The Continuous Elongation Treatment by the TEC Device for Severe Dupuytren's Contracture of the Fingers

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The continuous elongation technique is a preparatory step for excision of the pathologic palmar fascia for severe Dupuytren's contracture of the hands. It consists of a physiologic, painless, and atraumatic elongation that is obtained by means of a device fixed on the fourth and fifth metacarpal bones by two self-drilling pins.

This paper presents our experience since 1986 with the TEC device, which we designed and built for severe hand contracture; the device has been applied on 56 hands and 85 fingers seriously flexed by Dupuytren's contracture.

This advanced methodology also represents a real alternative to the surgical indication of finger amputation in progressive cases of the fascia retraction, and it avoids the necrosis, loss of vascularity, and bad functional results frequently seen after classical operations.

The TEC device also avoids the plastic surgical correction of digital or palmar skin loss, particularly when there is a need for a flap or a skin graft.

Dupuytren's contracture was for 160 years thought to be degenerative, progressive, and irreversible, but the TEC device, by bringing the contracture back to the initial stage of the disease, opens up new basic research into morphologic and biochemical processes of the collagen in the retracted palmar fascia. (*Plast. Reconstr. Surg.* 92: 84, 1993.)

The study and analysis of the progressive retraction of the palmar fascia during the clinical course of Dupuytren's contracture led us to consider the possibility of opposing the evolution of this pathologic contracture with a continuous traction that could lengthen the fascia and bring it back to the initial stage of the disease (Figs. 1, 2, 4, and 6). In this way, we could obtain a complete and definitive correction of the contracture and stop the evolution of the disease or, at least, create better conditions for the surgical approach and so reduce the complexity of the intervention in severe cases.[3]

To this end, in 1986, we built an apparatus, which we call the *TEC device*, capable of exerting a continuous lengthening on the retracted fingers of 2 mm per day, which would correspond to a biologic elongation[2] (see Fig. 4).

This method is therefore able to stop the retraction of the fascia and even reverse it. This type of contracture was, in fact, thought for 160 years to be progressive, degenerative, and irreversible. Hence the TEC device calls into question the very definition of Dupuytren's contracture and may open up new prospects of morphologic and biochemical research into aponeurosis contracture.[1,4]

Materials and Methods

Application Technique of the TEC Device

Under regional or block axillary anesthesia, two self-drilling pins are inserted on the cubital side of the hand through the skin (without incision) (Fig. 3). The pins are inserted transversely through the fourth and fifth metacarpal bones at the proximal and distal metaphyses. Clinical and x-ray control of the length and position of the inserted pins must confirm that they have completely penetrated both the cortices of the fourth and fifth metacarpal bones.[3] In this way, we obtain a very stable and painless assembly that sup-

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FIG. 1. Active Dupuytren's contracture with rapid progression of ring finger's flexion. Some difficulty of surgical approach. Immediate and "classical" surgical extension of the finger is always traumatic for retracted joints and collateral vasculonervous bundles. (Continuous elongation of the finger is recommended.)

ports the TEC device in order to obtain continuous elongation of the retracted fingers (Fig. 4).

A Kirschner wire is then inserted transversely through the distal metaphysis of P_2, through the proximal metaphysis of P_3 if this is retracted, or through both metaphyses if both the proximal and distal interphalangeal joints are flexed together in severe contracture. The Kirschner wire is bent to form a traction loop (see Fig. 4). After skin dressing, the TEC device is assembled on the metacarpal pins outside the operating room, and the phalangeal traction loop is connected to a threaded screw that allows 2 mm of lengthening of the retracted finger per day. The device is regulated in terms of direction and height until complete extension of the retracted finger has been achieved (see Fig. 4). The pins and Kirschner wire are removed on an ambulatory basis (see Fig. 6).

