



# Analysis of recurrence and complications after percutaneous needle fasciotomy in Dupuytren's disease

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## Abstract

**Introduction** The partial aponeurectomy for treatment of Dupuytren's contracture represents the gold standard for treatment of Dupuytren's contracture. In selected cases, the alternative is the percutaneous needle fasciotomy (PNF).

**Materials and methods** Between 2008 and 2018, 80 rays in 64 patients were treated using PNF. 53 patients (68 rays) were reviewed with a mean follow-up of 31 months.

**Results** The recurrence rate was 18.9%. 49 patients with 62 rays had a totally free extension intra-operatively (92.4%). There were no complications. Only one patient reported a transient dysesthesia (1.8%) in the zone of operation. 86% of all patients would undergo the treatment again, if necessary. Patients were able to return to their job in an average of 5.5 days.

**Conclusions** PNF is reliable and relatively simple to perform compared to partial aponeurectomy. Therefore, the PNF could be seen as a serious alternative for selected cases.

**Keywords** Percutaneous needle fasciotomy · Dupuytren's contracture · Aponeurectomy · Recurrence rate · Complication rate

## Introduction

Dupuytren's contracture is a benign fibroproliferative disorder of the palmar hand aponeurosis that may be associated with strand formation [1, 2]. Progress shows an increasing flexion contracture of the affected finger [1]. The prevalence varies regionally, with the highest emergence in northern Europe of up to 56%, and rise with increasing age [1, 3, 4]. Men are affected more frequently than women and the etiology is multifactorial [1]. Risk factors are genetic and sometimes related to diabetes mellitus [5]. No single gene has been identified as the primary cause, although certain genetic mutations may lead to contribute to the severity of the disease [2]. There is no spontaneous remission [5] and

the disease is often progressive, irreversible, and commonly bilateral [3].

The treatment of Dupuytren's contracture has long been a subject of controversial debates. Partial aponeurectomy as an invasive surgical treatment option is currently regarded the "gold standard" in the treatment of Dupuytren's disease [6–8]. Partial aponeurectomy treatment represents a time-consuming procedure regarding the operation time as well as the period of convalescence and post-operative therapy. Additionally, there is a specific risk of considerable complications, such as infections (2.4%), nerve, and artery lesions (5.4%), diminished blood flow of the finger, intolerance for cold temperatures, and reduced range of motion (3.6%) [9].

Percutaneous needle fasciotomy (PNF) was initially developed by French rheumatologists between 1957 and 1980 [10–12]. PNF is a minimally invasive procedure that uses a sharp cannula to sever the palmar aponeurotic cord [1]. The aim is not the removal of the pathological tissue, but the reduction of flexion contracture [1] and the passive range deficit. Due to an initially unlimited application with a high incidence of nerve and tendons injuries, the method came in disrepute in France [12]. Only since the method was used by hand surgeons with limited indication [13] did the complications diminish [12].

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The present study evaluates the results of PNF as a less invasive, less time consuming, and less risky alternative to conventional fasciectomy. There are some studies on recurrence and complication rates in the literature, but these are very poorly comparable. Therefore, we would like to present our results and assign them to the current literature.

## Materials and methods

### Patients and methods

This study was authorized by the ethics committee of the Technische Universität Munich (95/19S). Between 2010 and 2017, 80 rays in 64 patients with Dupuytren's contracture were treated using "percutaneous needle fasciotomy". 68 rays in 53 patients with Dupuytren's disease have been clinically reviewed with a mean follow-up of 31 months (minimum 12 months; maximum 50 months). The patient data and pre-operative parameters were collected from the patient files. In case of insufficient or missing documentation, patients were contacted in writing and interviewed by questionnaire or summoned for follow-up. The missing 11 patients did not undergo follow-up and were also not reached, so that no data could be obtained. The mean age was 63.7 years (range 37–82) consisting of 38 men and 15 women. The right hand was affected in 36 cases (67%) and the left hand in 17 cases (33%). Most often treated was the fourth finger in 40 cases (58%). The fifth finger was affected in 25 cases (36%), the third in 2 cases (3%), and the thumb 1 case (1%). The pre-operative flexion contracture was classified by Tubiana [14]. Only the vaguely defined stage transitions in the original classification by Tubiana was modified, so that an unequivocal division was possible.

