

# Preliminary Soft-Tissue Distraction versus Checkrein Ligament Release after Fasciectomy in the Treatment of Dupuytren Proximal Interphalangeal Joint Contractures

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**Background:** Checkrein ligament release for treatment of proximal interphalangeal joint Dupuytren contractures does not address the shortened arteries or deficient skin. The Digit Widget uses soft-tissue distraction to overcome these issues. This study compares checkrein ligament release after fasciectomy versus preliminary soft-tissue distraction, followed by operative release, for treatment of proximal interphalangeal joint Dupuytren contractures.

**Methods:** The authors compared operative and postoperative characteristics of patients treated with either fasciectomy plus checkrein ligament release or Digit Widget distraction between 2001 and 2008. Seventeen patients (20 digits) underwent ligament release (mean contracture, 55.9 degrees); six of these 20 were reoperations. Thirteen patients (17 digits) underwent distraction (mean contracture, 67.6 degrees); 10 of 17 were reoperations.

**Results:** The 20 digits treated with fasciectomy plus ligament release had an average extension improvement of 31.4 degrees (range, -4 to 70 degrees). Digits treated with distraction had an average extension improvement of 53.4 degrees (range, 30 to 75 degrees) ( $p < 0.001$  versus ligament release). Three digits treated with distraction improved to full proximal interphalangeal extension. Initial contractures of 60 degrees or less treated by ligament release ( $n = 12$ ) or distraction ( $n = 7$ ) improved by means of 28.8 degrees and 47.7 degrees, respectively ( $p = 0.048$ ). Contractures greater than 60 degrees treated by ligament release ( $n = 8$ ) or distraction ( $n = 10$ ) improved by means of 35.3 degrees and 57.3 degrees, respectively ( $p = 0.02$ ).

**Conclusion:** Soft-tissue distraction followed by operative release showed greater correction than Dupuytren fasciectomy plus checkrein ligament release. (*Plast. Reconstr. Surg.* 128: 1107, 2011.)

**CLINICAL QUESTION/LEVEL OF EVIDENCE:** Therapeutic, III.

**T**reatment of chronic Dupuytren proximal interphalangeal joint contracture remains a challenging problem in hand surgery. Long-term outcomes for the operative correction of these contractures have been consistently disappointing.<sup>1,2</sup> Progressive disease is common, with deformity re-

curing 12 to 18 months postoperatively in up to 60 percent of patients.<sup>3-5</sup> Although few reports in the literature specifically address the management of severe proximal interphalangeal Dupuytren contractures, controversy exists over the ideal approach to this difficult problem. Some authors have advocated fasciectomy alone, thus avoiding violation of the proximal interphalangeal joint and the concomitant potential morbidity of a permanent limitation of flexion.<sup>6-8</sup> Other surgeons have found that severe contractures of 60 degrees

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or more require release of the contracted volar joint structures for optimal benefit.<sup>9</sup> Failure to achieve complete passive extension has also been attributed to failure of at least partial division of the capsuloligamentous structures.<sup>9</sup> These were labeled the “checkrein ligaments” by Watson et al., who also described the technique of checkrein ligament release for the treatment of proximal interphalangeal contractures that do not significantly improve with fasciectomy alone.<sup>8</sup>

Unfortunately, the checkrein ligament release procedure does not address two additional problems found in long-term proximal interphalangeal joint Dupuytren contractures. First, the shortened digital arteries are stretched when the contracted proximal interphalangeal joint is fully extended after the checkrein ligament release. This stretch can initially produce arterial spasm and will lead to thrombosis if not relieved by placing the proximal interphalangeal joint back in a flexed position. This need to recreate the proximal interphalangeal contracture to maintain digital viability negates the potential improvement of checkrein ligament release. Second, the contracted soft-tissue envelope frequently cannot be closed primarily after checkrein ligament release. The flexor tendon sheath, which is opened at the level of the A3 pulley to perform the checkrein ligament release, is not the ideal bed for skin grafting. Various external fixator devices have been described that apply the concepts of progressive soft-tissue distraction to overcome these limitations of the checkrein ligament release procedure.

