Clinical and morphological outcomes after percutaneous needle fasciotomy in Dupuytren’s disease according to the contracture severity

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Abstract

Background and Objectives: Dupuytren’s disease (DD) is a chronic progressive disorder causing contractures in the palmar and digital fascia. The primary aim of management is to correct the deformity while reducing the risk of recurrence and avoiding complications. The purpose of our retrospective study was to validate the efficacy, safety and the rate of recurrence of DD after percutaneous needle fasciotomy (PNF).

Patients, Materials and Methods: We present results for a population of 40 patients, divided into three groups, based on the severity of the contracture according to Tubiana staging. We analyzed patient demographic data, encountered complications and the degree of release achieved both post-procedure and at one-year follow-ups.

Results: From a total of 98 joints we treated, we obtained satisfactory release [passive extension deficit (PED) ≤10°] in 85% of joints, while full release was obtained in 70% of joints. Full release was obtained mostly in metacarpophalangeal (MCP) joint (95%) rather than proximal interphalangeal (PIP) joint (50%) or distal interphalangeal (DIP) joint (60%).

Conclusion: Our patient preferred PNF in comparison to open fasciectomy because of its minimum invasive approach and the quick recovery time. The study shows that PNF has great short-term results and it is suitable for patients who prefer minimally invasive care.

Keywords: Dupuytren’s disease, percutaneous needle fasciotomy, morphological aspect, contracture.

Introduction

Dupuytren’s disease (DD) was first described by Baron Guillaume Dupuytren (1777–1835) in 1831 as a fibro-proliferative, progressive, benign hand pathology that can cause flexion contracture of the fingers. It is characterized by the presence of firm, painless nodules that adhere to the skin and deep fascia and generate a specific flexion deformity. It mainly affects males between 40 and 80 years old and causes extension deficits in one or several finger joints. The disease affects palmar fascia and generates fixed flexion deformity (Figure 1), patients struggle while performing daily activities with the affected hand. DD has been associated with a combination of genetic and environmental factors, such as excessive alcohol intake, smoking, diabetes, manual labor, and hand trauma [1, 2]. Also, patients with more aggressive manifestations usually have a family history of DD.

Commonly affected joints are the metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints, with distal interphalangeal (DIP) joints rarely affected. While all digits can be affected, the common cases are seen in the ring, the middle and the fifth fingers [3–6]. Differential diagnoses that need to be excluded for patients complaining of pain are osteoarthritis of the MCP and PIP joints or trigger finger. Clinical examination should focus on identifying cords, nodules, and digit(s) in fixed flexion (Figure 1). Furthermore, contractures can be checked using Hueston’s table top test (Figure 2). If the patient cannot place the palm flat on the table, results are considered positive [7, 8].

The aggressiveness of this disease is associated with the early onset (before the age of 40), bilateral involvement, radial digit involvement, and the localization on other sites (ectopic disease, affecting the feet or penis) [9].

There is no definitive treatment or cure for Dupuytren’s contracture. The primary aim of treatment is to control and correct the deformity while reducing the risk of recurrence and avoiding complications. The recommended treatment options are: (i) needle aponeurotomy (percutaneous fasciotomy), (ii) collagenase injection, (iii) limited fasciectomy or (iv) complete fasciectomy. Unfortunately, it is usually not possible to excise all Dupuytren’s tissue, thus there is always a risk of recurrence. The disease management plan established by the physician should consider the severity of deformity, the level of deformity and the digits involved. The indication of each type of intervention depends on the disease stage. Interventional treatment is generally recommended when MCP contracture is over 30° or when...
the PIP joint has any flexion deformity. Of course, the patient’s general condition, functional limitations, and expectations for recovery are also to be carefully considered [10, 11]. Given that this is a progressive disease, the recurrence rates, associated risks, and benefits need to be carefully explained to patients for each treatment option.

Figure 1 – Cords, nodules, and digit in fixed flexion.

Figure 2 – Hueston’s table top test.

Badois et al. (1993), Foucher et al. (2003), and van Rijssen & Werker (2006) present good results on the use of fasciotomy, and its popularity further increased over time [11–13]. Recent literature also reported good results of the technique compared with the alternative [14, 15].

Aim

With this work, we aim to confirm the technique’s efficacy and safety and promote its adoption in our hospital. In particular, we focus on measuring the degree of release obtained for each treated joint, according to the initially observed Tubiana stage, and determine a statistically significant relationship between the two variables.

