Treatment of Proximal Interphalangeal Joint Flexion Contracture: Combined Static and Dynamic Orthotic Intervention Compared With Other Therapy Intervention: A Randomized Controlled Trial

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Purpose To test the effectiveness of static and dynamic orthoses using them as an exclusive treatment for proximal interphalangeal (PIP) joint flexion contracture compared with other hand therapy conservative treatments described in the literature.

Methods 60 patients who used orthoses were compared with a control group that received other hand therapy treatments. Clinical assessments were measured before the experiment and 3 months after and included active PIP joint extension and function.

Results A significant improvement in the extension active range of motion at the PIP joint in the second measurement was found in both groups, but it was significantly greater in the experimental group. Improvement in function (Disabilities of the Arm, Shoulder, and Hand score) between the first and second assessment was similar in the control and experimental groups.

Conclusions Using night progressive static and daily dynamic orthoses as an exclusive treatment during the proliferative phase led to significant improvements in the PIP joint active extension, but the improvement did not correlate with increased function as perceived by the patient. *(J Hand Surg Am. 2015;40(5):951−955. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic I.

Key words Proximal interphalangeal joint, orthoses, static orthotics, dynamic orthotics.

PROXIMAL INTERPHALANGEAL (PIP) joint flexion contractures are a common problem seen by surgeons and hand therapists after various types of injuries. Normal movement of the PIP joint requires bone support; intact articular surfaces; and integrity of the collateral ligaments, volar plate, and tendons. Deficiency in any of these structures can lead to a loss of finger motion and decreased function.[1] After injury, loss of joint mobility may either be due to the formation of adhesions or scar shortening of the periarticular structures, which limit the range of movement.[1−3] Different situations can lead to a loss of mobility at the PIP joint: fractures, joint dislocation, or subluxation, synovitis, edema, or soft-tissue injuries such as ligament damage or affectation of the volar plate.[2,4] Once the extension of the joint is lost, the treatment options are either conservative and/or surgical. Conservative treatment should be the first option before surgery is considered.[5] If conservative treatment fails, surgery is the option of choice.

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TABLE 1. Description of Control Group Treatment

Exercises Used in Control Group	Description
10 minutes of local thermotherapy	*Paraffin bath*
Active exercises, 3 sets of 15 repetitions of each exercise	*We started with opening and closing exercises overall fists*
MCP selective exercises	*Active flexion and extension in intrinsic plus*
PIP selective exercises	*With MCP in neutral position and then with MCP at 90°*
DIP selective exercises	*With MCP and PIP at 0°*
Involved stretching at PIP level	*5 sets of 3 repetitions, holding for 10 sec*
Therapeutic ultrasound	*0.8 w/cm^2 / 7 min*

MCP, metacarpophalangeal; DIP, distal interphalangeal.

A large number of nonsurgical interventions to restore the range of movement at the PIP joint have been described. There are previous studies on orthotic design and appropriate application. Orthosis fabrication techniques to remodel shortened soft tissue structures are well described by Fess.[5] The use of orthoses is described in most conservative treatment protocols in the literature and is usually combined with other hand therapy interventions, such as joint mobilization techniques, exercises, heat therapy, stretching, paraffin, ultrasound, or shockwaves. Moreover, nowadays there are barriers to care and limited resources for prolonged physiotherapy treatment, so that the use of orthoses alone could be attractive if its effectiveness is demonstrated.

The purpose of our study was to examine the effectiveness of the combined use of static-progressive and dynamic orthoses as the sole treatment for improved active PIP joint extension.

MATERIALS AND METHODS

Design

The study was a single-blind, randomized, controlled clinical trial. The ethics committee approved the experiment and all patients gave informed consent. This study was performed in accordance with the Declaration of Helsinki.

Inclusion criteria for this study were adult, hand trauma resulting in PIP joint flexion contracture, and time since injury between 4 weeks and 6 months. Exclusion criteria for this study were PIP joint bony derangement, associated nerve or tendon injury (including deficit extensor system) damage, Dupuytren disease, camptodactyly, fractures, inflammatory signs, joint instability, avascular necrosis, or infection of the affected finger.

Participants were recruited from a waiting list of a general hospital, and the experimental process was carried out at a hand rehabilitation center from June to September 2013.

Intervention

A blinded hand therapist who did not participate in the experiment took baseline measurements (Spanish version of the Disabilities of the Arm, Shoulder, and Hand [DASH] questionnaire and active extension) prior to randomization.

All participants were instructed to complete the DASH questionnaire[6] before measurement of range of motion. Active extension range of motion of the PIP joint was measured using a standard baseline stainless 180° finger goniometer in a lateral position following the same protocol. All data were collected in the morning and after 10 minutes of active movement (opening and closing the hand in sets of 20 repetitions with 30 seconds of rest each minute to avoid muscle strain). Participants (N = 60) were entered in an Excel database in order of arrival and were randomized into 2 equal groups by an automatic program (30 patients in the control group and 30 in the experimental group).

Patients in the control group followed the hand-therapy treatment detailed in Table 1.

For the experimental group, static-progressive night and dynamic daily orthotic devices were constructed. For night static-progressive orthotics, an elastic material was used (Orficast; Orfit industries, Wijnegem, Belgium) at the maximum pain-free length allowed by the tissues (Fig. 1). For dynamic daily orthotics, non-perforated 2.0-mm thermoplastic material was used with Orfitube (Orfit Industries; Wijnegem, Belgium) as a dynamic component with a mobilizing force of 250−300 g/cm^2 (Fig. 2). Patients were instructed to wear it for at least 6 continuous hours per day and then remove it for activities of daily living.

We checked the static-progressive and dynamic orthoses once a week and adjusted them as necessary.