The Digit Widget (Hand Biomechanics Lab, Inc., Sacramento, Calif.) is one such device that applies soft-tissue distraction to improve chronic flexion contractures. The Digit Widget device is applied at a preliminary operative procedure to lengthen the soft tissues and neurovascular bundle without injury while decreasing the flexion deformity of the proximal interphalangeal joint. This takes place over an approximately 6-week period, with improvement of flexion contracture of up to 15 degrees per week. When the joint nears full extension, the Digit Widget is removed. Operative release may then be needed if the improvement seen with Digit Widget application plateaus short of full proximal interphalangeal joint extension or if the volar soft tissue of the proximal interphalangeal joint shows either residual symptomatic Dupuytren nodules or noncompliant hypertrophic scar, which can be seen in reoperative cases.

The purpose of this study was to evaluate our operative experience in managing Dupuytren contractures of the proximal interphalangeal joint. We

compared results obtained by using fasciectomy followed by checkrein ligament release versus preliminary placement of the Digit Widget and subsequent operative intervention, if indicated.

## PATIENTS AND METHODS

This study was approved by the Mayo Clinic Institutional Review Board. Between January of 2001 and June of 2008, 30 patients (37 digits) were treated for Dupuytren contractures of the proximal interphalangeal joint with either fasciectomy combined with checkrein ligament release or preliminary Digit Widget application, followed by operative intervention, if needed. All procedures were performed by the two senior surgeons (A.A.S. and S.F.M.D.). The patient group included 23 men and seven women, with a mean age of 70.3 years (range, 45 to 81 years). Seventeen patients (12 men and five women) underwent checkrein ligament release after Dupuytren fasciectomy in 20 digits for contractures ranging from 16 to 80 degrees (mean, 55.9 degrees). Ten of the 20 digits (mean contracture, 48.6 degrees) required Kirschner wire pinning of the proximal interphalangeal joint after checkrein ligament release to maintain the improvement attained intraoperatively. Six of the 20 digits had been operated on previously. Five of these six reoperated digits required a full-thickness skin graft to close the resultant soft-tissue defect.

Thirteen patients (17 digits) were treated with the Digit Widget device; the 11 men and two women had a mean age of 61.7 years (range, 45 to 75 years). Contractures of the proximal interphalangeal joint in these patients ranged from 30 to 100 degrees (mean, 67.6 degrees). Ten of the 17 digits had been operated on previously. Two of these patients required full-thickness skin graft for wound closure.

### Checkrein Ligament Release Technique

After satisfactory regional block anesthesia and under tourniquet control, the pretendinous cords to the involved digit are exposed from the midpalm to the distal interphalangeal joint and excised. If this does not allow the proximal interphalangeal joint to come into full extension with a minimum amount of passive stretching of the proximal interphalangeal joint, checkrein ligament release is carried out by opening the flexor tendon sheath between the A2 and A4 pulleys and retracting both flexor tendons to expose the checkrein ligaments, volar plate, and collateral ligaments. The checkrein ligaments are identified,