PNF was performed without local anesthesia in a fan-shaped fashion at several levels. Due to pain, the treatment had to be interrupted in one patient. The treatment was performed by > 10 surgeons at different levels of training. However, in each case, a board-certified hand surgeon was present. The treatment was performed within one session in all cases. Follow-ups were recommended at post-operative day 1, 3 weeks, 6 months, 12 months, 24 months, and 36 months. Minimum follow-up time for study inclusion was 12 months. During this follow-up, the flexion grade was measured to get an indication of the recurrence rate. Furthermore, possible complications with attention to sensibility disorders, tendon injuries, and skin injuries were documented and patient satisfaction was surveyed. On the basis of the work disability certificate and our documentation, it was determined when the resumption of the patient's work was possible.

### Surgical technique

The intervention was performed after written informed consent in an outpatient setting. Patients were instructed about the pain of initial needle penetration of the skin, the possibility of an incomplete outcome, the risk of nerve injury, infection, bleeding, and the possibility of a recurrence. The affected ray was held in an extended position to have the cord prominent and taut. Needle (20 gauge) puncture sites were only in the palm, not in the digits and initial usually distal to the distal palmar wrinkle, followed by release at a more proximal localization. On average, two palm localizations were performed. The insertion angle of the needle has been changed several times to penetrate and cut the cord successively and entirely. After the surgeons felt that the cord was mainly cut, the ray was hyperextended with force to prize off the remaining fibers. Generally, the intervention was performed without any anesthesia to prevent nerve damages. At the same time, the patients were instructed to inform if there was any electric sensation. In this case, the needle was retracted before seriously damaging the nerve. At the end of the treatment, the dressing was applied and a splint was fitted in fully extended position. It was recommended to wear the splint at night for 3 months. Furthermore, it was encouraged to do finger and hand movements during the day.

### Definition of recurrence

Recurrence was defined as 'a passive extension deficit of more than 20° for at least one treated joint, in the presence of a palpable cord compared to the result obtained intra-operatively [15, 16].

## Results

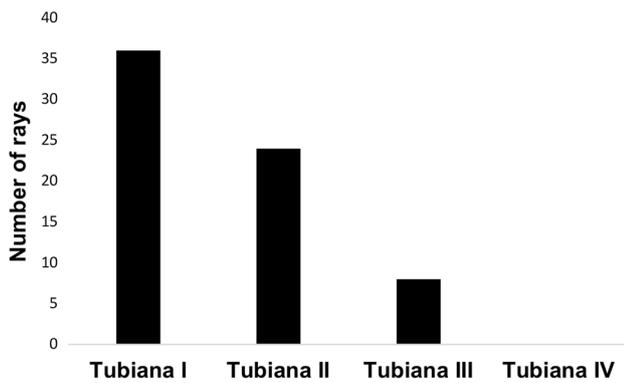
### Pre-operative classification according to Tubiana

The pre-operative flexion contracture of the 68 patients was classified after Tubiana with 36 rays stage I (0–45°), 24 stage II (46–90°), 8 patients stage III (91–135°), and 0 stage IV (> 135°) (Fig. 1).

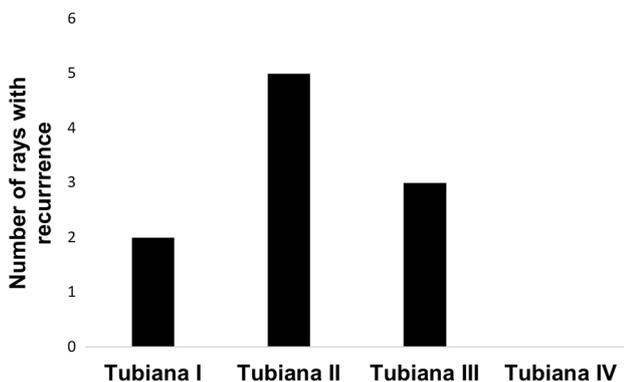
The mean operation time was 9.5 min.

### Recurrence rate

Intra-operatively 62 rays in 49 patients had a completely free extension in the post-operative follow-up at day 1 (92.4%). Four patients showed a mild residual flexion contracture between 5 and 15°. The direct post-operative mean



**Fig. 1** Number of patients according to the classification system of Tubiana



**Fig. 2** Number of patients according to the classification system of Tubiana with recurrence

improvement of range of motion was approximately 40°. The recurrence rate was 18.9% (10/53 patients) after a mean follow-up of 31 months. These patients were classified as: Tubiana I: 2, Tubiana II: 5, Tubiana III: 3, and Tubiana IV: 0 (Fig. 2).

