
Preliminary Soft-Tissue Distraction with the Digit Widget™ in the Management of Advanced Dupuytren Contracture at the Proximal Interphalangeal Joint

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38.1 Introduction

Dupuytren Disease results in a progressive shortening of the palmar soft tissues consequently restricting extension at the PIP joint. This limitation of active extension at the PIP joint is subsequent to the shortening of the pretendinous cord(s); checkrein ligament development; contracture of the collateral ligaments, the skin ligaments, and the flexor tendon sheaths; fibrous scar contracture; or a combination of these afflictions (McFarlane 1974; Craft et al. 2011).

Therapeutic interventions are performed for two purposes: firstly, to relieve the limitation of range of motion caused by the flexion contracture and, secondly, to improve active and passive extension at the proximal phalangeal and metacarpophalangeal joints (Agee and Goss 2012). Nonoperative techniques such as serial splinting, casting, enzymatic degradation, and stretching have been historically implemented to allow gradual lengthening of the contracted tissues (Ball and Nanchahal 2002; Messina and Messina 1993; Rives et al. 1992; Citron and Messina 1998; Larocerie-Salgado and Davidson 2012; Brandes et al. 1994). The success of these techniques relied upon the increase in newly synthesized collagen. This new collagen is remodeled and increased due to recruitment of degradative enzymes, metallo-

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proteinases, collagenase, and cathepsins B and L (Brandes et al. 1994). Serial splinting and casting are complicated by dorsal digital skin ischemia, pain, and potential dermal thinning and ulceration (Agee and Goss 2012). The Digit Widget™ (Hand Biomechanics Lab, Inc., Sacramento, CA) was specifically developed for the treatment of severe PIP joint contractures with the avoidance of soft-tissue complications previously associated with serial casting and splinting techniques.

38.2 Methods

38.2.1 Physiological Features of Soft-Tissue Distraction

The Digit Widget™ is a dynamic external fixation device designed to provide an extension torque across the PIP joint for lengthening of the palmar soft tissues in cases of advanced Dupuytren Disease. The force exerted by the Digit Widget™ is directly applied through the digital phalanges thereby eliminating any forces on the dermis. The traction device does not limit flexion. The patient can actively and passively flex the finger with the Digit Widget™ in place by releasing the traction produced by the device. The patient can adjust the extension torque to minimize pain and morbidity.

38.2.2 Indications for Use

The indication for use of the Digit Widget™ is a desire for improved range of motion and the correction of severe PIP joint flexion contractures. In those cases where there is evidence of advanced joint destruction such as in arthritis, or after trauma, the Digit Widget™ may be of limited benefit. Patients with unstable or subluxed PIP joints as a result of long-standing collateral ligamentous injuries are also not suitable candidates for the placement of the Digit Widget™. Any injuries to the pulley system, previous injuries, and previous surgical intervention are all important in the consideration of the use of the Digit Widget™, as these conditions are at the highest risk of recurrent flexion contracture.

38.2.3 Application of the Digit Widget™

In those patients who are appropriate candidates for placement of the Digit Widget™, the device is commonly used for 6 weeks. The Digit Widget can be placed under general anesthesia or with a local or regional block such as an axillary nerve block. The placement of the Digit Widget™ begins with marking the dorsal mid-longitudinal axis of the digit and identification of the PIP joint which is marked under fluoroscopy. The locating drill guide is then placed on the middorsal line just distal to the PIP joint. The locating drill guide is used to place a proximal and distal pre-drill pin under fluoroscopic guidance. These measures are followed to avoid drilling through the joint or to damage the flexor tendons. The distal pre-drill pin is then removed and replaced with a permanent distal screw which is then repeated proximally. After confirmation of permanent screw depth under fluoroscopy, the screw shrouds are cut and the drill guide is removed. The pin block is seated 5 mm above the dorsal skin which accommodates finger swelling.

Over the course of treatment, the Digit Widget™ will gradually stretch the palmar soft tissues, the neurovascular bundle, and the dermis of the affected digit. This will simultaneously reduce the flexion contracture deformity at the PIP joint. The goal of treatment is reducing the flexion deformity by up to 15° per week with full correction of skin and soft tissue by 6 weeks of treatment. If the PIP joint is fully extended and the volar PIP joint skin and soft tissue is supple, the Digit Widget™ is removed and no additional surgery is needed. When the Digit Widget™ therapy plateaus before full extension is achieved, surgery may be required to release the residual contracture (Craft et al. 2011). Additionally, surgery may be required if significant Dupuytren Disease or contracture is present.

