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ORIGINAL ARTICLE • HAND - DUPUYTREN DISEAESE

Dupuytren's disease: limited fasciectomy, night splinting, and hand exercises—long-term results

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Abstract

Background Dupuytren's contracture (DC) is a fibroproliferative disorder of palmar fascia that causes flexion contractures of one or more digits. There is currently no gold standard operative and postoperative protocol for reducing recurrence rates. We propose a combination of surgical intervention, night splinting, and home hand exercises as a treatment protocol.

Methods Thirty patients were included in our study, diagnosed with DC Tubiana grade II–IV. Our treatment protocol was limited fasciectomy followed by a 24-week night splint application, combined with home hand exercises for eight weeks. The outcomes were recurrence, QuickDASH score, extension or flexion deficit, and grip strength. The mean follow-up was 4.9 years (range 2–11 years).

Results Recurrence of DC occurred in two patients (7%), who had discontinued the use of the splint within two months postoperatively. All other patients had complied with the postoperative protocol. The mean QuickDASH score improved from 61.5 (SD 2.1) to 8.6 (SD 2) postoperatively ($p<0.001$). Grip strength did not differ significantly in the operated hands (37.9 kg, SD 1.3) when compared to the healthy hands (40.2 kg, SD 1.3, $p=0.035$). The recurrence was not significantly correlated either with the Tubiana grade ($p=0.7$), or with the patients' age ($p=0.27$).

Conclusions This study shows that limited fasciectomy followed by a 24-week night splint application, combined with home hand exercises for at least eight weeks, is a viable protocol which reduces the rates of recurrence of DC.

Keywords Dupuytren's contracture · Limited fasciectomy · Night splinting · Recurrence

Introduction

Dupuytren's contracture (DC) is a fibroproliferative disorder of palmar fascia that causes pathologic nodules and cords in the palm, leading to permanent and irreversible flexion contractures of one or more digits [1]. The etiology is unknown, although genetic factors and free radicals have been suggested to play a causative role [2, 3]. It is most common in senior Caucasian males, and the prevalence increases with age [4].

The most established procedures for DC are needle or open fasciotomy, segmental or limited fasciectomy, and dermofasciectomy [5]. Although new treatment options such as collagenase injections and needle fasciotomy combined with percutaneous lipofilling have been suggested, it seems that such treatments have concentrated on reducing the symptoms rather than treating the underlying abnormality [1]. Postoperatively, dressings applied range from bulky bandages to night splints, but there is currently no consensus. In

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general, there is a great intraregional variation regarding the rehabilitation program, the exercises, and the use or not of night splinting [5].

As a result of the wide variation of operative procedures and postoperative protocols, one of the most common considerations after treatment is recurrence, with long-term rates as high as 50%, varying depending on the definition [6]. However, current evidence does not correlate the postoperative dressing protocol with recurrence rates [7]. The aim of this study is to report the recurrence rates and functional results after our proposed treatment protocol; limited fasciectomy followed by a 24-week night splint application, combined with home hand exercises for eight weeks (Fig. 1).

Materials and methods

Participants

We included adult patients undergoing surgery for DC from 2007 to 2016 in the Orthopaedic Department of a tertiary University Hospital. Inclusion criteria were a flexion contracture of at least 30° in the MCP, or any contracture at PIP or DIP joints, and a clinically defined pathologic cord in the palmar fascia. The minimum follow-up period was predefined at two years, taking into account the threshold to detect early recurrent DC [5]. The mean follow-up was 4.9 years (range 2–11 years). All patients provided informed consent, and the study was approved by the hospital's ethics committee. Exclusion criteria were previous DC surgery and major hand trauma. Patients with severe extension deficit of the affected digits, i.e., grade IV in Tubiana classification (> 135° deficit), were excluded if a local flap or skin grafting was utilized, rendering our results non-uniform for assessing our protocol [8].

We included a total of 30 hands (30 patients) in the study. All of the patients were available for the final follow-up assessment. Sixteen patients had one ray affected, 15 two rays, one patient had three rays, and one four rays (Fig. 2). Thirty-one rays were affected at the MCP joint, 19 at the PIP joint, and three at the DIP joint (Fig. 3). The duration of the disease was at least one year for all patients. The patients' demographics are presented in Table 1.

Twenty-one (70%) patients had been manual laborers for more than 20 years. The rest of the patients reported that they used their hands intensively during their everyday activities. One patient suffered from Ledderhose's disease, whereas none had Peyronie's disease.