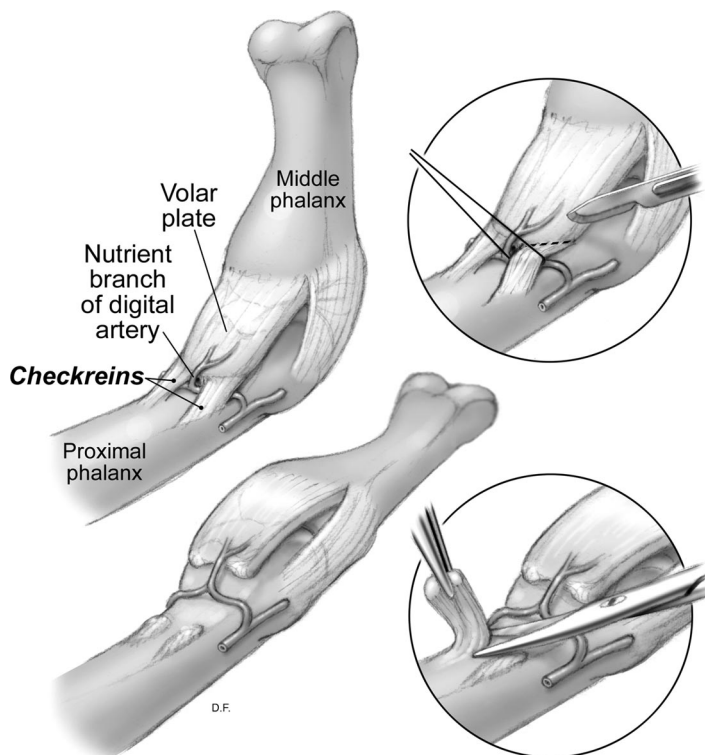
and a transverse incision proximal to the volar plate is carried out down to the level of the proximal phalanx (Fig. 1). Once this is completed and the checkreins are completely released, the proximal interphalangeal joint should come into full extension with a minimum of passive stretch on the proximal interphalangeal joint, although in rare instances partial release of the collateral ligaments may be required. The tourniquet is then deflated, restoring vascular flow to the operated digit. After the digit has appropriate capillary refill, the proximal interphalangeal joint is transfixed with an oblique Kirschner wire, maintaining the proximal interphalangeal joint in the maximum amount of extension allowed that will still provide adequate inflow to the digit.

### Digit Widget Application

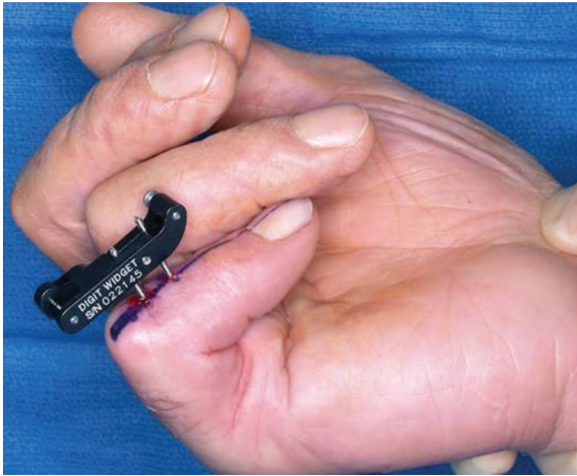
The Digit Widget is applied in the operating room under fluoroscopic guidance. The pin block

is applied to the middle phalanx of the involved digit in the operating room. The middle phalanx is predrilled and then the two middle phalanx screws are placed and connected with a bar, which has a distal attachment point for a rubber band. The connector assembly and cuff are then placed (Fig. 2). Patients are instructed to remove the cuff and connector assembly for hand washing and active finger flexion exercises daily. Patients are also instructed on placement of rubber bands between the pin block and connector assembly.

Distraction begins the day after surgery, with the goal of fully correcting the contracture within 6 weeks. According to the manufacturer's recommendations, the patients start with the lightest rubber bands and increase the strength as tolerated, with the goal of 10 to 20 degrees of improvement in flexion contracture per week. Patients initially return to the clinic weekly, but as they become more comfortable with the technique,



**Fig. 1.** Illustration of the checkrein ligament release technique for the treatment of proximal interphalangeal joint contracture. (Above, left) Volar view of the proximal interphalangeal joint, with volar plate and checkrein ligaments intact and obvious proximal interphalangeal contracture. (Above, right) Checkrein ligament mobilized, before release. (Below, right) Checkrein ligaments completely released, preserving nutrient branch of digital artery. (Below, left) Improved proximal interphalangeal joint contracture after checkrein ligament release. (Used with permission of the Mayo Foundation for Medical Education and Research.)



**Fig. 2.** Operative photograph illustrating application of the Digit Widget. The middle phalanx screws have been placed and are connected with the bar.

they return every other week. The Digit Widget is left in place until the proximal interphalangeal joint is straight or until improvement in the distraction reaches a plateau (Fig. 3), with the goal of removing the Digit Widget after a maximum of 6 weeks. The Digit Widget is then removed; surgical intervention is undertaken only if the digit is not fully straight or if prominent Dupuytren nodularity or hypertrophic scar remains.