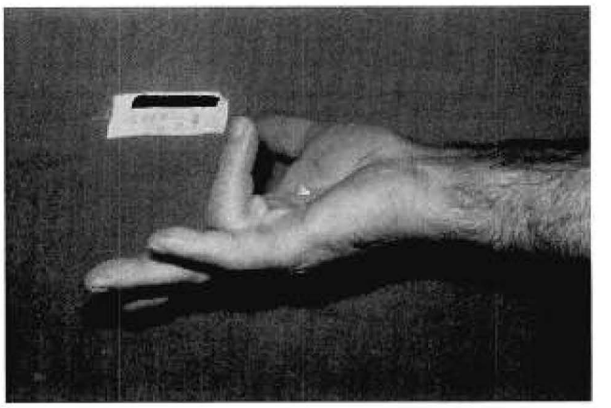

FIG. 2. In evolutive Dupuytren's contracture, thanks to the TEC methodology, the surgical approach is very simple; the length of operation and the risk involved are reduced for both the surgeon and the patient.

FIG. 3. With locoregional anesthesia, two self-drilling pins are inserted transversely through the proximal and distal metaphyses of the fourth and fifth metacarpal bones. In this way, a stable and painless assembly is mounted, and the continuous extension device is fixed to it. The continuous lengthening is carried out by the patient himself or herself at home.

The treatment consists of elongation of 2 mm per day distributed over four sessions (8 A.M., 12 noon, 4 P.M., and 8 P.M.) and carried out by the patient himself or herself at home. The TEC device is removed after 2 weeks, on average.

All patients were operated on with brachial-axillary block anesthesia or with regional anesthesia in an outpatient setting (see Fig. 3).

CLINICAL STUDY

Our experience with the TEC method is limited to 50 cases of severe Dupuytren's contracture in 170 patients treated in the period 1986 to 1991. The average age of the patients was 58 years. Dupuytren's contracture was present in 77 hands. The average duration of the disease was 5 years.

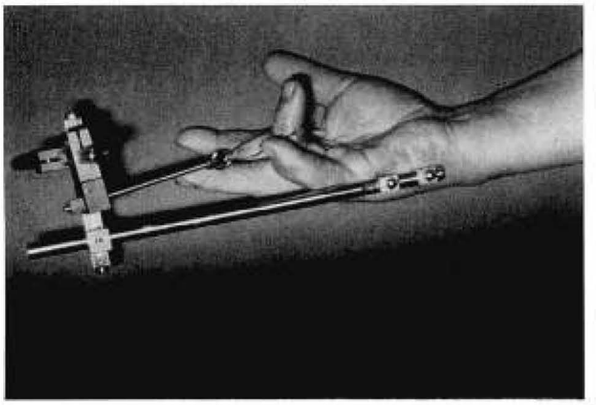

FIG. 4. TEC device. A Kirschner wire is inserted transversely through the phalanx metaphysis of the retracted finger and is then bent to form a traction loop. The insertion is made through the distal metaphysis of the proximal or the intermediate phalanx or through the proximal metaphysis of distal phalanx (or through both if they are severely retracted). The TEC device is secured firmly to the two self-drilling pins by a rod. The continuous elongation is carried out on the retracted finger by means of a screw, the height and direction of which is calibrated according to the retraction degree of the finger. It is then progressively adjusted in relation to the elongation of the finger. The screw is given a half-turn every 4 hours (8 A.M., 12 noon, 4 P.M., and 8 P.M.), which corresponds to an extension of 2 mm. In this way, the elongation is atraumatic and painless, and there is no risk of vasculonervous bundle damage.

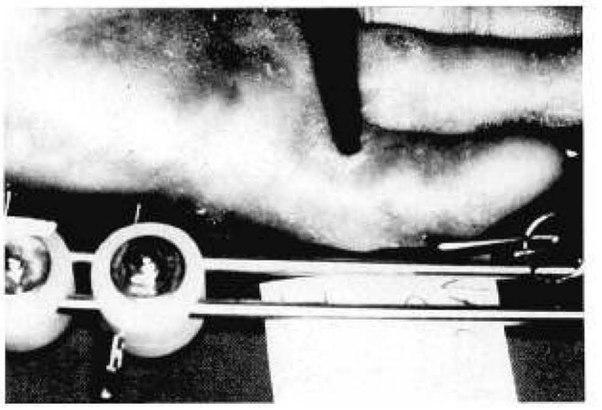

FIG. 5. Compression test. This test confirms that at the end of elongation the nodule is flattened and the pretendinous cord has disappeared.