### Complication rate

There was no hematoma, infection or injury of any tendons or vessels but we observed three minor skin lesions in size of 0.5–2 cm which healed conservatively. One patient reported a transient dysesthesia (1.8%) in the zone of the operation. The finger sensitivity was not affected.

### Post-operative outcome

Eighty-six percent of all patients would, in case of recurrence, again undergo this treatment and would also recommend this procedure. All patients, except one who was unemployed, were able to return to their job after an average of 5.5 days.

## Discussion

Our study shows that PNF is a minimal invasive, safe treatment option for isolated flexion contraction of Dupuytren's disease. However, this treatment is controversially discussed in the literature. In 2015 and 2017, 530 members of the German Society for Surgery of the Hand were invited to take part in an online survey, asking for their preferred treatment option for Dupuytren's disease, including decision criteria according to the Tubiana stages [17]. 110 and 101 responders, respectively, took part. In both surveys, 86 surgeons stated that they treated up to 100 patients per year (Group A), while 24 and 15 surgeons, respectively, treated more than 100 patients annually (Group B) [17]. In both surveys, partial aponeurotomy was found to be the preferred method (82.9% and 87.7%) [17]. Treatment with clostridial collagenase was only performed sporadically (1.3% or 1.4%) [17]. Percutaneous needle fasciotomy was of minor relevance in stage I (19.1% or 10.9%) and II (16.4% or 9.9%) and was performed mainly by surgeons who treat more than 100 patients per year [17]. The most important criterion for the decision which treatment should be chosen was “best outcome” (54.3% and 68.6%). This shows that although the risks are low, PNF is performed quite seldomly compared to partial aponeurotomy. Looking at gender and age distribution in general, the data of our study are consistent with the literature.

PNF is a technique, which is easy to perform, if the surgeon is aware of the anatomy and contraindications: Multiple, infiltrating or broad-based cords within the palm, irritated skin conditions, exclusive digital cord localization recurrence after aponeurotomy, previous surgical intervention at the site of interest, and digital nerve lesions are not considered as indications for PNF [18].

### Recurrence rate

In addition to the fear of any structural damage, the recurrence rate is a permanent issue for discussion. We observed a recurrence rate of 18.9% after a follow-up of 31 months and a direct post-operative improvement of 92%. The literature cited a wide variety of different information about the recurrence rate. It differs between 9 and 65% according to observation periods of up to 60 months (see Table 1) [13, 19–21]. Some authors even warn that a recurrence rate of up to 85% must be expected [1, 22, 23].

Badois et al. [19] reviewed his patients after performing PNF plus steroid injection [19]. He concluded that 81% had good or excellent primary results, which decreased to 69% of good or excellent results after 5 years [19]. Foucher et al. [13] reported about an immediate improvement of

**Table 1** Literature overview of the recurrence rate

Author	<i>n</i> (rays)	Recurrence rate (%)	Follow-up (months)
Badois et al. [19]	123	43–61	60
Foucher et al. [13]	311	24	38.4
van Rijssen et al. [21]	55	65	33
Pereira et al. [20]	44	9	28

76% in his study [13]. Pereira et al. [20] demonstrated a recurrence rate of 9% at 28 months follow-up of 44 patients [20]. van Rijssen et al. [21] published in his study an average improvement of 77% of 55 patients, after 32 months. Their recurrence rate was 65% [21]. Spies et al. [18] reported a recurrence rate of 53% in 15 retrospectively examined patients after a mean interval of 40 months post-operatively [18]. Molenkamp et al. [24] presented the data of 470 treated patients from 451 patients with Dupuytren's disease who underwent PNF. The results indicated a mean total passive extension deficit correction of 85%. He proposed that PNF was most effective for metacarpophalangeal joints and less effective for proximal interphalangeal and distal interphalangeal joints [24]. Mansha et al. [25] showed a statistically significant improvement at a mean follow-up of 15 months. Approximately, 97% of the fingers fully corrected at surgery remain straight. However, two (40%) out of five partially corrected fingers showed recurrence of Dupuytren's disease [25]. Pess et al. reported over 1000 fingers with a minimum follow-up of 3 years a recurrence of 20° or less over the original post-procedure corrected level in 80% of MP joints and 35% of PIP joints [26]. Therefore, the recurrence of the present study would expectedly be higher with a minimum follow-up of 3 or 5 years. The short follow-up states the major limitation of this study.

According to the authors of this literature review, PNF can be used very successfully and is a viable treatment option. PNF can also be used effectively for a recurrent Dupuytren's disease, which was shown by van Rijssen et al. In her study, 50% of the patients remained free of another recurrence for 4.4 years on average [22].