## RESULTS

### Fasciectomy plus Checkrein Ligament Release Cohort

Seventeen of the 20 digits treated with checkrein ligament release after Dupuytren fasciectomy had improvement in the proximal interphalangeal joint contracture ranging from 8 to 70 de-



**Fig. 3.** Lateral view of the right hand with the Digit Widgets in the small and ring fingers, with the connector assembly in place.

grees (mean, 37.4 degrees). The other three digits had worsening of the proximal interphalangeal joint contracture ranging from 2 to 4 degrees of further contraction. Mean  $\pm$  SD overall improvement in the 20 digits treated with fasciectomy plus checkrein ligament release was  $31.4 \pm 21.5$  degrees. In the 10 digits that were pinned, nine had improvement, from 17 degrees to 70 degrees (mean, 40.1 degrees). In our series, slightly better outcomes were obtained with pinning the proximal interphalangeal joint to maintain the improvement attained intraoperatively. However, the contracture worsened in one pinned digit (contracture of 16 degrees worsened to 20 degrees). The overall mean gain in extension in the pinned digits was 35.7 degrees. Pins were left in place from 1 to 29 days (mean, 19.4 days). Eight of the 10 nonpinned digits had improved proximal interphalangeal extension (mean, 44.4 degrees; range, 8 to 52 degrees), and in the other two proximal interphalangeal joint extension decreased by 2 and 3 degrees. The overall gain in proximal interphalangeal joint extension in nonpinned digits was 27 degrees.

For the two contractures of 30 degrees or less, fasciectomy plus checkrein ligament release improved one contracture by 17 degrees and worsened one contracture by 4 degrees. For the 11 contractures between 30 and 60 degrees, fasciectomy plus checkrein ligament release worsened one contracture by 7 degrees and improved 10 contractures by 7 to 60 degrees (mean, 33.6 degrees), for an overall improvement of 29.9 degrees. For the seven proximal interphalangeal joint contractures greater than 60 degrees, one worsened by 3 degrees after fasciectomy plus checkrein ligament release and the other six contractures improved (mean, 40.7 degrees; range, 19 to 70 degrees), for an overall improvement of 35.3 degrees.

In the six digits in which the operation was repeated for recurrent disease, fasciectomy plus checkrein ligament release worsened two contractures by 3 and 4 degrees and improved four contractures by 19 to 70 degrees (mean, 44 degrees), for an overall improvement of 28.2 degrees. In the 14 proximal interphalangeal joints treated primarily with fasciectomy plus checkrein ligament release, the contracture worsened in one digit by 2 degrees and improved in 13 digits (mean, 35.4 degrees; range, 8 to 60 degrees), for an overall improvement of 32.7 degrees.

Three complications occurred in the fasciectomy plus checkrein ligament release cohort: two of the digits requiring full-thickness skin graft had

partial loss of the graft, and in one digit the Kirschner wire was removed on postoperative day 1 for digital ischemia. No recurrences or loss of gained extension were observed after a mean follow-up of 18 months (range, 3 to 24 months).

**Digit Widget Cohort**

Of the 17 digits treated with the Digit Widget device, three had complete correction of the contracture and did not require subsequent operative release (Table 1). All 14 digits that did require operative release after Digit Widget treatment had improvement in contracture ranging from 30 to 75 degrees (mean, 54.8 degrees). Mean duration of Digit Widget distraction before operative release was 42 days (range, 22 to 64 days). In the three digits that did not require operative release, the duration of Digit Widget distraction ranged from 43 to 64 days (mean, 50 days). Percutaneous pinning was not used in the Digit Widget cohort. Two patients with reoperation in the Digit Widget cohort required full-thickness skin grafting for wound closure. Mean  $\pm$  SD improvement in contracture for the entire Digit Widget cohort ( $53.4 \pm 13.8$  degrees) was significantly greater than that for the checkrein ligament release group ( $31.4 \pm 21.5$  degrees) ( $p < 0.001$ , two-sample *t* test).

