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ORIGINAL ARTICLE

Dupuytren's contracture: Long-term outcomes and complications after operative treatment with resection of the contracted palmar fascia.

Athanaselis E.D., Papageorgiou F., Deligeorgis D., Dailiana Z.H., Malizos K., Varitimidis S.E.

Department of Orthopaedic Surgery & Musculoskeletal Trauma, University of Thessaly, Greece

ABSTRACT

Dupuytren's disease is a condition that affects skin fascia of palm and fingers resulting in the formation of nodules and cords, and the sequential "Dupuytren's contracture". Fingers are pulled inward and towards the palm, interfering with hand function. Operative treatment of Dupuytren's contracture includes percutaneous division and partial or total excision of the affected palmar fascia. Partial fasciectomy remains the most effective type of treatment in advanced, late stages, although technically demanding. Complications are frequent with the most serious being a digital nerve and artery injury, haematoma formation and skin necrosis, infection, complex regional pain syndrome and recurrence of the disease.

KEY WORDS: Dupuytren's disease, nodules and cords, palmar fascia contracture, fasciectomy, open palm technique

Introduction

Dupuytren's disease represents a clinical entity, typically described as a contracture of the hand palmar fascia which compromises hand function and appearance, affecting more commonly middle-aged males 40 to 60-years-old. The disease was first described in the scientific literature by Guillaume Dupuytren, a French military surgeon [1, 2, 3].

Clinical presentation includes subcutaneous nodules and cords in the palm and fingers usually on the ulnar side of the hand. Cords cause MCP and PIP joint extension lag and stiffness. Functional impairment in everyday activities is associated to restricted range of motion. Moreover, diverse descriptions of patients' clinical experiences do exist, that can influence cosmesis and self-confidence (**figure 1**). Pain though not characteristic of the disease, can be present especially at the early onset of nodules [4, 5].

Antiepileptic drugs, alcohol intake, smoking and diabetes mellitus have been reported as predisposing factors and an autosomal dominant pattern of inheritance has been well described. Prevalence of the disease has geographic variations affecting northern Europeans (up to 30% in Norwegians over 60 years

CORRESPONDING AUTHOR, GUARANTOR

Sokratis E. Varitimidis
Professor, Department of Orthopaedics & Musculoskeletal Trauma University of Thessaly, Greece
e-mail address: svaritimidis@hotmail.com, tel. 00302413502723

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of age) while very rare in Africans and Asians [6, 7].

The earlier the onset of the disease, the more likely is thought to be the recurrence and progression [1].

The pathophysiology includes 3 phases: proliferative, involutional and residual. Proliferation of fibroblasts which are transformed into myofibroblast cells and produce abnormal connective tissue and collagen deposition in the palm and fingers, results to flexion contraction deformities via transformation of normal ligaments and bands in pathological cords [8].

Molecular basis has been well documented, with alterations in the disease process including deregulated signaling of FGF, WNT, cytokines, matrix metalloproteinase, and TGF-β, which through a pathological cascade involving vascular constriction and tissue hypoxia subsequently result in abnormal proliferation and differentiation of fibroblasts into myofibroblasts. These increased concentrations of myofibroblasts consequently lead to over-abundance and abnormal modification of ECM proteins, namely collagen type III [9].

There are several treatment options including non-invasive, minimally invasive and surgical interventions. The aim of this study is to present the results of partial fasciectomy. Complications and long-term outcome were studied in a large group of patients with Dupuytren's disease treated with resection of the contracted palmar fascia of the affected rays.

Figure 1: *Dupuytren disease affects usually middle-aged males and in almost 50% of cases, is bilateral. Nodules in palm and cords starting in palm and progressing to fingers are the characteristic findings, located more commonly at ulnar-sided rays of the hand (a). Subcutaneous fibrotic contractures cause extension lag in MCP and PIP joints (b).*

Material and methods

Between January 2000 and January 2018, 234 patients (190 men, 44 women), were treated operatively for Dupuytren's contracture, with excision of the contracted palmar fascia in the affected rays (partial fasciectomy). Indications for operative intervention and subsequent inclusion to the study were: the presence of cord and flexion contraction causing extension lag of more than 25° at the level of MCP joint and more than 30° at PIP joint of ring and little finger (for the index and middle finger the limit is 20°), positive Hueston test and objective functional impairment. In addition, patients' follow-up of at least 2 years was required for inclusion in the present study.

