' forearm rotation arc. It can be used for patients with forearm rotation limitations.

Materials

The following materials are required to fabricate the orthosis.

1. Low-temperature thermoplastic material (3.2 mm thick; wrist component and elbow component)

2. Aluminum bars (12 mm wide, 3 mm thick)
3. Stainless screws (10 mm long, 3 mm in internal diameter)
4. Stainless nuts (3 mm in diameter)
5. Rivets
6. Nylon rope
7. Velcro loop
8. Velcro hook

Fabrication

1. Fabricate a wrist component by fixing the wrist joint at the neutral position. The appropriate length of the wrist component is around 1/3 length of the forearm. Make 2 circles using the nylon rope and apply them through the holes near the radial and ulnar edges of the wrist component. Stick Velcro hook and apply Velcro loop at the corresponding sites (Fig. 1).
2. Fabricate an elbow component fixing the elbow joint at 90° and use 2 rivets to consolidate the folded orthotic material of the 2 sides of elbow (Fig. 2). A useful tip is covering several layers of bandage around the forearm while molding the elbow component to avoid creating a tight forearm tube.
3. Fabricate a circle with the diameter of 13 cm using an aluminum bar and bend another 3 aluminum bars as the shape shown in Figure 3. The length of these 3 bars is appropriate where they can fix the aluminum circle around the wrist joint.
4. Drill 3 holes at 3-o'clock, 6-o'clock, and 9-o'clock positions of the circle, to connect the circle and these 3 bars, and another 6–8 well-distributed holes. Also install stainless screws and stainless nuts into each drilled hole of the circle. Drill 1 hole at the distal terminals of aluminum bars and 2 holes at the proximal part to connect them onto the elbow component (Fig. 3).

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Fig. 1. Completed wrist component.

5. Use stainless screws and nuts to connect the circle, aluminum bars, and elbow component. Stick Velcro hook and apply Velcro loop at the corresponding sites of elbow component (Fig. 4).
6. Before patients wear this orthosis, hand therapists should double check whether there are any pressure points on patients' skin and whether the edge of the orthosis is smooth.

Application

Before applying this orthosis, the experienced hand therapist should double check whether the patient can tolerate the stretching force provided by the orthosis. This orthosis should not be applied on patients with unstable or nonunion fractures, open wounds, severe traumatic arthritis, or any patients who do not have adequate compliance with the application instructions.

For wearing the orthosis, the wrist component should be placed first and then the elbow component. To avoid discomfort, the strap, Velcro loop, of the wrist component should not be too tight. After wearing the wrist and elbow components, the 2 nylon rope circles should be hooked on the screws, which are installed on the aluminum circle, to provide opposite torque for rotating around its longitudinal axis (Fig. 5). For the appropriate stretching force on forearm, we recommend the minimum tensile force that positions the forearm at the maximum tolerable end range of pronation or supination.¹ A long total end range time is more important than strong tensile force on the forearm.



Fig. 2. Completed elbow component.



Fig. 3. Completed aluminum circle and 3 bars.

Meanwhile, we also recommend patients wear this static orthosis for at least 6 hours of total end range time per day, 60–120 minutes per session, 3–6 sessions per day, if they do not receive any other rehabilitation interventions based on our clinical experience and previous study.³ The total end range time can be reduced if the patients have been receiving other rehabilitation interventions. If the patients cannot tolerate the tensile force for 60 minutes per session, the tension may be too strong and should be decreased to increase the wearing time of each session.

Summary

As shown as Figure 6, the x-ray radiograph of a healthy adult wearing this orthosis can passively stretch the forearm in supination and pronation with satisfactory effectiveness. We also adopted the position fixing the elbow in 90° to avoid the influence of shoulder rotation. Although this design may limit the function of the involved hand, we believe that many patients will have good compliance if they are given clear application instructions.

The advantages of this static progressive orthosis are as follows: (1) improving pronation and supination using the single device; (2) the maximum tolerable end range of pronation or supination is easily adjusted through hooking the circles on different stainless screws; and (3) lower cost compared with commercial products.



Fig. 4. Connect the circle, aluminum bars, and elbow component using stainless screws and nuts.



Fig. 5. The static progressive orthosis applied to the forearm at (A) supination, (B) neutral position, and (C) pronation.

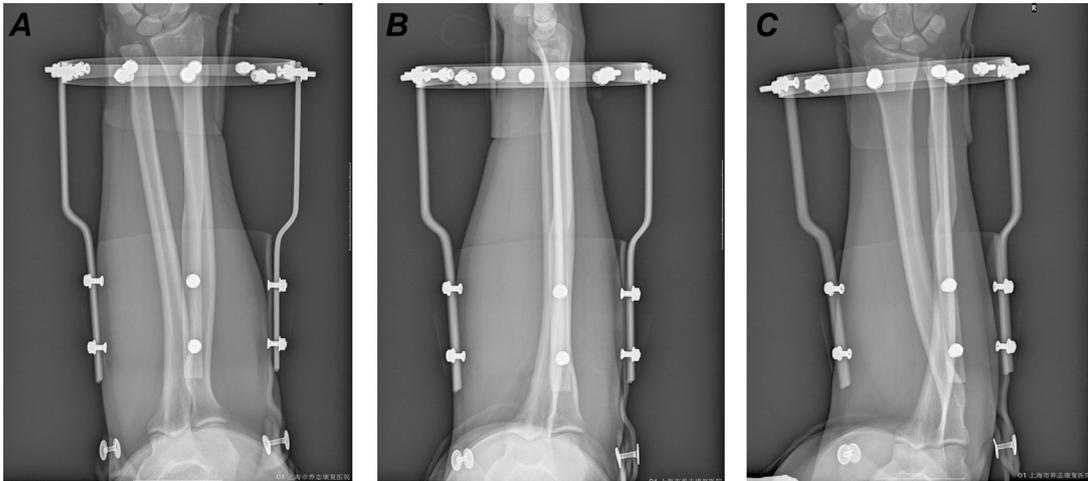


Fig. 6. X ray radiographs. The forearm at (A) supination, (B) neutral position, and (C) pronation.

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Quiz: # 630

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- # 1. The most appropriate classification for the device is
 - a. dynamic
 - b. static
 - c. static progressive
 - d. none of the above
- # 2. The creators' intention was to be able to deliver tension which
 - a. has a high TERT value
 - b. has a high over-pressure value
 - c. can be calculated in newton units
 - d. is applied entirely proximal to the carpus
- # 3. The rods are made of
 - a. plastic
 - b. steel

- c. copper
 - d. aluminum
- # 4. The authors concede that
 - a. it is difficult to gain patient compliance regarding wearing schedules
 - b. fabrication is beyond the skill set of the average CHT
 - c. hand function is severely limited while wearing the device
 - d. the cost of the materials may be a challenge for many clinics and patients
 - # 5. A major advantage is that the device can deliver a rotatory tension in either pronation or supination
 - a. false
 - b. true

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