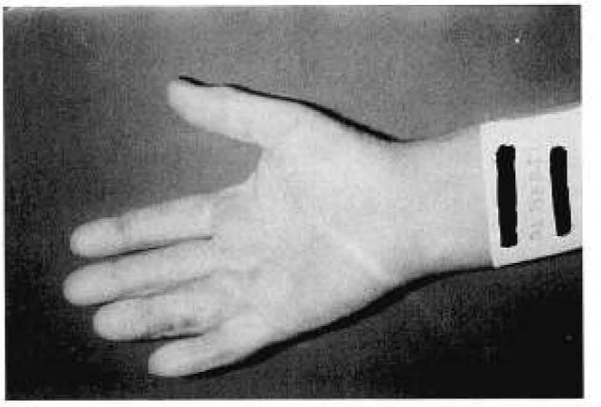

FIG. 6. Ring finger extended at the end of continuous elongation (about 2 weeks). The elongation is carried out by the patient himself or herself at home. The fasciectomy must be performed immediately after the TEC device is removed; the surgical approach is as simple as in the first stage of Dupuytren's disease.

There were 47 male patients, with 47 right hands and 5 left hands involved. There were 4 female patients, with 3 right hands and 1 left hand involved. Dupuytren's contracture was bilateral in 27 patients (25 males, 2 females); Ledderhose's disease (nodule and contracture of plantar fascia) was present in 9 patients; and Peyronie's disease was present in 3 patients.

Treatment with the TEC device was applied to patients affected by grades III and IVb Dupuytren's contracture.[6] The device was applied to 19 previously unoperated hands and 37 hands that showed recurrence/extension after a previous operation performed in another hospital. Twenty of these latter patients reported the following problems after the first operation: sepsis in 10, interdigital mycosis in 4, little finger amputation in 3, hyperpathy (exaggerated pain) following the operation in 1, vascular trouble and cyanosis of the finger in 1, and complete stiffness in the operated finger in 1.

The joint flexion contracture of the fingers treated with the TEC device varied from 10 to 90 degrees for the metacarpophalangeal joint, from 25 to 100 degrees for the proximal interphalangeal joint, and from 0 to 90 degrees for the proximal interphalangeal joint (see Figs. 1 and 2). The digital palmar skin loss was 1.5 cm on average. In previously operated patients longitudinally retracted scars, adhesion, and nodule

TABLE I

Hands and Fingers Extended by Continuous Elongation Technique (56 Hands, 85 Fingers)

Males (52 hands: 47 right + 5 left); *extended fingers*: 78				
Little finger:	right,	47	left,	5
Ring finger:	right,	18	left,	2
Middle finger:	right,	5	left,	1
		70		8
Females (4 hands: 3 right + 1 left); *extended fingers*: 7				
Little finger:	right,	3	left,	1
Ring finger:	right,	1	left,	1
Middle finger:	right,	1		
		5		2

thickening with the dermis and skin contracture together with joint stiffness of varying grades were all observed.

RESULTS

In 1986 and 1987, patients were treated only with the TEC device (15 hands, 23 fingers were treated; 14 male, 12 right hands, 2 left hands; 1 female, left hand) because at the beginning of our experience we wanted to know if the continuous elongation technique was sufficient by itself to stop the evolution of Dupuytren's contracture and to correct the contracture once and for all (see Fig. 5).

The elongation was followed by 20 hand therapy and ultrasonic sessions. In 6 patients there was no recurrence of contracture of the finger, and active and passive functionality both in flexion and in extension was practically complete.

In 9 patients, the contracture returned, on average, 10 days after the TEC device had been removed and during the hand therapy sessions. To delay the recurrence of the contracture, a plaster cast was applied during the night with the finger in an extended position.

An average of 3 months after the treatment had been completed, the fingers retracted, but to a lesser flexed functional position (PIP, 50 degrees; DIP, 10 degrees) than before the continuous elongation treatment.

The active flexion of the phalanges was conserved; the extension loss was not a potential or invalidating functional disturbance of the fingers. This was demonstrated by the fact that none of the patients asked for limited fasciectomy treatment after use of the TEC device, since they said that they were satisfied with the functional position reached by the fingers.