Operative technique

All surgical procedures were performed by the senior author under either general anesthesia or transscalene nerve block,

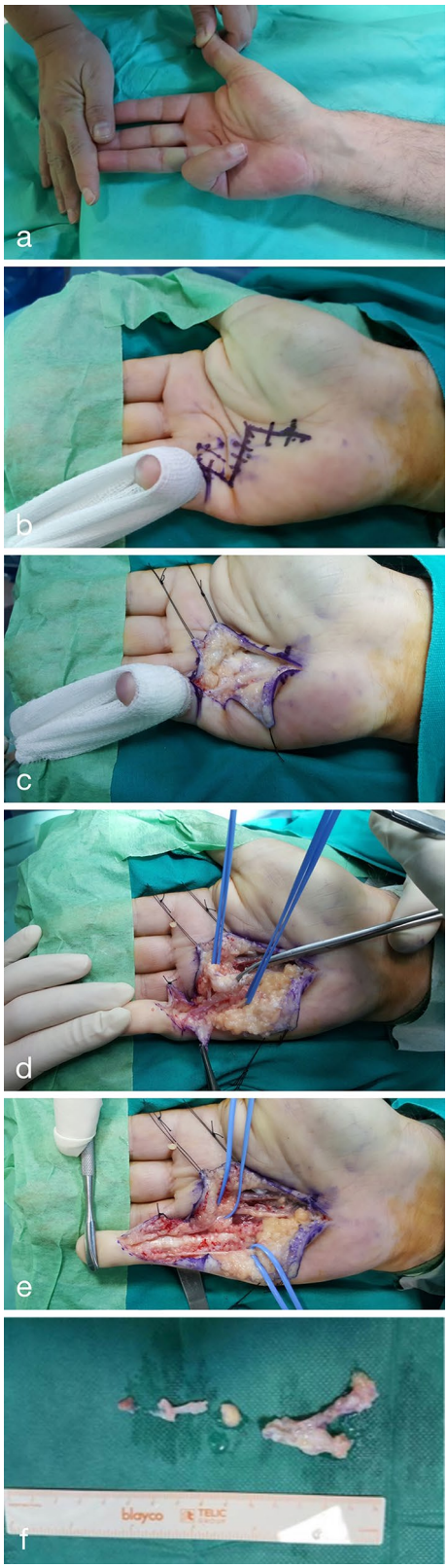

Fig. 1 Dupuytren's contracture of the fifth ray (**a**), classical Brunner incision (**b**), skin and fat tissue mobilization and retraction of the skin edges with silk sutures (**c**), identification and protection of the neurovascular bundles, and cord transection (**d**), achievement of full extension (**e**), the pathological tissue after limited fasciectomy

