

Proposal for Treatment of Severe Dupuytren Disease in 2 Steps: Progressive Distraction With External Fixator and Collagenase - A Preliminary Case Series

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Abstract

Background: We want to describe a treatment for advanced Dupuytren disease using a spanning external fixator (EF) applied dorsally to produce progressive extension, followed by collagenase injection. **Methods:** Between October 2014 and September 2016, a total of 22 fingers from 18 patients were treated with an EF. The devices were implanted under local anesthesia, and the patients were instructed to gradually extend the hinge to gain a progressive extension. The EF was removed in an outpatient clinic setting after obtaining a complete extension of the treated joint in a mean of 19 days (range 15-22 days), and a collagenase injection was performed in the residual cord after a mean of 20 days (18-24 days), followed by splinting. **Results:** All patients were evaluated at an average follow-up of 14 months (range 3-23 months): the total average residual flexion deformity was 9.7° (range 0°-19°) with a correction of 107.2° (range 94°-138°), the average flexion deformity of the proximal interphalangeal joint was 7.4° (range 0°-15°) with a correction of 64.4° (range 46°-92°), and the average flexion deformity of the metatarsophalangeal joint was 2.4° (range 0°-9°) with a correction of 42.8° (range 15°-59°). No complications were reported in relation to EF treatment. Two cases of cutaneous laceration after collagenase injection were observed, neither of which required any additional treatment. **Conclusions:** All patients obtained a regression from 2 to 3 stages in disease severity only with EF. We had no report of complications due to the device. After collagenase injection and splinting, we obtained further finger extension with a mean total residual flexion deformity of 9.7° at 14-month follow-up.

Keywords: collagenase, Dupuytren, external fixation, distraction, local anesthesia

Introduction

Dupuytren disease (DD) is characterized by progressive flexion deformity of one or more fingers due to a benign proliferation of fibroblasts associated with increased accumulation of collagen in the palmar aponeurosis. In the late stages of DD, surgical treatment is challenging due to limited anatomical space and soft tissue contracture, increasing the risk of complications and incomplete correction. Over the past 10 years, nonsurgical treatments, like collagenase, have represented another therapeutic option for managing this as-yet incurable disease. For these severe cases, we propose a 2-step technique based on external fixation followed by collagenase injection, aiming at extension of the contracted fingers. Indications for this treatment are severe DD stages 3 and 4 affecting no more than 2 fingers, even if recurrence, without contracted arthritic joint.

Due to its dorsal positioning, the device we used is particularly comfortable for patients, leaving free the

other finger sides. As for the collagenase, the European Commission's approval for the only formulation available (Xiapex) was obtained in 2010. The product was approved in Italy in February 2013 (GU Serie Generale n.49 del 27-02-2013),¹ for contractures of the metatarsophalangeal joint (MPJ) ranging from 20° to 50° and for contractures of the proximal interphalangeal joint (PIPJ) between 15° and 40° (eligibility criteria, source AIFA—the Italian Drugs Agency).

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Supplemental material is available in the online version of the article.

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Table 1. Features and Results of the Treated Population.