Mean age was 68 years (range 37-86 years). The dominant hand was affected in 146 patients (62,3%). The fourth ray (ring finger) was most often affected (149 patients, 63,6%) with the little finger following, while in 98 patients (41,88%) two or more finger rays were affected. Preoperative flexion contracture at the level of MCP and PIP joints was recorded, with mean values of 38° (range 32-48°) and 32° (range 15-90°) respectively.

Postoperative clinical outcome was evaluated in terms of possible minor and major complications and functional improvement using a standard rehabilitation and follow-up examination protocol. Cases of post-operative haematoma formation, superficial or deep infection, digital nerve and artery injury, wound healing impairment, recurrence, complex regional pain syndrome (CRPS) and cold intolerance were recorded and patients were observed until possible resolution of the condition or additional intervention.

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Figure 2: *extension lag of more than 25º at the level of MCP joint and more than 30º at PIP joint, are indications for operative treatment (a). Zigzag incisions are planned, taking into account viability of skin flaps (b). Diseased fascia is excised from proximally to distally. Neurovascular structures must be recognized and protected through-out the procedure (c). Surgical wounds are closed without tension and not hermetically, to avoid haematoma formation subcutaneously (d).*

The post-operative flexion contracture was objectively recorded in degrees at MCP and PIP joints immediately postoperatively and at the long-term follow-up. Functional results and post-operative patients' satisfaction were evaluated using the DASH score.

Operative technique

The procedure was performed with the patient lying in supine position with the hand over an arm support extension table. Axillary nerve block anesthesia was performed in all patients by anaesthesiologist experienced in regional anaesthesia techniques. A tourniquet was applied at the arm and magnifying surgical loupes were used in all cases. After preparing the operating field in an aseptic manner, zigzag incisions were designed in the palm and conducted avoiding passing vertically the palmar creases (**figure 2b**). Superficially dissection starts proximally in the palm and after recognizing neurovascular bundles, continues distally, creating full-thickness skin flaps. Diseased fascia is excised from proximally to distally. Extension to the affected fingers is performed by the Bruner type incisions (**figure 2c**). Vertical septa are resected, and capsular release is carried out via checkrein cut, if necessary. Protection of the neurovascular bundles in all stages of the procedure is mandatory, especially at the level of proximal phalange where the spiral cord can transpose the digital neurovascular bundle medially and superficially (**figure 3**). Meticulous haemostasis is performed after tourniquet release in order to restrict possible haematoma formation and subsequent overlying skin necrosis. Primary closure of the wound is carried out by suturing previously created skin flaps without tension or by the z-plasty technique (**figure 2d**). In cases that the skin was infiltrated by the disease, or skin defect has been created, wound is left to close by secondary healing process (McCash technique) or full thickness skin grafts are used. Finally, a boxer dressing is applied (**figure 4**).

Post-operative rehabilitation protocol

A splint is applied for 24-48 hours post-operatively and the hand is kept elevated. Mobilization starts after 3-5 days postoperatively and physical therapy as soon as the wound healing has been completed. Night splints are used to reduce pain and preserve the achieved