Patients, Materials and Methods

Study design

We aim to conduct a retrospective randomized study divided into two parts. The first one shows the results obtained after one year, and the second one will show the results at a three-year follow-up. The study took place at the Department of Plastic Surgery, where all patients included were treated by the same two plastic surgeons between October 2017 and May 2020, with a one-year follow-up after treatment. The primary target was a straight finger, defined as a reduction in extension deficit in the affected MCP joint to 5°. Secondary targets were patient-reported outcomes and the presence of complications. The third aspect of our study is represented by the histological examination of palmar fascia on the patients with early recurrence, under one year. Before interventions, we performed ultrasound examination observing the echogenicity and the localization of the cords in relation with tendons and neurovascular bundles. We notice the aspect of the skin that was adherent to the cords, especially at the level of the nodes.

The study focuses on a population of 40 patients treated in our Hospital between October 2017 and May 2020, respecting the inclusion criteria. On initial presentation, for each patient, we carefully measured and summed the flexion contractures of the MCP, PIP and DIP joints to obtain the total passive extension deficit (TPED) and infer the Tubiana stage. We provided each patient with complete and detailed treatment options, including in-depth advice regarding benefits and risks associated with each procedure. Only patients who self-opted to receive percutaneous needle fasciotomy (PNF) were included in the study to reduce selection bias. Exclusion criteria were the option for another type of treatment, Tubiana stage IV, association with other pathologies (fractures, malunion, vicious consolidation, trauma of the tendons, other surgical intervention) of the hand or fingers involved. We had grouped the patients
into three groups according to the severity of the disease: stage I, when the joint contracture angle was between 0° and 45°; stage II, with an angle between 46° and 90° and stage III, with an angle between 91° and 130°. We notice the presence of some factors that indicate high Dupuytren’s diathesis, like age <50 years at presentation, recurrent or bilateral disease, extra-palmar localization of contracture, or liver disease. We recorded the postoperative degree of passive extension for each patient, and we carefully monitored the incidence of surgical complications. The main focus points were permanent sensory disturbance, flexor rupture, infection or minor complications (small skin tear, hematomas, loss in sensitivity). Another aspect carefully monitored during follow-up visits was the disease recurrence. We compared the postoperative and one-year follow-up measurements and considered disease recurrence when a difference in contracture over 30° between the two measurements was observed [10, 11].

Operative technique

We used a minimally invasive procedure that can be carried out by a surgeon under local anesthesia with little assistance from a nurse.

Passive extension of affected rays was done, and all palpable cords are identified and marked. To avoid skin tear, we perform the fasciotomy on the areas where the skin is not tightly adherent to the cords. Before releasing any cords, we performed intradermal anesthesia, with 1% Lidocaine plain, in the palmar portals. The cord was palpated and then grabbed between the fingertips. We aligned the needle perpendicularly to the cord. For ensuring that the needle was not inserted into the flexor tendon, we flexed and extended the finger after needle insertion. The insertion portals must be chosen above the palpable cords in the areas of a maximum bowstring, and as far as possible from the neurovascular bundle. Patients need to be alert and signal any electric shocks they feel. By repeatedly puncturing the cord in a 360° manner, we release the contracture. For isolating the cord and nodule from the dermis, on the pitting areas, we use a tangential clearing motion, which will also lower the risk of skin tears. During the release, we applied gentle extension tension on the cord, followed by increased passive extension for cutting it. We felt a release as the fibers were ruptured (Figure 3). Following the distal towards proximal direction, we completed a cord release and then reassessed the palm and finger for residual cords and continued until full release was obtained. At the end, we applied a compressive dressing and a thermoplastic splint.

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Postoperative management

After the procedure, we indicate 10 days splinting, with temporary removal for 30 minutes twice a day for
exercise, and avoidance of heavy grasping. After this period, we recommended night splintage for three months.

Results

In total, 40 patients were included in the study cohort who underwent these procedures on 45 hands, 65 rays and 98 joints (Table 1).

There were no significant demographic differences between patient groups (Table 2).

Table 1 – Affected hands characteristics with the localization of contracture at the digital rays\(^{\text{a}}\) level and the grade of extension deficit across the digital joints

| Affected rays/joints (total) | 65/98 |
|-----------------------------|-------|
| Thumb ray                   | 0     |
| Index ray                   | 2     |
| Third ray                   | 11    |
| Fourth ray                  | 40    |
| Fifth ray                   | 12    |

| Total passive extension deficit (range) | 30–130° |
|----------------------------------------|---------|
| MCP joint                              | 10°–60° |
| PIP joint                              | 0°–60°  |
| DIP joint                              | 0°–10°  |

DIP: Distal interphalangeal; MCP: Metacarpophalangeal; PIP: Proximal interphalangeal.