Pt.	Age/ sex	Finger	Dupuytren disease stage	Recurrence	EF model/ articulation	Before EF (°)		Precollagenase (°)		Follow-up postcollagenase (°)	
						Total	PIPJ	Total	PIPJ	Total	PIPJ
							MPJ		MPJ		MPJ
1	67/M	IV	3	+	R25/PIPJ	94	79	17	2	0	0
							15		15		0
2	61/M	IV	4		R25/PIPJ	136	86	64	23	13	13
							50		41		0
3	74/M	IV	3		R30/MPJ + PIPJ	108	61	40	8	11	9
									32		2
		V	3	+	R25/PIPJ	117	61	58	15	13	11
							56		43		2
4	64/M	V	3		R25/PIPJ	92	63	22	0	10	8
							29		22		2
5	74/M	V	4	+	R25/PIPJ	139	88	53	2	10	7
							51		51		3
6	59/M	IV	4	+	R25/PIPJ	138	92	49	17	0	0
							46		32		0
7	66/M	III	3		R25/PIPJ	97	62	32	8	11	9
							35		24		2
		IV	3		R25/PIPJ	91	63	33	12	5	4
							27		21		1
8	60/M	IV	3		R30/MPJ + PIPJ	100	57	18	3	8	6
							43		15		2
		V	4		R25/PIPJ	142	84	63	18	17	15
							58		45		2
9	69/M	V	3	+	R25/PIPJ	97	67	33	10	8	7
							30		23		1
10	64/M	V	3		R30/MPJ + PIPJ	112	60	51	10	18	6
							52		41		4
11	61/M	V	3		R30/MPJ + PIPJ	123	70	61	19	18	11
							53		42		7
12	69/M	V	3		R30/MPJ + PIPJ	110	62	28	9	10	7
							48		19		3
13	74/M	III	3		R25/PIPJ	116	77	43	17	2	0
							39		26		2
14	61/M	V	3		R30/MPJ + PIPJ	125	68	40	11	16	7
							57		29		9
15	63/F	V	4	+	R25/PIPJ	147	86	60	10	9	7
							61		50		2
16	68/F	IV	3		R30/MPJ + PIPJ	95	54	31	7	0	0
							41		24		0
		V	4		R25/PIPJ	149	86	64	17	19	14
							63		42		5
17	32/M	V	3		R25/PIPJ	107	74	40	10	6	5
							33		30		1
18	38/F	V	4	+	R25/PIPJ	138	79	55	17	10	9
							59		38		1

Note. Postcollagenase degrees were measured at a mean follow-up of 14 months. EF = external fixator; PIPJ = proximal interphalangeal joint; MPJ = metatarsophalangeal joint.

Our proposal for treatment arises from the fact that even if the common algorithm of single joint injections with monthly intervals has changed (following multiple reported experiences in the medical literature),² the Italian National Health System covers only the expense for one collagenase injection per hand for DD stages 1 and 2. Given that severe DD stages 3 and 4 generally involve MPJ and PIPJ simultaneously, a single injection is not enough to treat both of the articulations.¹ Therefore, it is mandatory to decrease the severity of the disease; in such cases, patients can ben-

efit from a completely public health system–covered treatment.

Materials and Methods

Between October 2014 and September 2016, we performed 22 treatments in 18 patients with DD stages 3 and 4 according to the Tubiana classification²⁶ (Table 1). Seven cases were recurrences of DD previously treated with open aponeurotomy. Informed consent was col-

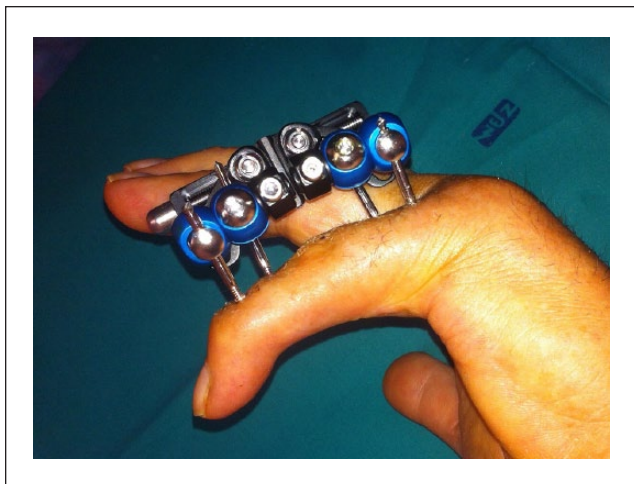


Figure 1. MiniFlo (Citieffe), model R25 in place.