From 1988 to 1991, we treated 41 hands (62 fingers) with the TEC device followed by limited fasciectomy (38 male, 35 right hands, 3 left hands; 3 female, right hands). The patients were operated on by limited fasciectomy at the end of the elongation in order to avoid the strong tendency of the rapid retraction of the fascia and the fingers (Figs. 6 and 7).

We can confirm complete extension of the severely contracted fingers at the end of lengthening in every patient. When the TEC device is removed, the metacarpal and proximal and distal interphalangeal joints are rigid and extended; active flexion is zero. Active and passive finger mobility after treatment with the TEC device increases quickly, but at the same time the palmar fascia and the pretendinous cord retraction increase quickly too; *then fasciectomy must be carried out as soon as possible at the end of the elongation while the fingers are extended* (see Fig. 7). The sutures are removed 3 weeks after the operation; during this period, the fingers are kept in extension by a plaster cast. The hand therapy lasts for 4 weeks, together with ultrasonic sessions and paraffin baths.

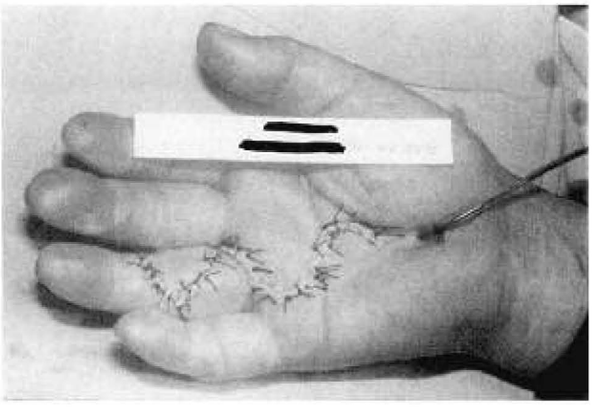

FIG. 7. Fasciectomy is very simple; skin trophism is excellent due to the improvement of the microvascularity of the finger during continuous elongation; the nodule is flattened and the retracted fascia is completely elongated like a ribbon. The complementary operations of skin plastic and joint surgery are thus avoided.

A recurrence of Dupuytren's contracture was observed in 8 patients with the appearance of a nodule in the operating room. Five patients presented with an extension of the disease either on the border of the operated area with the appearance of a little nodule or with some cords on the radial side of the hand.

With use of the TEC device, the localized progression of the disease has so far been halted. The patients treated represent the most severe types of contracture [2,3] (Figs. 1, 2, 8, and 9).

All other plastic skin operations, including Z-plasties, skin grafts, etc., were unnecessary by treatment with the TEC device. The elongation of the retracted skin obtained was 1.5 cm on average. A considerable improvement in elasticity, skin trophism, and microvascularity of the elongated skin was observed (see Fig. 7). The skin's microbial protection also was notably improved by spontaneous healing of the interdigital mycosis affecting the skin in four patients. No exaggerated pain or painful scars were noted, and skin sensitivity was found to be normal (like that of the surrounding normal skin).