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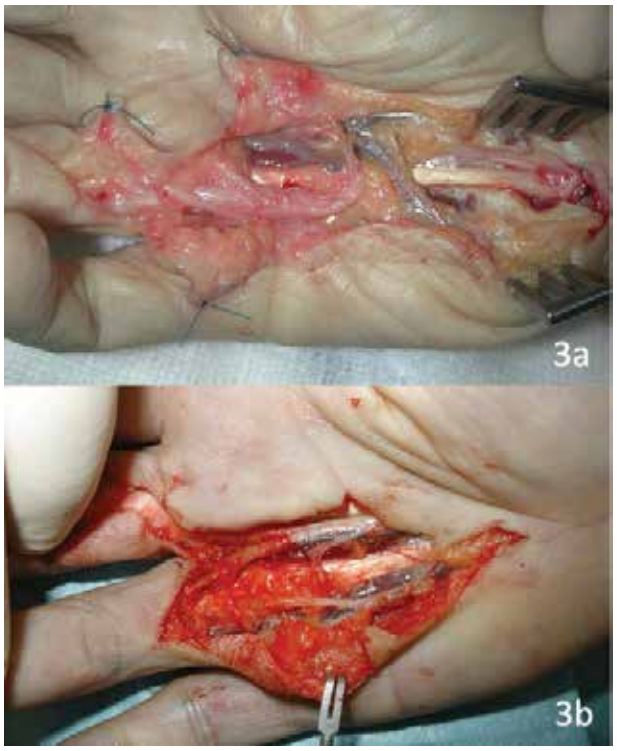

Figure 3: *spiral bands are transformed to fibrotic spiral cords that contracting, displace neurovascular bundle superficially and medially (even across the mid-line) at the region between mid-palm and the base of middle phalange (a). Under these circumstances, intra-operative, iatrogenic injury of digital nerve and artery (more commonly) is a possible complication, especially during secondary surgery after recurrence of Dupuytren disease (b).*

range of motion instead of 24h splinting. Post-operative follow-up was conducted on an outpatients' basis every week until complete wound healing, at 3 and 6 months and every year later on.

Results

Patients' post-operative follow-up period was ranged from 2 to 16 years, with a mean duration of 10 years. The average pre-operative extension deficit in the MCP and PIP joint was 38° and 32° respectively. Post-operative value at the final follow-up was 10° in both joints which represents an improvement of 28° (73,68%) and 22° (68,75%) respectively. Mean recorded DASH score value was 38 (range 32-46) pre-operatively and 5 (range 0-35) post-operatively, difference that is statistically significant.

Figure 4: *closure of the wounds may not be uneventful. MCP and PIP joint contracture excision often creates skin defects and forceful approximation can violate blood supply of skin flaps (a). Therefore, wound can be left partially open to heal by secondary intention (as in McCash technique) (b).*

Complications occurred in 61 patients (26%) including 16 cases of recurrence, 15 cases with CRPS, 7 superficial infections, 5 injuries of digital nerves, 7 sensory neuroapraxias and 7 patients with cold intolerance. Digital nerve injury required immediate end-to-end repair, while sensory neuroapraxias resolved after a mean period of 6 months (range 4-8 months) without intervention. Cold intolerance was observed to subside at two years post-operatively and in one case amputation of the distal phalange was performed 2 weeks postoperatively due to delayed ischaemia in a patient with a history of atherosclerosis. Three patients were treated with arthrodesis as a salvage procedure for non-reducible flexion contracture at the indexed operation.

Discussion

Dupuytren's disease is a non-traumatic, progressive disease of the hand which involves fibrotic cords in the fascia of the palm and fingers, leading to formation of nodules, cords and contracture of the affected rays usually on the ulna side of the hand (**figure 1**). There is a higher reported incidence in men, white, hypertensive patients as well as older, diabetic individuals who have higher consumption of alcohol [10, 11].

An increased prevalence of Dupuytren's contracture has been found in working population using pneumatic tools, compared to other working groups [12]. In a recent meta-analysis, manual laborers using vibration tools appear a higher risk of developing Dd with a prevalence of 9.8% and 3-fold higher incidence

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compared with controls [13].

On the other hand, genetic linkage between Dupuytren's contracture and epilepsy is possible, taking into account a 40% prevalence in male chronic institutionalized epileptics over 40-years-old and geographic distribution of the disease, as well [14]. The rapidly progressing contractures, presenting in young persons indicate a strong 'Dupuytren's diathesis'. Such a defined diathesis can be recognized in cases of strong family history, early onset of the disease, and diffuse conditions with dermal involvement, as Dupuytren disease can be associated with similar lesions found in other body regions like Garrod's nodules or Peyronie and Ledderhose diseases [15].