Table 2 – Patients’ characteristics including demographic differences and the presence of Dupuytren’s diathesis according to Tubiana staging

| Patients No. (n=40) | Tubiana stage I (20 (50%)) | Tubiana stage II (15 (38%)) | Tubiana stage III (5 (12%)) |
|---------------------|----------------------------|-----------------------------|-----------------------------|
| Median age [years]  | (range)                     | (range)                     | (range)                     |
| Family history      | 5 (2)                      | 3 (0)                       | 0 (0)                       |
| Age <50 years       | 4 (1)                      | 3 (1)                       | 0 (0)                       |
| Recurrent           | 5 (3)                      | 2 (0)                       | 0 (0)                       |
| Previous intervention| 5 (4)                      | 1 (0)                       | 0 (0)                       |
| Bilateral           | 16 (4)                     | 10 (1)                      | 2 (0)                       |

| Associated pathologies (Garrod’s pads, Ledderhose disease, Peyronie’s disease) | 2 (0) | 2 (0) | 0 (0) |
|-----------------------------------------------------------------------------|------|------|------|
| Anticoagulant/antiaggregant therapy                                          | 28   | 10   | 5    |
| Side (R/L)                                                                   | 38/18| 10/3 | 26/9 |
| Follow-up [months]                                                          | 12   | 12   | 12   |

F: Female; L: Left; M: Male; n: No. of cases; R: Right.

We did not notice major complications after the performed procedures, such as permanent sensory disturbance, hematoma, infection, arterial laceration, tendon rupture, pulley rupture, or complex regional pain syndrome, and no patient was hospitalized. We noticed minor complications, such as skin tear of 1.5 cm or less, in five patients. Two of them needed sutures and healed without complication within 5–7 days. During follow-up encounters, we noticed bruising in the cases of seven patients and swelling in the case of four patients.

Outpatient clinic follow-ups were scheduled one-year post-procedure, for surgeons to measure the joint contractures and check the presence or absence of complications. The mean preoperative TPED was 53.5°, with a mean of 28° at the level of MCP joints and a mean of 25° at the level of PIP joints.

The immediate post-procedure results show the reduction of joint contractures from an average of 30° preoperatively [range, 15° to 95°; standard deviation (SD) 14°] to an average of 1° post-procedure (range, 0° to 20°; SD 6°).

Figure 4 illustrates the immediate improvements we obtained post-procedure. In 20 (50%) patients, we obtained full release. The greatest frequency of full release was observed in the MCP joint (99%), while on the DIP joint full release was obtained in 67% of cases. The PIP joint was commonly affected by a small residual PED (≤10°).

Eighty-three percent of the patients included in our study presented acceptable clinical outcomes, with a residual PED release smaller than 10°. The average PED improvement of the MCP joints was of 54°, while the PIP joint release was of 56°. According to the Tubiana staging, on patients grouped in stage I, we have noticed full release at 78% and an acceptable outcome residual PED≤10° on 100%. Stage II patients present only 30% of full release, meanwhile 58% present acceptable release and 12% shown residual PED between 10–30°. Full release was not obtained on patients from stage III where the measurements shown 20% with acceptable release and 80% with a residual PED of 10–30° (Table 3).

![Immediate improvement after procedure](image)

Figure 4 – Immediate overall improvement of PED after procedure. PED: Passive extension deficit.

Table 3 – Post-procedure outcomes on PED according to Tubiana staging

| Average preoperative contracture according to Tubiana stages | Full release** | Residual PED ≤10° | Residual PED 10–30° |
|------------------------------------------------------------|---------------|------------------|--------------------|
| Tubiana stage I (n=20)                                     | 16/0          | 4/6.25°          | –                  |
| (average preoperative contracture value 38°)               |               |                  |                    |
| Tubiana stage II (n=15)                                    | 4/0           | 8/8.75°          | 1/15°              |
| (average preoperative contracture value 57.7°)             |               |                  |                    |
| Tubiana stage III (n=5)                                    | –             | 1/8°             | 4/17.5°            |
| (average preoperative contracture value 107°)              |               |                  |                    |

n: No. of patients included in groups; PED: Passive extension deficit.
**Average residual passive extension degrees after procedure.