Figure 2. MiniFlo (Citieffe), model R30 in place.

lected from each patient, and approval by our ethics committee was obtained before study initiation (*code: Miniflo-ITA14*) for the use of external fixator (EF) *MiniFlo*, developed by Citieffe (Bologna, Italy). This device is a single-bar articulated transarticular hinged EF, placed dorsally on the affected fingers via 4 self-drilling pins, applied using a percutaneous technique after determination of the joint center of rotation. The device is available in 2 different configurations to treat a single affected joint (PIPJ and MPJ—model R25) (Figure 1) or for treatment of both PIPJ and MPJ simultaneously (model R30) (Figure 2).

Increasing digital extension was performed by the patients by operating a worm screw in the hinge of the EF with a custom wrench. The palmar side of the treated fingers remained free to perform daily life activities. Inclusion



Figure 3. External fixator application on proximal interphalangeal joint on male patient, Dupuytren disease stage 4, affecting ring finger.

criteria for participation in the trial were the following: adults aged 18 years or older, DD stages 3 to 4, absence of arthritis at MPJ-PIPJ, no more than 2 fingers treated simultaneously, and patient's motivation; exclusion criteria were the following: mental illness; unwillingness to undergo follow-up visits; DD stage 0, 1, or 2; joint ankylosis; and pregnancy and nursing mothers.

The treatment protocol was the same in all cases and comprised 2 steps:

Step 1: Fixator Application and Progressive Distraction

The EF is applied by placing the patients in the supine position in the operating room (Figure 3), with the affected limb placed on a radiolucent arm board for fluoroscopy. Local anesthesia (10 mL mepivacaine chloride—20 mg/mL—digital block) is performed in the affected fingers. The choice between the 2 EF models depends on the contraction discrepancy at the MPJ and PIPJ: in our cases, if the contraction severity was similar in both of the articulations, we used the R30 model to treat them together (Figure 2); the R25 model was used instead to correct a more contracted PIPJ compared with a less involved MPJ. In this way, it is also possible to treat a “reverse” situation, that is, a more contracted MPJ opposed to a less severe PIPJ. Under fluoroscopic control, in lateral view a 1.5-mm Kirschner wire is inserted percutaneously with a power drill on the dorsal aspect of the bone: for PIPJ correction, it is directed to the joint center of rotation, corresponding to the center of the head of the proximal phalanx in lateral view (Figure 4a); for simultaneous correction of PIPJ and MPJ,