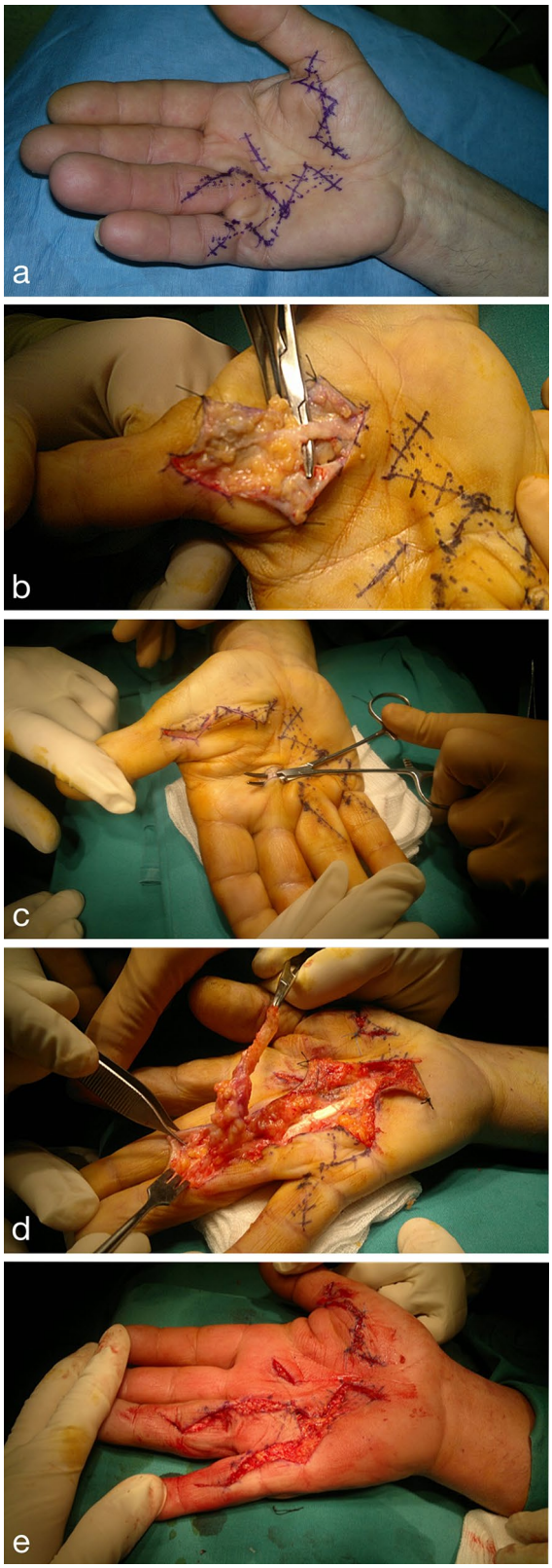

Fig. 2 Dupuytren's contracture of four rays and the planned incisions (**a**), limited fasciectomy of the thumb, middle, ring, and little fingers (**b**, **c**, **d**), the incisions used for the ring and little fingers form a V-shape in the palm, with the apex of the "V" extended proximally to expose the pretendinous cords

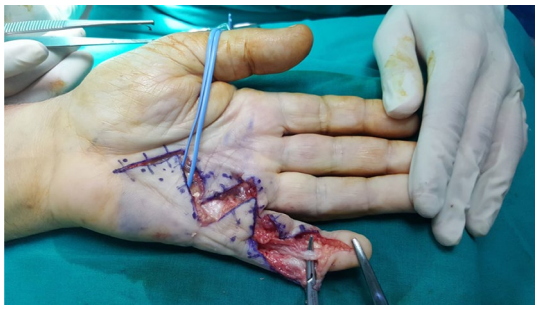

Fig. 3 Dupuytren's contracture of the fifth ray with involvement of the DIP joint

Table 1 Patients' demographics

Gender (male/female)	27/3
Age (mean, SD)	66 (7)
Smoking	19 (63%)
Everyday alcohol consumption	4 (13%)
Diabetes mellitus	10 (33%)
Family history of DC	6 (20%)
Dominant hand affected	21 (70%)
Tubiana grade (total passive extension deficit)	
I (0°–45°)	No patients
II (45°–90°)	4 patients
III (90°–135°)	24 patients
IV (> 135°)	2 patients

according to the anesthesiologist's and patient's preference. We used an above-elbow pneumatic tourniquet after 2-min extremity elevation, inflated at 100 mmHg above systolic arterial pressure. All procedures were performed under magnification using loupes of 3.5×.

Classical Brunner incisions were used, which could be combined when multiple fingers were involved forming a V-shape in the palm (Fig. 1a, b). In such cases, the apex of the "V" was extended proximally to expose the pretendinous cord. The skin and fat tissue were mobilized sharply, and the skin edges were handled carefully and retracted with silk sutures 3-0 (Ethicon, Somerville, NJ, USA) (Fig. 1c). Subsequently, the neurovascular bundles were always identified and protected, while the skin and fat tissue were elevated from the cords (Fig. 1d). The tissue dissection volarly to the transverse fibers of the aponeurosis in the palm (Skoog's fibers) was considered safe regarding the neurovascular bundles, because they are located dorsally to them. The neurovascular bundles were identified proximally on either side of the flexor tendon, before following them to the diseased aponeurosis. When the PIP was affected, the incision was extended over the middle phalanx, and the cord was transected proximally to allow extension and improve the

exposure. After achievement of full extension, the diseased tissue was sent for biopsy, the tourniquet was released to obtain proper hemostasis, and then the skin was sutured with interrupted Prolene 4-0 sutures (Ethicon, Somerville, NJ, USA) (Fig. 1e, f).

Postoperative protocol

Postoperatively, the hand was immobilized in a short-arm thermoplastic splint, which was fashioned to maintain the fingers in full extension. The wound was inspected at 24 h after surgery. At the second day the patient was instructed to remove the splint at daytime and start tendon gliding active and passive exercises five times daily for at least 15 min. The sutures were removed at 12–14 days, with documentation of sensory and motor function. After wound healing, the patient was instructed to self-massage the grain of the scar, for reducing tenderness and scar tissue formation; small, firm, circular movements were applied across the incision, using any non-perfumed cream, twice daily for 5–10 min. All postoperative complications were recorded. The extension splint was used at nighttime for six months after surgery, and the exercises were continued for eight weeks. The patients were assessed at the end of the night splinting and then at the final follow-up, which was at least two years postoperatively.