At the final one-year follow-up, there was a residual contracture of 11° (range, 0° to 40°; SD 11°). In 99% of MCP joints, the contracture was corrected immediately postintervention and the correction was maintained at the one-year follow-up in 72% of the joints. Full release was maintained in 50% of the patients from Tubiana stage I.
and II. Patients with acceptable outcome, with PED ≤ 10° were grouped in the Tubiana stage I and II and represent 60% of the studied population. Recurrence was found in 10% of patients – two from Tubiana stage II group and two from Tubiana stage III group (Table 4).

**Table 4 – Results according to Tubiana staging at one-year follow-up, including the recurrence**

| Tubiana stages | Average preoperative contracture according to | Full release/°* | Residual PED ≤ 10°/°* | Residual PED 10–30°/°* | Recurrence ≥ 30°/°* |
|----------------|---------------------------------------------|-----------------|------------------------|------------------------|---------------------|
| Tubiana stage I (n=20) (average preoperative contracture value 38°) | 15/0 | 2/5° | 3/20° | – |
| Tubiana stage II (n=15) (average preoperative contracture value 57.7°) | 5/0 | 2/7.5° | 8/15° | 2/12.5° |
| Tubiana stage III (n=5) (average preoperative contracture value 107°) | – | – | 5/26° | 2/66.7° |

n: No. of patients included in groups; PED: Passive extension deficit. °: Average residual passive extension degrees after procedure at one year.

All patients included in Tubiana stage I disease achieved satisfactory release (≤ 10° residual PED) compared with 85% of patients with Tubiana stage II disease. Three of five patients with Tubiana stage III disease present a residual PED ≤ 30°, which shows that the minimally invasive procedure produced good results even in severe cases. Disease recurrence was observed in four (10%) out of the total 40 cases. Regarding patient-reported satisfaction, 34 patients stated that they would prefer this procedure instead over the more invasive options, while one patient claimed he will opt for the open surgical method with general or regional anesthesia. Open operation with full anesthesia was the preferred treatment for four patients and two patients stated that would not seek any further treatment. The four patients underwent open fasciectomy.

**Statistical analysis**

The data was analyzed using the standard Analysis ToolPak from Microsoft Office Professional Plus 2019 and SciPy 1.4.1, a python library for scientific computing. We have performed standard summary statistics for continuous data and counts, average and percentages computation for categorical data. We have performed outlier detection using GraphPad Outlier Calculator (α=0.05), and Kolmogorov–Smirnov test for goodness of fit (using SciPy) (α=0.05). Immediate release results were compared among the three Tubiana stages using χ² test, and a p=0.0037 was obtained, which showed a strong association between the two variables (p<α=0.05).

**Morphological aspects**

Regarding the histological aspect of the palmar fascia of the analyzed samples, we observed that three patients presented proliferative fibromatosis (Figure 5) and one patient late-phase fibromatosis (Figure 6).

The proliferative phase consists of an increased number of fibroblasts. Proliferating fibroblasts are producing collagen contraction in longitudinal aspect of the traction lines. Progressive fibroblast proliferation and deposition of collagen is likely to encourage further microvessel narrowing with a positive feedback effect consistent with the progressive nature of the condition.

**Discussions**

Many aspects need to be considered when designing a treatment strategy for a patient with DD. First of all, the patient must be informed that there is no cure for the disease. Then, currently available treatment options, with their short and long-term implications must be explicitly presented to patients. Their expectations must be correctly managed, and awareness of the progressive nature of the disease needs to be clearly established, notably in the case when Dupuytren’s diathesis [1, 16] is present, as the disease progression is rapid and recalcitrant in that case.

Among available treatment options, surgical fasciectomy was the reference treatment in the past, especially for advanced contractures. As the *Clostridium histolyticum* collagenase (CHC) therapy was eliminated in some European countries, the PNF is currently the only minimally invasive treatment [17].

![Figure 5](image1.png)  
**Figure 5** – (a) Proliferative fibromatosis; (b) Palmar aponeurosis with a well-circumscribed cell node consisting of a myofibroblastic proliferation with reduced collagenous stroma. Hematoxylin–Eosin (HE) staining: (a) ×100; (b) ×40.
Currently, we are missing long-term prospective trials comparing outcomes of the three treatments between each other [fasciectomy, percutaneous needle aponeurotomy (PNA), and CHC].