The active and passive flexion of the joints in

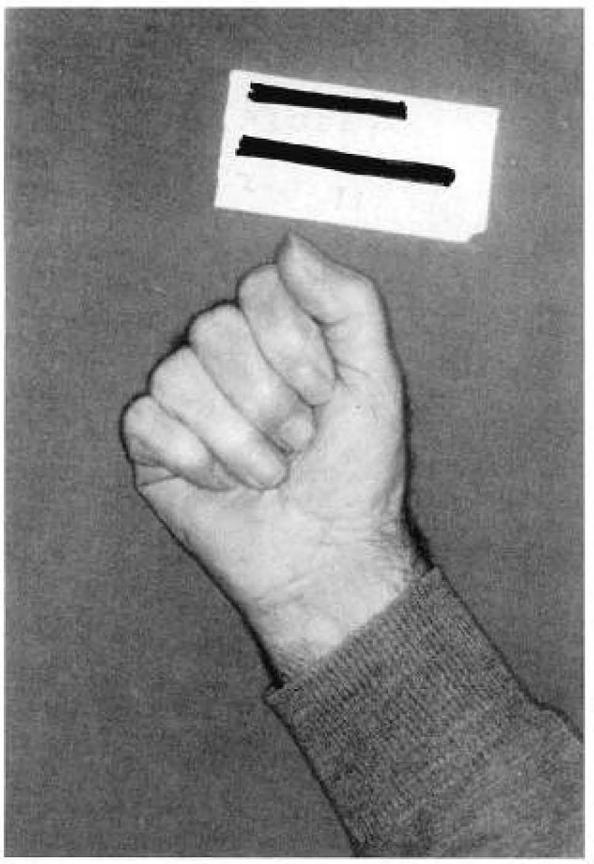

FIG. 8. Functional result of the TEC methodology: active flexion of the finger. The TEC methodology is an advanced methodology for severe cases of Dupuytren's disease and its recurrences; it is able to bring the tissues and structures of the retracted fingers back to the initial stage of the disease.

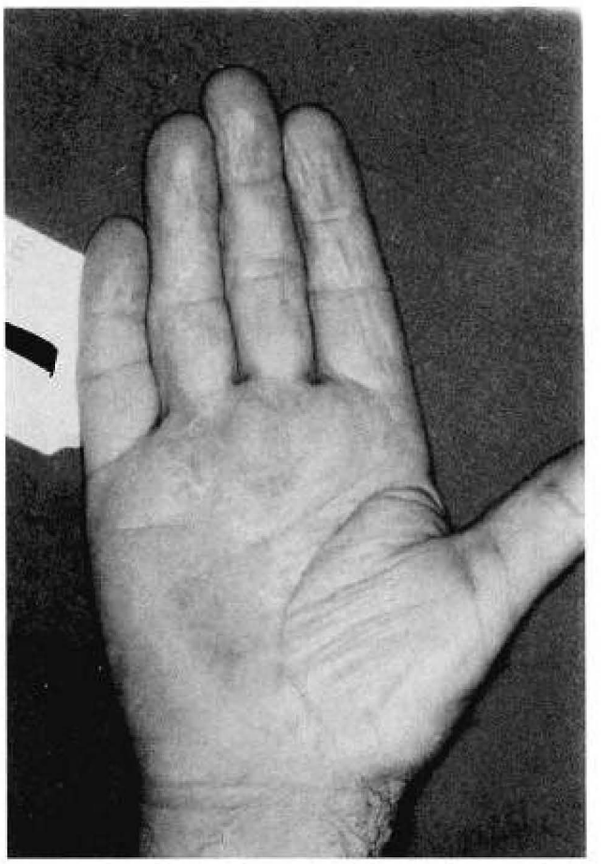

FIG. 9. Functional result of the TEC methodology: active extension of the finger; amputation of the severely contracted fingers is thus avoided.

45 fingers treated was completely restored; these patients were able to use their fingertips to touch the distal flexion crease on the palm of the hand (see Figs. 8 and 9). In 10 fingers, the fingertip was just able to touch the palmar skin; this was due to a limitation of flexion of the phalanges without real joint rigidity (complete passive joint flexion). In 7 fingers, there was a 25-degree deficit of proximal interphalangeal joint extension and a 10-degree deficit of distal interphalangeal joint extension, while the distance from the fingertip to the palmar skin was more than 2 cm.

According to total active motion evaluation, our results were

Grade 1: 75 percent excellent
Grade 2: 15 percent good
Grade 3: 0 percent fair
Grade 4: 10 percent bad

At present, the clinical results with the TEC device allow for the preservation of the severely contracted finger, for which today the surgical indication is amputation, and the possibility (almost nonexistent before) of achieving a functional recovery and an atraumatic and physiologic elongation of the retracted skin, joints, fascia, pretendinous cord, and vasculonervous bundles without surgical intervention or any risk (see Figs. 8 and 9).

Complications

We did not observe any pin-tract infection or vascular difficulties, or trophic disturbances in the treated fingers (see Fig. 6). Interphalangeal joint subluxation occurred in one patient. The subluxation reduced spontaneously, leaving traction at the end of the finger elongation. In three patients, after fasciectomy we observed a swan-neck deformity of the proximal interphalangeal joint without loss of joint mobility. It is possible to prevent joint subluxation by extend-

ing the finger harmonically according to its curve. Nevertheless, proximal and distal interphalangeal joints must be elongated simultaneously if both are retracted in flexion.