The Digit Widget™ when used in tandem with operative correction of Dupuytren contracture yields the best results in correcting advanced cases of PIP flexion contracture (Craft et al. 2011). Prior to placement, the dorsal mid-longitudinal axis of the affected digit is meticulously delineated

(Fig. 38.1). We include a case presentation of a 76-year-old right hand-dominant male with right small finger flexion of 55° at the metacarpophalangeal (MP) joint and right small finger 90° at the PIP joint due to Dupuytren Disease. The patient had no prior surgery (Figs. 38.2, 38.3, 38.4, and 38.5).

38.2.4 Postoperative Considerations

Complications of Digit Widget™ placement are acute or delayed. Acute complications are related to inaccurate placement of the pins leading to iatrogenic middle phalanx fracture or leaving the pins too long causing impingement on the cuff as the contracture improves. Delayed complications are rare but include severe pain or infection and if either does not resolve with treatment may necessitate removal of the Digit Widget™ prior to complete correction.

38.2.5 Management of Applied Torque

Applying the correct amount of torque to the PIP joint is critical to avoid pain, edema, and loss of flexion in the joint. Torque imbalances can also cause MP joint hyperextension due to reduced resting tension in the proximally translocated flexor

digitorum superficialis and profundus tendons as well as an increased moment arm due to the dorsal dislocation of the extensor tendon off the metacarpal head. The extension torque on the MP joint caused by PIP joint flexion contractures leads to MP joint hyperextension which reduces the efficiency of the Digit Widget™ (Agee and Goss 2012). The result is a limitation of proximal excursion of the extensor tendon and its central slip. The net effect is inefficient mechanics required for PIP joint extension. Therefore, critical to achieving long-term active PIP joint extension after reversal of contracture is restoring central slip tension and excursion. If one identifies excessive hyperextension in the MP joint, the MP flexion strap can be used to prevent MP joint hyperextension to facilitate rebalancing of torque forces across the MP joint to allow more efficient PIP joint extension. Edema which causes stiffness of the PIP joint can further undermine device effectiveness.

38.2.6 Monitoring Device Efficacy

Patient participation is critical to the success of treatment with the Digit Widget™. Full correction of the PIP joint flexion deformity is achievable by 6 weeks after placement. Patients are carefully followed at weekly intervals; range of

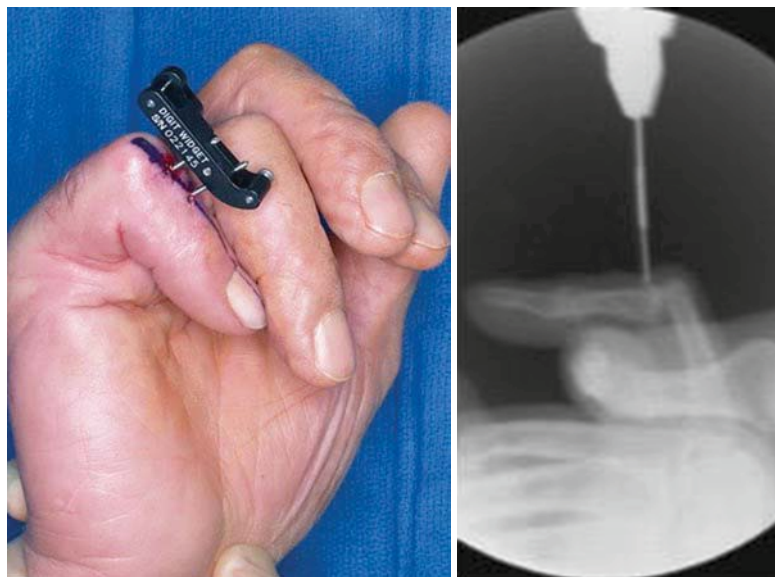


Fig. 38.1 Placement of the Digit Widget™. The Digit Widget™ is placed on the dorsal mid-longitudinal axis. Placement under fluoroscopy assures the device is placed in good position and that pins are not put into the joint.

motion is plotted and rubber bands are adjusted as needed. Progress is plotted as a graph of the change in range of motion as a function of time. Patients are also encouraged to record their progress daily in a “diary.” Rubber bands, which include light, medium, and heavy, are changed daily and added if needed. Once 5 bands of the same gauge are used together, a switch to a larger rubber band is made.