For the one proximal interphalangeal contracture of 30 degrees or less, the Digit Widget improved the contracture by 30 degrees. For the six contractures between 31 and 60 degrees, the Digit Widget improved the contractures by a mean of 50.7 degrees. For all initial contractures of 60 de-

grees or less, the Digit Widget improved the seven contractures by a mean  $\pm$  SD of  $47.7 \pm 10.8$  degrees, compared with  $28.8 \pm 21.8$  degrees for the 12 digits in the checkrein ligament release cohort ( $p = 0.048$ ). For the proximal interphalangeal contractures greater than 60 degrees, the Digit Widget allowed a mean  $\pm$  SD improvement of  $57.3 \pm 14.8$  degrees in the 10 digits, compared with  $35.3 \pm 22.0$  degrees in the checkrein ligament release cohort ( $n = 8$ ) ( $p = 0.02$ , two-sample *t* test). In the 10 digits that had had previous surgery before application of the Digit Widget (mean initial contracture, 64.9 degrees), contractures improved by a mean of 52.7 degrees. In the seven primarily treated digits (mean initial contracture, 71.4 degrees), contractures treated with the Digit Widget improved by a mean of 54.3 degrees.

Four complications occurred in the Digit Widget cohort. One Digit Widget was removed early because of impingement on an adjacent digit, two pin-track infections were treated with antibiotics, and one patient required a splint-blocking metacarpophalangeal joint extension to appropriately direct the forces of soft-tissue distraction to the proximal interphalangeal joint. There were no recurrences or loss of gained extension after a mean follow-up of 18 months (range, 3 to 24 months).

**DISCUSSION**

Several small series have described varying degrees of success with external fixation devices for the treatment of severe proximal interphalangeal

**Table 1. Clinical Data and Outcomes for the 13 Patients (17 Digits) Treated with Digit Widget Distraction**

Patient	Finger	No. of Previous Procedures	Duration of Digit Widget Application (days)	Angle of Contracture (degrees)		Improvement (degrees)	Operative Release
				Initial	Final		
1	Index	0	64	50	0	50	No
	Small	0	64	70	40	30	Yes
2	Small	0	36	60	0	60	Yes
3	Small	0	22	70	10	60	Yes
4	Small	0	43	90	30	60	Yes
5	Small	0	26	80	30	50	Yes
6	Ring	0	43	80	10	70	Yes
7	Thumb	1	29	44	0	44	Yes
8	Small	1	44	90	15	75	Yes
9	Small	1	56	100	55	45	Yes
10	Small	1	33	60	0	60	Yes
	Ring	1	33	30	0	30	Yes
11	Small	1	56	75	32	43	Yes
12	Small	2	40	70	0	70	Yes
	Ring	2	40	90	20	70	Yes
13	Small	3	43	50	0	50	No
	Ring	3	64	40	0	40	No
All digits, mean $\pm$ SD			43.3 $\pm$ 13.4	67.6 $\pm$ 20.0		53.4 $\pm$ 13.8	

joint contractures, but none has directly compared outcomes of these devices with those of checkrein ligament release. In our current series, preliminary placement of the Digit Widget, followed by operative release when indicated, resulted in promising outcomes. When all digits treated with fasciectomy followed by checkrein ligament release are aggregated, mean improvement was 27.7 degrees. In contrast, mean improvement of digits treated with the Digit Widget was 54.7 degrees (range, 30 to 75 degrees). No digits in the Digit Widget cohort had worsening contracture, in contrast to the checkrein ligament release cohort. Three digits treated with the Digit Widget improved to full extension without requiring surgical release. Our results are particularly promising for reoperative cases and severe contractures (>30 degrees). In the checkrein ligament release cohort, the six reoperative digits had an aggregate mean improvement of 28.2 degrees, compared with a mean improvement of 52.7 degrees in the 10 reoperative digits treated with the Digit Widget preliminarily. For contractures between 30 and 60 degrees, the checkrein ligament release cohort had a mean improvement of 29.9 degrees, compared with an improvement of 50.7 degrees in the Digit Widget cohort. For the seven patients in the checkrein ligament release cohort with contractures greater than 60 degrees, a mean improvement of 40.7 degrees was seen; in contrast, patients with contractures of greater than 60 degrees in the Digit Widget group had a mean improvement of 57.3 degrees.