Outcome measures

Our primary outcome was recurrence at the final follow-up evaluation, which was defined as flexion contracture of at least 30° or more in the MCP, or any contracture at PIP or DIP joints, and a clinically defined pathologic cord in the palmar fascia. We also assessed the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score for assessing functionality, as well as the extension or flexion deficit, and the grip strength measurement with a Jamar Handgrip Dynamometer. Flexion was defined as reduced if a flexion deficit of 1.5 cm from the pulps to the distal palmar crease persisted.

Statistical analysis

Mean preoperative and follow-up QuickDASH scores were compared with Wilcoxon signed-rank test because it was non-normally distributed, whereas grip strength of the operated hands was compared to the healthy hands with paired-samples *T* test. The correlation of the recurrence with the Tubiana grade and with the patients' age was evaluated using Kendall's tau coefficient and Spearman rho coefficient, respectively. The level of significance was set at $p < 0.05$. The software used for data analysis was SPSS (Statistical Package for the Social Sciences), version 24.

Results

The mean follow-up was 4.9 years (range 2–11 years). Recurrence of the contracture occurred in two patients (7%), which were staged as Tubiana III preoperatively (Fig. 4). These two patients had discontinued the use of the splint within two months postoperatively. All other patients had complied with the postoperative protocol.

The mean QuickDASH score improved from 61.5 (SD 2.1) preoperatively to 8.6 (SD 2) postoperatively, and the difference was statistically significant (Wilcoxon signed-rank test, $p < 0.001$). We did not observe significant difference in the mean grip strength of the operated hands (37.9 kg, SD 1.3) when compared to the healthy hands of the patients (40.2 kg, SD 1.3, paired-samples *t* test, $p = 0.035$). The recurrence was not significantly correlated either with the Tubiana grade (Kendall's tau, $p = 0.7$) or with the patients' age (Spearman rho, $p = 0.27$).

Complications

Two patients had flexion deficits more than 1.5 cm of the operated rays, none caused by a flexor tendon division. Another two cases developed temporary paresthesia and numbness. One skin necrosis was treated with a free split-thickness antebrachial flap (Fig. 5). We did not observe

Fig. 4 Recurrence of Dupuytren's contracture of the fourth ray (**a**) and revision surgery (**b**)

Fig. 5 Postoperative skin necrosis treated with a free split-thickness antebrachial flap

hematoma, infection, and digital nerve injury requiring treatment. None of the patients developed complex regional pain syndrome.

Discussion

In this study we propose a treatment protocol for the treatment of DC: limited fasciectomy followed by a 24-week night splint application, combined with home hand exercises. This protocol aims to reduce recurrence rates, which is one of the most common considerations after treatment of DC, with long-term rates as high as 50%, varying widely depending on the definition [6]. We implemented our protocol in a series of 30 patients, and we noted two cases of recurrence (7%) in patients who failed to adhere to the splint application. The mean follow-up of the series was 4.9 years (range 2–11 years).

Our study shows favorable results when compared to other series using limited fasciectomy. Tonkin et al. reported recurrence rates for men and women 54 and 25%, respectively, for fasciectomy [9]. Mäkelä et al. published a study with a mean follow-up of 3.2 years, and their recurrence rate was 27% [10]. All of these surgeons did not implement long-term night splinting postoperatively. Anwar et al. reported a recurrence rate of 14% in a 109-women series [11]. It must be noted that they used dynamic splintage for four months in patients with more than 20° contracture release, and it was applied for 20 min per hour during the daytime, with no night splintage. Abe and colleagues found 14% recurrence rate in a Japanese population series, but they did not specify their postoperative protocol [12]. One study reported a particularly high recurrence rate, with 71% of 58 patients showing recurrence, half of them in the first two years and a fifth after five years [13]. Finally, Vollbach et al. reported no recurrences in a small series, but no specifics about night splinting are included in the article [14]. When utilizing the limited fasciectomy, there are several skin incisions recommended, but the choice depends on the surgeon's preference. We used classical Brunner incisions, and there is little evidence of any difference when compared to other incisions, i.e., transverse or longitudinal incisions with Z-plasty and Brunner's incisions with V–Y plasties [15].