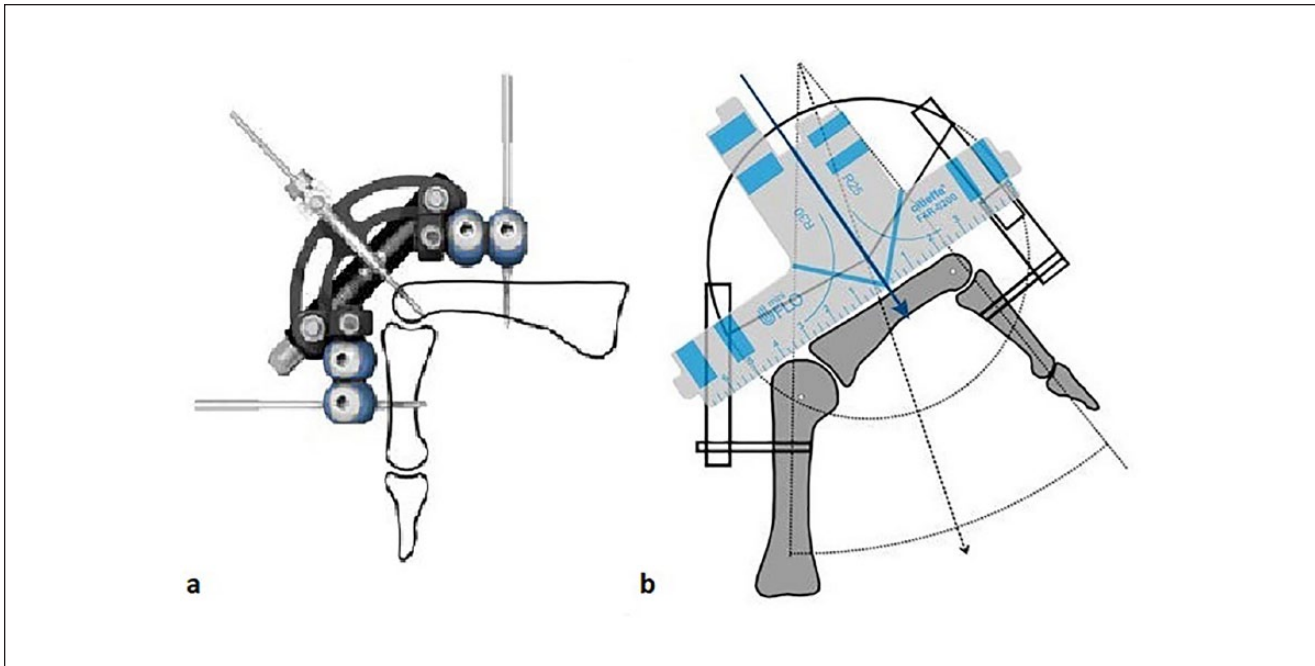


Figure 4. (a) How to detect center of rotation for model R25 and (b) how to detect the center of rotation for model R30. Courtesy of Citieffe.

the center of rotation is established by considering the bisector of the angle between the axes of the metacarpal and the middle phalanx. Hence, the Kirschner wire direction lies approximately on a perpendicular line to the middle point of the proximal phalanx in the lateral view. A ruler guide is stored in the device container, to be more precise (Figure 4b). The EF slides along the Kirschner wire and, once in place, is fixed with a self-drilling pin in the most proximal clamp; the second pin is inserted in the distal clamp followed by the remaining 2 pins. At the end of the procedure, the Kirschner wire is removed. It is important to leave at least 5 mm between the skin and the EF for pin care.

The patients start progressive extension the day after surgery by turning the worm screw 1 full turn a day, corresponding to 3° . Usually, we suggest patients to split the full turn into 2 half turns, one in the morning and the other in the evening, for better compliance and pain control.

Weekly checks are planned to evaluate pain and discomfort and any adverse events and to check whether the patients were applying the correct amount of distraction. The EF is removed in the outpatient clinic without anesthesia, after reaching a complete device extension at an average of 19 days (15-22 days).

After EF removal and before collagenase injection, all the patients had undergone physiotherapy and local skin treatments plus capsuloligamentous stretching, associated

with splinting and assisted mobilization, for a mean period of 20 days (18-24 days).

Step 2: Collagenase Procedure

According to international guidelines^{3,4} *Clostridium histolyticum* collagenase (Xiapex [Sobi]) is injected in the residual palmar MPJ cord in the treated digital ray. The next day, cord rupture is obtained by finger manipulation and distraction under local anesthesia (4 mL mepivacaine chlorhydrate—20 mg/mL) (Figure 5). Previous distraction with EF considerably decreases the risk of skin lacerations after manipulation,⁵ a rather common eventuality especially in high-grade contractures with tight skin adhesion.⁶⁻⁸

Subsequently, a customized thermoplastic dorsal traction splint is applied⁹ (Supplementary Figure 1). Patients wear the splint for 21 days, around 22 hours a day, whereas the remaining 2 hours are dedicated to active and passive finger mobilization assisted by physical therapist. After that, the splint is worn only at night for an additional 6 weeks.

Results

Upon EF removal, the mean residual angular deformity was 43.4° (17° - 64°) with an average correction of 73.5° (58° - 89°). The average pain level measured using a Visual



Figure 5. After metatarsophalangeal joint collagenase injection and finger manipulation.



Figure 6. Clinical follow-up at 7 months after treatment showing good articular extension recovery in the fourth digit, although slight elastic recontracture (13°) is noticeable due to a moderate active extension impairment following a long period of forced flexion deformity.