Excellent results are reported by several authors (Badois et al. [12] since early on the adoption hype of the PNF treatment for DD). A few years later, Duthie & Chesney also reported an average improvement rate of 69% [18] on their cohort. Pess et al. claim their success rate, efficacy, and safety are similar to previous results, while their recurrence rate was higher than for fasciectomy, but they mention rare and minimal complications [14]. In 2021, Patel & Patel offered further evidence on the usefulness of this approach. Their study shows satisfactory release (≤10° residual PED) in 87% of all treated joints, without major complications [15]. The present study reports good results as 90% of studied patients at one-year follow-up present satisfactory release. Our study declares better results than other studies probably because it includes only Tubiana stages I to III, patients with contracture between 30° and 135°, excluding patients from Tubiana stage IV.

Another study conducted by van Rijssen et al. compared limited fasciectomy to percutaneous fasciotomy. The authors reported that six weeks post-procedure, in the case of patients with Tubiana stage I or II, there was no significant difference in PED. Passive extension for patients with advanced Tubiana stage who underwent fasciectomy was significantly improved. The same study reported higher complication rates for fasciectomy and better patient comfort and hand function in the case of PNA procedures. However, the recurrence of contracture was higher in the case of PNA vs. fasciotomy, at five years post-procedure. Buckwalter et al. published an overall recurrence rate of 76%, which included subjects reporting only minimal recurrence (19%) [19]. van Rijssen et al. reported an 85% recurrence rate after PNA, which was significantly higher than limited fasciectomy (24%) at five years [10, 20].

While generally associated with lower complications rate and fast recovery periods, needle aponeurotomy is less durable compared to limited fasciectomy [20, 21], thus patients prefer it even if reinterventions are necessary [10].

In terms of procedure complications, the most frequent are bleeding, slow wound healing, infections, nerve injury, vessel injury, tendon injury, neuropraxia affecting digits and of course disease recurrence [22]. Recent studies report an average complication rate of 17% in fasciotomy treatment compared to 19% in needle fasciotomy and 12% in dermofasciectomy [19, 22–24].

Our study highlights a complication rate for needle fasciotomy of 10%. The most frequently reported complications were skin tear observed on five patients and which were solved in 5–7 days. We did not encounter major complications. Recurrence rate from our study is 10% at one-year follow-up showing good outcome with the reserve that Tubiana stage IV patients were not included in the study. The recurrence was solved with open fasciectomy.

In terms of cost analysis, our experience shows that the time needed for a ray release with PNF was no longer than 15 minutes, performed by one surgeon and a surgical assistant and with a minimal cost of the materials. The open fasciectomy procedure, takes longer, requires an anesthetist, more resources and more intensive postoperative care. Our findings are sustained by other studies [25, 26].

Verjee et al. studied the correlations between histological aspect of the cords and contracture severity or recurrence appearance. They found a distribution of two thirds nodular cords at their patients and demonstrate that the digital contracture is higher in patients without nodular cords in comparison with patients with nodular cords. When discussing about recurrence and histological aspect, they demonstrate that an increased movement level of hands with remnant pathological tissue increase the recurrence appearance [27]. Our study shows that the patient with earlier recurrence have nodular cords aspect with proliferative fibromatosis.

The physiotherapy and kinesiotherapy play an important role in movement recovery after this procedure and also for a better long-term outcome.

Study limitations

Limitations of the current study include a relatively short follow-up. Also, the limited number of patients is an inconvenient and was caused by the lack of compliance from the patient who refused to come for the one-year follow-up. Second part of our study will be with the results at three years follow-up, and we want to analyze immunohistochemically and histologically the tissue obtained after open fasciectomy to observe the correlation...
between histological aspect and recurrence or aggressiveness of the contracture.

**Conclusions**

Our work aligns with similar studies and tests that the short-term results of PNF are excellent. PNF might represent a better option for elderly patients or for any patients who prefer simpler treatments and want to avoid more invasive surgeries which involve lower recovery time and longer functional impairment. We obtained clinically significant release for all the patients included in the study, even for Tubiana stage III patients. The recurrence is also affected by the phase of fibromatosis, as in proliferative phase the recurrence seems to appear earlier than in late-stage fibromatosis. PNF is a safe and effective procedure, simple and cost effective, and it deserves an important place alongside the fasciotomies in DD treatment.

**Conflict of interests**

The authors declare no conflict of interests. The authors report no involvement in the research by the sponsor that could have influenced the outcome of this work.

**Institutional Review Board statement**

The study was conducted according to the Guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of Emergency Clinical County Hospital, Târgu Mureș, Romania.

**Informed consent statement**

Informed consent was obtained from all subjects involved in the study.

**Data availability statement**

Database from Department of Plastic Surgery, Emergency Clinical County Hospital, Târgu Mureș.

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