Apart from the consecutive bad cosmesis, functional impairment related to the disease can be severe, with the most disabling self-reported limitations affecting activities such as body washing and grooming, putting on gloves, shaking hands, and performing fine hand movements in general. [16].

Several treatment options have been reported varying from non-operative to operative techniques.

Non-invasive treatment includes physiotherapy and splinting. More sophisticated techniques as extra-corporeal shockwave therapy, fractionated CO_2 laser, and radiotherapy have been proposed but the evidence is still weak and does not clearly support their practical use [17, 18, 19]. Furthermore, based on the molecular mechanism of the disease, a novel, non-invasive, molecular therapy has been proposed for investigation [20].

Minimally invasive treatment options include Clostridium histolyticum collagenase (CHC) injection (Xiapex®) and percutaneous needle fasciotomy (PNF). Both can be office-based procedures, offering fast recovery, low complication rates and significantly lower costs when compared with surgical intervention. However, both are associated with high recurrence rates, ranging from 30% to 80% over a 2 to 5-year follow-up [21, 22, 23].

On the other hand, partial or total fasciectomy and dermofasciectomy are surgical procedures that are usually applied in most advanced stages of the disease. They aim to excise nodules and cords of fibrotic tissue releasing the contractures of the affected rays. Palmar aponeurosis is completely excised in total fasciectomy. In more severe cases Hueston dermofasciectomy is used [24, 25].

Comparing minimally invasive and surgical treatment options, PNF has the lowest overall direct cost and CHC is much more cost-effective compared with fasciectomy. However, taking into account the recurrence rate of CHC, especially in cases of more severe PIP joint contractures and young age of initial intervention (predictive factors of possible re-intervention after collagenase injection), fasciectomy turns out to be still the more widely used treatment [26].

In our case series, partial fasciectomy was the treatment of choice. Excision of the affected and contracted palmar fascia showed to be an effective procedure in the treatment of Dupuytren's contracture. The results show significant reduction of extension lag in MCP and PIP joints with consequent improved patients' satisfaction rate (**figure 2**).

McFarlane in late 80's stated that "it is not necessary, nor wise, to operate upon a patient simply because the disease is present". The presence of a large cord interfering with hand function, however, would constitute a well-established operative indication. As a general rule, surgery is justified for contractures of 30° or more at the MCP joint due to the eventual risk of post-operative complications [27].

However, fasciectomy remains a technically demanding method, especially in cases where the contracted fascia is extended distal to MCP joints, requiring hand surgery and microsurgery expertise. Care must be paid in the following three steps of the surgical procedure: making of incisions, neurovascular bundles dissection and wound closure.

Skin incisions must be carefully planned in order to provide access to the subcutaneous fascia that must be excised, anticipating possible extension need without compromising skin blood supply. In case there are two or more affected rays and contractures distal to MCP joint, in the proximal phalanges, pre-operative planning of complex incisions and Z-plasty technique may be needed for giving the ability of skin elongation over the contracted area. Excision of the fascia too superficially can create avascular skin flaps that will be necrotized, delaying wound healing and increasing infection rates (**figure 2, 4**).

Neurovascular bundles must be carefully rec-

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ognized and protected throughout the procedure. Pathologic cords transpose the proximal digital neurovascular bundle medially and superficially and such distorted anatomy may put it in danger, especially in revision cases, requiring special surgical skills and familiarity with the specific anatomic area. Microsurgical skills are essential not only for the safe handling of these structures but also for the repair of possible intra-operative injuries of the digital artery and nerve. Arteries are more commonly injured and both structures are in greater danger during secondary surgery in case of Dupuytren's disease recurrence. In our case series, there were 5 patients (2,13%) with intra-operative digital nerve laceration treated with immediate end-to-end repair using microsurgical technique while no arterial injury was occurred (**figure 3**).