Analog Scale (VAS) during treatment with the EF was 0.75 (0-1.6). VAS values >3 were not reported in any patient. In 4 cases (patients 3, 7, 8, 16), we performed a treatment in 2 fingers simultaneously: one injection was covered by the national health system (as expected), whereas the other was paid by the patient's private health insurance. The collagenase was injected in the residual palmar cord about 20 days (18-24 days) after EF removal, with subsequent manipulation 24 hours later. All patients were reassessed with an average follow-up of 14 months (3-23 months); the total average angular deformity was 9.7° (0- 19°) (Figure 6; Table 1).

No complications were reported in relation to EF treatment. Two cases of cutaneous laceration during finger manipulation under local anesthesia were observed after collagenase injection, neither of which required any treatment.

Discussion

The treatment of advanced DD stages remains a challenge even for skilled hand surgeons who still consider open surgery the standard of care,¹⁰ although collagenase is rapidly becoming an established treatment. The incidence of complications such as neurological and vascular damage, infection, hematoma, and scar adhesion in surgical treatment is relatively high, ranging from 3.6% to 39.1%.¹¹ Technical difficulties and incidence of complications increase with higher grades of disease,^{12,15} where narrow anatomical spaces and the risk of excessive distraction result in vascular lesions of the finger or joint stiffness due to long-term disease after the removal of the fibrous cord.¹⁰

Some authors consider amputation the intervention of election for severely deformed fingers and/or in the presence of associated neurological damage with severe

functional deficits, when standard surgery has proved to be ineffective.¹³

Two minimally invasive techniques report encouraging data: percutaneous fasciotomy with needle (percutaneous needle fasciotomy [PNF]) and the injection of collagenase. Currently, a meta-analysis shows that PNF is indicated in stages 2 and 3 in the palmar area^{14,25}, but it is also characterized by high grade of recurrence. *Clostridium histolyticum* collagenase injection represents the most interesting minimally invasive technique in recent years. Witthaut et al²⁸ found a correction greater than 50% in 89% of treated MPJ and 58% of PIPJ; this discrepancy is not surprising because it is known that PIPJ contraction is less responsive to treatment, regardless of the method, and the result is less durable.^{16,18,25,26}

Minor complications with spontaneous resolution occur in almost all patients: rash, local edema, pain at injection site, bruising, and skin rupture due to manipulation. Major complications such as tendon rupture have a reported incidence of 0.27%.^{20,27}

The use of an external device to achieve a gradual distraction of fingers was proposed in 1989 by Messina.^{21,22} Further histological studies have shown that continuous traction leads to cord weakening, due to cellular changes in myofibroblasts.²³ Based on these considerations, we developed our protocol where the corrective potential of the EF on soft tissue was supported by the latest techniques available for DD treatment. The use of a dedicated external articulated fixator placed dorsally has allowed a gradual, painless, and controlled correction, well accepted by patients.

As for improvement on external fixation applied to DD, recently Agee and Goss developed a 1- or 2-stage approach

based on a new dynamic external fixation device (Digit Widget), starting with the evidence that continued splinting and casting can be complicated by skin pain and ischemia prone to ulceration.²⁴ Compared with our EF, this device allows patients to freely flex treated fingers against an extension torque; in any case, in their method surgical excision of contractile bands and nodules is always associated with fixation.

In all patients, since the first treatment step, a regression of 2 or 3 stages in disease severity was noted, with a normotrophic and elastic palmar skin ready for any additional therapy, avoiding the need of an open surgical approach and all its possible related complications (from skin necrosis to infections and potential neurovascular damage), especially in these advanced cases. We had no report of extensor tendon adhesion due to transtendinous pinning. The second step with only one collagenase injection in the residual DD cord allows the completion of a safe and minimally invasive treatment under full National Health Service coverage.

The reduced extension of the test sample and the short follow-up do not provide definitive evidence on the recurrence rate; therefore, further study is needed to assess and characterize possible recurrence and complications. However, the results achieved propose our solution as a valid alternative to more invasive conventional techniques and to collagenase injection alone.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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