However, there is a broad range of recurrence rate. As the surgical technique used was quite comparable in most of the studies, we noticed that these studies tend to use a variety of definitions of recurrence. The definition of recurrence is elusive [15]. A standardized definition, such as that proposed after a Delphi expert consensus: 'a passive extension deficit of more than 20° for at least one treated joint, in the presence of a palpable cord, compared with the result obtained at time 0', would be helpful [15, 16]. Furthermore, there is the Huestons et al. definition for recurrence, which is the most widely accepted definition. Hueston et al. used the

appearance of new Dupuytren's tissue within the area, which was initially cleared in the operation [27, 28]. This definition, however, could not be used for PNF, since tissue is never removed [27]. The definition by Pereira et al. implied a return to the baseline. Depending on the initial situation, this may rule out a higher-grade contracture as a recurrence and may explain the low recurrence rate in this study. While Foucher et al. [13] did not share specific information about their definition, the definition of van Rijssen et al. [21] seems similar, and thereby did not explain the large deviation. A systematic review of 69 articles found no common definition of recurrence and only 72% of the papers even reported any recurrence [7, 29].

### Follow-up treatment

In the literature, follow-up treatments vary greatly, which to some detail may explain the occurrence or the lack of any recurrence. The study from van Rijssen et al., for example, showed a high recurrence rate, which may be explained by not using any splint or physiotherapy for their patients. However, Foucher et al. did not use a specific definition of the recurrence rate, but they also used extension splints, which resulted in a similar recurrence rate compared to our study. Similarly, the low recurrence rate correlated with the follow-up treatment of an extension splint for 3 weeks in the study by Pereira et al., which we think is too short. Both the unclear definition and follow-up treatment may explain the large fluctuations found in the literature (see Table 2). Even though we read the publication of Jerosch-Herold et al. ( $n = 154$  patients) which reported no statistically significant difference between a group who were all routinely splinted after surgery and a group of patients receiving hand therapy and only splinted if and when contractures occurred [30]. These differences relate to the DASH questionnaire, total extension deficit of operated digits and patient satisfaction at 1 year post surgery [30]. In the study of Jerosch-Herold et al. ( $n = 154$  patients) a nocturnal static splint was worn for 6 months after contracture release [30]. Similar results are shown by Collis et al. ( $n = 56$  patients) after a follow-up of 3 months [31]. However, these studies do not provide information on whether initial treatment using nocturnal static splinting will affect the recurrence rate in the course of time. We suspect that the use of a nocturnal extension splint for 3 months has a favourable effect on the reduction of the recurrence rate. But there is no evidence-based data so that further examinations would be necessary.

### Complication rate

In the beginning, there were reasonable scruple if PNF would lead to a higher number of nerve and artery lesions. In our study, one patient reported a transient dysesthesia

**Table 2** Definition of recurrence and follow-up treatment

Author	Definition of recurrence	Hand splint	Recommended duration of treatment with hand rail
Foucher et al. [13]	No definition	Night-time extension splint	Unknown
van Rijssen et al. [21]	Total passive extension deficit of 30° or more in a ray	No splint No physiotherapy	Not applicable
Pereira et al. [20]	Recurrent joint contracture sufficient to require further surgery	Extension splint	3 weeks

**Table 3** Literature overview of nerve injuries

Author	n (fingers)	Nerve injury (%)	Follow-up (months)
Badois et al. [19]	123	2	60
Lermusiaux et al. [11]	799	5.2	
Foucher et al. [13]	311	0.32	38.4
van Rijssen et al. [21]	55	3.6	33

(1.8%) in the zone of the operation. There was no hematoma, infection or injury of any tendon or vessel. These results were obtained although the PNFs were performed by different surgeons with different levels of training.

In a systematic literature overview (see Table 3), Krefter et al. [32] analyzed a total of 113 studies referencing another 2251 studies. The highest number of nerve and vessel lesions was reported after fasciectomy, whereas the highest rate of edema was observed after collagenase injection. Accidental skin tears were mostly associated with collagenase and PNF treatment. Pooled complication incidences for PNF were 18.9% [32]. This number by far exceeds what is most often stated in the literature. There it is consistently reported that the complications were rare and mostly minor [13, 24, 25, 33]. van Rijssen et al. reported that 2 patients out of 55 cases experienced a slightly diminished sensibility on one side of the finger. There were no flexor tendon injuries [21]. In summary, it can be recorded that the risk of nerve damage is very low, but not excluded.