Fig. 38.2 Connector assembly and rubber band placement

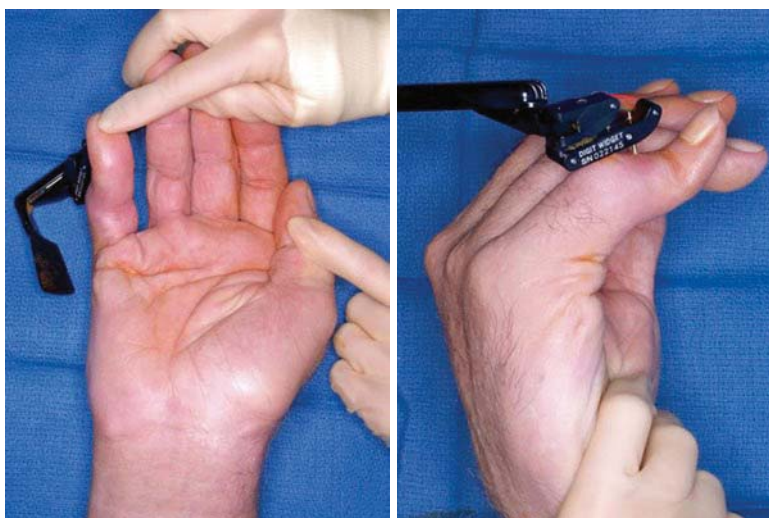
38.3 Discussion

The ideal management of severe PIP joint contractures is likely a combination of many treatments, and surgical management of Dupuytren contractures remains a challenge (Donaldson et al. 2010; Misra et al. 2007; Van Giffen et al. 2006). The Digit Widget™ is an important tool to add to the armamentarium of the hand surgeon in treating difficult flexion contractures of the PIP joint.

There has been a limited recorded experience regarding the use of the Digit Widget™ combined with surgery (Craft et al. 2011; Agee and Goss 2012; Bailey et al. 1994). To date, there have been no studies that compare the effectiveness of the Digit Widget™ to dynamic extension splint orthoses.

Many groups have studied various external fixators with and without fasciectomy. Craft et al. demonstrated a statistically significant extension improvement in digits treated with distraction of 53.4° compared to 31.4° in digits treated with fasciectomy plus ligament release (Craft et al. 2011). If avoidance of uncommon complications can be maintained and if there is patient compliance, the Digit Widget™ is extremely effective in advanced contractures.

Fig. 38.3 Following 6 weeks of Digit Widget™ application, the patient’s PIP contracture is dramatically improved. Though the patient’s DIP joint is hyperextended, this improved with the surgical Dupuytren contracture release and postoperative hand therapy. No Fowler distal tenotomy was required



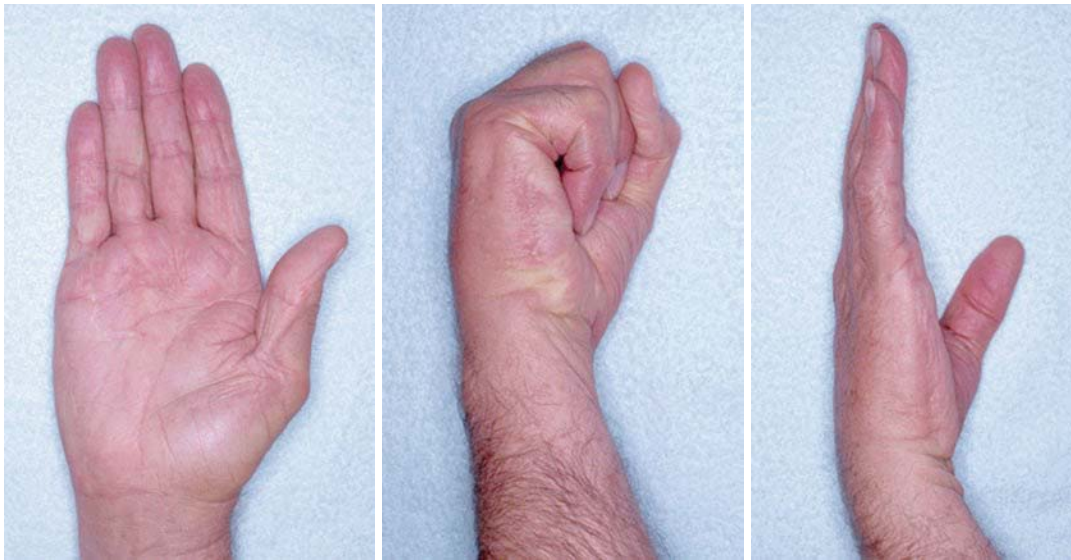


Fig. 38.4 3 months following widget removal and contracture release



Fig. 38.5 5 years following widget removal and contracture release

Conclusions

- Long-term data on the role of the soft-tissue distraction devices for PIP joint flexion deformities are lacking.
- Preliminary distraction with the Digit Widget™ may be followed by fasciectomy.
- Preliminary data of the Digit Widget™ shows superior extension improvement compared to checkrein ligament release after fasciectomy, with no recurrence in the Digit Widget™ cohort particularly in those with severe disease (>60° contracture of the PIP joint).

- Highly powered studies are needed to characterize recurrence and complications after use of the Digit Widget™.

Conflict of Interest Declaration We do not have any disclosures to declare or conflicts of interest in the completion of this work.

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