Wound closure without tension and meticulous intra-operative haemostasis to avoid hematoma formation, are prerequisites. Skin complications include necrosis subsequent to bad surgical technique or to haematoma formation, inadequate coverage and infection. Our results regarding wound healing complications include 7 cases of superficial infection (2,99%), but no recorded skin necrosis or deep soft tissues infection. To prevent or cope with these complications, suitably planned skin flaps can be re-ordered to facilitate skin elongation in a Z-plasty mode. Alternatively, full thickness skin grafts can be used. However, secondary wound healing is an option in cases that complete primary wound closure is impossible. As it has been described by McCash in the "open palm" technique, skin defects in the palm are very well healed by secondary intention (figure 4). Studies on this procedure give satisfactory results including less pain, better motion, and low complication rate regarding hematoma, skin necrosis, and infection [28, 29, 30, 31]. Malingue's procedure and Z-plasty are simple local flap techniques while other described flaps, like Cronin cross-finger flap or Ekerot dorsal intermetacarpal flap are considered as a second-line treatment, keeping in mind the implied donor site sequelae [32, 33, 34].

Le Gall and Dautel have proposed the 3-flap plasty for defects reaching up to 40% of the palmar surface of the proximal phalange in order to allow a tension-free skin closure. This type of coverage involves incisions delineating three local flaps: a radially based quadrangular palmar flap, a triangular proximally based laterodigital flap and a distally based triangular web space flap. This technique has been found reliable, making it possible to achieve skin closure in serious cases, without skin necrosis [35].

Our post-operative rehabilitation protocol includes beginning of physiotherapy as soon as possible in order to achieve early movement and return to the desired functional level. However, several studies have shown that an increase of range of motion is poorly correlated with patients' reported hand function improvement [36, 37].

Hand's appearance might be also important to patients with Dupuytren's disease, as suggested by the large improvement in the 'aesthetic' subscale that is greater when compared to finger goniometry improvement and function-related subscales. These findings are in line with analogous ones in patients with degenerative or inflammatory joint diseases or with injuries, who despite the clear loss of function, still have concerns about hand appearance [38].

Though complex regional pain syndrome (CRPS) complication of Dupuytren's disease operative treatment is considered relatively rare generally, patients unable to cope with early physical therapy were found to be prone to develop it. In our study there were 15 cases with post-operative CRPS treated with repeated week sessions of i.v. steroid and anaesthetic drug therapy via Bier's block. Cold intolerance was noticed in 7 patients (3%) and it is one of the most common complications of Dupuytren's disease operative treatment. As after any hand surgery, altered sensitivity to the cold can be present. It resolves gradually often over several winters but meanwhile it can be quite annoying, and gloves need to be used in a permanent basis during cold seasons.

Recurrence is another surgeon's great concern in terms of preferred treatment. Patients with recurrent disease often have larger extension deficit and worse self-assessed hand function and complication rates appear to be higher. On the other hand, treatment of recurrent Dupuytren's disease seems to be as effective as the initial treatment, in reducing contracture correction and improving patient reported hand func-

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tion [39]. Recurrence appears histologically the same after limited fasciectomy or collagenase injection [40]. In patients where recurrence is noted soon after fasciectomy, diathesis for further tissue production is very strong indeed. In such cases, great care must be taken to select the appropriate surgical procedure, which will achieve to arrest this process probably by involving dermofasciectomy or skin replacement [41]. In our study, there were 16 cases of recurrence observed at a minimum of 2 years follow-up (range 2-7 years). Only 2 of these patients accepted to be re-operated due to severe functional impairment (post-operative DASH score higher than 30).

Conclusion

Excision of the contracted palmar fascia is effective in the treatment of Dupuytren's contracture. Although it is technically demanding, it remains the most effective type of treatment in advanced stages. Complications, early and late, are frequent with the most serious being digital artery and nerve injury, infection, complex regional pain syndrome and recurrence of the disease. Early complications need immediate and appropriate treatment for a satisfactory outcome while recurrence may compromise the final long-term outcome. A

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