Several operative procedures have been proposed for DC; needle or open fasciotomy, segmental or limited fasciectomy, and dermofasciectomy are currently advocated [5]. Limited fasciectomy has shown better finger extension and patient satisfaction when compared to percutaneous needle fasciotomy [16]. Van Rissen et al., using the same techniques, found limited fasciectomy superior to percutaneous needle fasciotomy for Tubiana grade III and IV DC, but 23.2% of the patients showed recurrence [16]. A systematic review of outcomes reported a significantly higher recurrence rate for needle fasciotomy than open partial fasciectomy (50–58% versus 12–39%, respectively) [17]. Regarding open fasciotomy, Bryan and Ghorbal found a 45% recurrence rate after an average of 5.3 years, but more research is needed to establish whether there is an advantage to accept such high recurrence rates in return for a simpler procedure of excising a small segment of the cord [18]. Segmental fasciectomy using small curved skin incisions was popularized by Moermans, who reported a 38% recurrence rate at 2.9 years postoperatively, and later used by Clibbon and Logan in a series of 67 patients, with 11 (16%) recurrences at 2.5 years [19, 20]. It seems that when small pieces of fascia are excised, DC will progress and further surgery may be required in the future. When compared to dermofasciectomy, there are a few data concerning recurrence rates. Schneider reported a recurrence rate of 34% at five years. Foucher et al. concluded that there was no statistical difference in the recurrence rate between patients treated with the open-palm technique and those treated with other techniques [21, 22]. A recent study showed a lower rate of 4% at 25 months of follow-up [23].

Magnification is a necessity during limited fasciectomy for DC [24]. Regardless of the experience of the hand surgeon, identification and protection of the neurovascular bundles during the dissection of the diseased aponeurosis is considered safer using magnification. Furthermore, in the unfortunate event of an intraoperative injury of a small vessel or nerve, repair can be performed using microsurgical techniques [25, 26]. We used 3.5X magnifying loupes, which provided a high level of utility and comfort.

We propose the use of an extension splint at nighttime for six months after surgery. This splinting intervention proved to be efficient for reducing recurrence, as the two patients with recurrent DC had discontinued the use of the splint within the first two months postoperatively. The patients are also instructed to start hand gliding active and passive exercises five times daily for at least 15 min, and to self-massage the scar for reducing tenderness. The tendon gliding exercises should be continued for at least

eight weeks, when there is no longer the risk of developing scar contractures [1]. The rehabilitation after DC surgery is not yet evidence based, because there are few references for specific protocols, and a Cochrane review is proposed and probably underway [27]. A recent review assessing the use of night orthosis after surgical correction of DC concluded that the current literature does not appear to support the use of static night orthosis in addition to hand therapy after surgical correction, but the studies included did not report the rates of recurrence, rather than the improvement in range of motion [7]. Our choice of 24-week night splinting was based on previous studies which demonstrated that contracture resolution is directly proportional to the total orthosis dosage [28–30]. These studies demonstrate that short, tight tissues often require prolonged orthosis use to effect a change in tissue length, by remodelling scar tissue. We also instructed the patients to self-massage the grain of the scar after wound healing, for reducing tenderness and fibrous adhesions. The role of massage on postsurgical wounds has been discussed in the literature, and several postoperative protocols, including those for Dupuytren's contracture, have been used [31–33]. Although the mechanism of action has not been investigated, it is thought that massage helps to break up collagen fibers, which helps the scar soften, flatten, and fade [34].

The present study has certain limitations. Firstly, it represents a small patient cohort, which reflects our effort to maintain the homogeneity of our patient population, by recruiting patients to undergo a specific protocol with the same surgical team. However, a strong point of our study is the length of the follow-up period (mean follow-up 4.9 years, range 2–11), which exceeds the threshold of six months required to detect early recurrent DC [5]. Another limitation is that a head-to-head comparison of our protocol to other methods of treatment, both operative and postoperative, was not made. The reason is that there is not currently a gold standard treatment protocol in the literature, so we focused on reporting our results regarding the recurrence, which can be compared to other series.

Conclusions

Although the understanding of the anatomy and pathology of the hand has evolved over the years, the treatment of DC remains a challenge for hand surgeons. In this study we suggest that limited fasciectomy followed by a 24-week night splint application, combined with home hand exercises for eight weeks, is a viable protocol which reduces the rates of recurrence of DC. Further high-quality studies comparing operative and postoperative protocols are needed for concluding the gold standard treatment protocol.

Compliance with ethical standards

Conflict of interest All authors declare no conflicts of interest.

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