Long-term outcomes for the operative correction of chronic flexion contractures of proximal interphalangeal joints have been universally disappointing.<sup>1,2</sup> Although a large body of literature describes various approaches for the treatment of Dupuytren contractures, little is available regarding the specific management of the severely contracted proximal interphalangeal joint. The anatomy of the proximal interphalangeal joint makes it prone to persistent contracture after excision of diseased fascia. Secondary joint contracture may also result from shortening of the skin over the palmar aspect of the finger, the collateral ligaments, and the volar plate. Proximal adhesions of the volar plate can produce thickening of the check ligaments. These pathologic structures may differ in size and tightness, contributing to secondary contracture.<sup>8</sup>

Controversy exists over the ideal surgical management of severe proximal interphalangeal joint Dupuytren contractures. Watson et al.<sup>8</sup> described the checkreins and their surgical release through a

midlateral or V-Y volar incision; they achieved full intraoperative release in 100 of 115 joints. The authors believed that violating the joint was almost never required to achieve satisfactory extension. Both McFarlane<sup>10</sup> and Hueston<sup>11</sup> thought that, except for simple division of the proximal checkrein ligaments, capsulotomy was not recommended, stating that a residual deformity of up to 45 degrees may need to be accepted in the treatment of severe proximal interphalangeal joint contracture.

Weinzweig et al.<sup>9</sup> retrospectively reviewed their outcomes in treating severe contractures of the proximal interphalangeal joint with fasciectomy combined with capsuloligamentous release versus fasciectomy alone. Their reported experience involved 42 proximal interphalangeal joints (contractures  $\geq 60$  degrees) in 28 patients with Dupuytren contractures. In the fasciectomy-alone group, preoperative contracture averaged 78.4 degrees and postoperative contracture averaged 36.6 degrees—a 53 percent improvement. In the capsulotomy group, preoperative contracture averaged 82.5 degrees and postoperative contracture averaged 36.8 degrees—a 55 percent improvement (no significant difference between the two groups). Importantly, the initial degree of correction obtained at surgery in both groups was not maintained during the short follow-up period.

Because of these disappointing results obtained from current methods of operative correction of Dupuytren contractures, various external fixation devices have been described to apply continuous soft-tissue distraction in the correction of severe proximal interphalangeal joint flexion contractures. The most extensively studied, the continuous extension technique, was introduced by Messina and Messina.<sup>12,13</sup> Continuous passive distraction was applied over a 2- to 4-week period with the aim of preoperatively decreasing or eliminating Dupuytren flexion contractures. In 51 patients with grade III and IVb Dupuytren contractures, those who underwent fasciectomy after removal of the continuous extension technique device had fewer recurrences of contracture at 5 years than those treated with the device alone.<sup>13</sup> However, a subsequent report of the continuous extension technique and the Verona external fixator applied for 1 to 4 weeks preoperatively before conventional fasciotomy described less improvement in contractures and more recurrences.<sup>14</sup>

The multiplanar distracter, originally designed for distraction of the mandible, was used by Kasabian et al.<sup>15</sup> to improve proximal interphalangeal joint contracture in one patient, with disappointing results. Siow et al.<sup>16</sup> described their

experience with a miniature external fixator device in the treatment of severe, fixed, flexion contractures involving the metacarpophalangeal, distal interphalangeal, and proximal interphalangeal joints in three patients, with varying degrees of improvement. Houshian et al.<sup>17</sup> reported their outcomes with the compass hinge external fixator in treating 27 digits with chronic flexion contractures of various causes. After a mean of 33 days, the fixator was removed, for an average extension gain of 38 degrees (range, 0 to 70 degrees). No patient underwent open surgery in their series.

Although the role of soft-tissue distraction in the treatment of Dupuytren contractures remains to be determined through ongoing randomized trials and with longer follow-up, especially with regard to the potential for recurrence, our initial experience with the Digit Widget device has shown promise, especially for digits with severe contractures.

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