In another patient we observed psychological intolerance to elongation and to the cumbersome nature of the TEC device. This patient was an elderly, restless person, who had a vascular or neurologic disturbance of the retracted hand that was operated on elsewhere for severe Dupuytren's disease. The TEC device was removed.

Indications

The TEC device is indicated in severe Dupuytren's disease,[1] especially in those cases in which the most sophisticated operating techniques prove to be inadequate in keeping the finger rigidly retracted in flexion or in achieving satisfactory functional results, i.e., in cases which present[2,3]

- Long-term retracted joint stiffness
- Evolutive stage already operated on with severe recurrence and extension
- Loss of the finger's volar skin or of hand palmar surface
- Severe trouble with collateral vasculonervous bundles in prolonged contracted fingers
- Systemic illness (severe and unstable diabetes, immunodeficiency, serious cardiopulmonary illness)
- Old age
- Surgical indications for amputation of the retracted finger

Discussion

In 1986, we designed and built a device for the realization of continuous elongation of contracted fingers.[2] The TEC device is a very simple treatment that always achieves finger extension and the regression of the Dupuytren's contracture back to the initial stage of the disease. In all patients we found that the palmar nodule was elongated and the pretendinous cord had disappeared or flattened (compression test; see Fig. 5).

This technique is atraumatic, since the elongation of retracted fingers is only of 2 mm per day (physiologic lengthening) *carried out four times a day by the patient himself or herself at home in order to achieve a continuous elongation* (see Fig. 4).

In many patients, the locoregional anesthesia is sufficient to apply the TEC device, and it may be done at a day hospital or in the ambulatory surgical service.

The TEC device is prepared before the operation; only two self-drilling metacarpal pins and the Kirschner wire are sterilized and inserted percutaneously in the operating room. X-ray control is recommended.

At removal of the TEC device (after finger extension), the flexion contracture of the fascia returns within 10 days on average, so a fasciectomy quickly becomes necessary (see Fig. 7). This confirms that the TEC device is a preparatory step to pathologic fascia exeresis during finger extension and not a Dupuytren's contracture treatment.

We may suppose that after continuous elongation, the hand therapy may cause a strong tendency for the rapid retraction of the fascia because of alternative movements (flexion-extension) of the fingers (functional stress).

Advantages

The TEC device (1) facilitates the intervention performance, greatly reducing surgical trauma and the complexity, length, and difficulties of operation (see Fig. 6), (2) simplifies the skin incision and surgical approach, avoiding complementary articular interventions such as capsulotomy, arthrolysis, and surgical release of check-reins, collateral ligaments, and retracted lateral digital fascia[8] (see Fig. 7), (3) avoids the sudden surgical extension of the retracted finger and the stretching and tearing of collateral vasculonervous bundles, which are the causes of devascularization and trophic difficulties in fingers retracted for many years in complete flexion,[6] (4) is an alternative methodology to plastic surgical correction of digital or palmar skin loss, particularly when there is the need for a flap or a skin graft[5] (see Figs. 2 and 6), (5) improves on the McCash "open-palm" technique in terms of both practical application and theoretical principles,[7] and (6) gives the possibility for conservation and functional reconstruction of a seriously retracted finger (this was impossible or at the limits of technical possibility with classical operations[2,3]).

Conclusions

From our experience, we have observed that the treatment of severe cases of Dupuytren's disease with the TEC device offers notable advantages both for the patient and for the surgeon. In every case the patient must be personally followed and encouraged. The treatment should always be explained to the patient; the patient

will understand that, with the TEC device, he or she will avoid two or three complicated operations involving lengthy plastic and articular surgery with the possibility of not regaining the complete use of the finger and the risk of necrosis.

This technique, by bringing the contracture back to the initial stage of the disease, also offers new basic research into the formation of collagen and of the nodules.[9,10] Studies of this type are, in fact, under way to examine the nature and evolution of this mysterious illness, which up to now has been studied from the standpoint of its classical, irreversible, and degenerative aspects. Continuous elongation technique methodology reactivates the classical biologic process of contracture of the fascia by transforming it from a degenerative into a regenerative process, from an irreversible into a reversible disease, and from an involutive into an evolutive morphology.

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