Assuming a similar definition, the recurrence rates of partial aponeurectomy are in line with the illustrated recurrence rate. The influence of the follow-up treatment on the recurrence rate is emphasized as already described. A complication rate of 3.6–39.1% were given for partial aponeurectomy [6, 9]. The average risk for a wound healing disorder is, therefore, up to 22.9%, for nerve injuries 3.4%, for finger artery injury 2.0%, and the general wound infection risk is 2.4% on average [6, 9]. In summary, the partial aponeurectomy showed a higher complication rate with the same recurrence rate. The short operation time of less than 10 min and the short convalescence time already led Maravic et al.

to replace partial aponeurectomy with PNF for one-ray Dupuytren's disease [34].

The level of needle penetration must also be carefully considered. Newer studies reported using palm and finger levels, respectively [13, 21]. Other studies recommend to use as many palm levels as possible to avoid nerve and artery lesions. It seems that the treatment is still safer at the palm level compared to the finger levels. Regarding complications, our study observed three minor skin lesions which resulted from the described hyperextension maneuver when the cord was still adherent to the skin. Other authors reported the same issue although mostly at higher numbers [19].

### Satisfaction

Eighty-six percent of all patients would, in case of recurrence, again undergo this treatment and would also recommend this procedure. All patients, except one who was unemployed, were able to return to their job in an average of 5.5 days. The duration of the recovery period or the time interval to return to work after operation is even more important, especially for unemployed patients in advanced age who may labor to return to the job market. It was also noticeable that many patients who are self-employed or in a management position opted for this procedure. In the study of Pereira et al., most of the patient were satisfied with the result and would recommend the procedure or would be willing to repeat if it necessary [20]. Especially the results in stage I and II of Tubiana were interesting, with an average improvement of more than 70% in our collection. Medjoub et al. also reported a satisfaction rate of 75% [33]. More severe deformities could not corrected in the same satisfactory manner and the overall satisfaction decreased significantly over time.

### Alternative treatments and costs

In summary, our data showed a recurrence rate of 18% with a complication rate < 1% and high patient satisfaction. In the literature, the comparison of the recurrence rate of PNF is significantly ( $p < 0.001$ ) higher in the 5-year

comparison than in partial aponeurotomy (84.9% vs. 20.9%), and occurs significantly earlier ( $p = 0.001$ ) [6, 23, 35]. If the excessively high recurrence rate of the PNF in this literature data is replaced by the data from our study, then there seems to be no significant difference to the currently accorded highest priority treatment of Dupuytren's disease (= partial aponeurotomy) [6–8], while the complication rate is lower. Interesting would be a new comparison with a balanced follow-up time.

Comparable alternatives are available as injectable collagenase *Clostridium histolyticum* (CCH). Skov et al. demonstrated that CCH is not superior in the treatment of isolated proximal interphalangeal joint Dupuytren's contracture regarding clinical outcome, and higher complications than PNF [36]. A prospective, randomized, single-blinded, controlled trial, by Strömberg et al., included 156 patients with a contracture of the metacarpophalangeal (MCP) joint of  $> 20^\circ$ . The patients were allocated to treatment with either PNF or by CCH. There was no advantage of CCH treatment compared with PNF in terms of clinical outcome at any time during a 2-year follow-up [37].

Dupuytren's disease in total lead to 18.707 hospitalizations (26 million Euro) in France in 2012, of which 8534 hospitalizations were necessary for one-ray aponeurotomy (11.9 million Euro) [34]. By replacing surgical aponeurotomy with PNF for one-ray Dupuytren's disease, 91–97% and 56–59% of the treatment costs could be saved using hospitalizations for one-ray aponeurotomy or total hospital costs, respectively, as reference [34]. This implementation could greatly reduce the treatment costs for all Dupuytren's disease [34]. Diaz et al. recommended this implementation especially for elderly patients with less severe contractures, who desire a less invasive procedure, due to the supposedly high recurrence rate or as a first stage to delay surgery in those with more aggressive disease [38]. Another approach was published by Erne et al. in 2014. They used the PNF technique by heavy flexion contractures to facilitate access for partial aponeurotomy. They proposed that nerve and vessel preparations are easier and safer using more extended finger positions in the procedure [39].

The advantages of this technique are its simplicity, minimal discomfort to patients, rapid functional recovery, and low costs [40] with low morbidity [20]. To suggest this treatment, we advise that a good visible and definable cord is important. Multiple cords, broad, the skin infiltrating cords or post-operative scar tissue are preconditions which are not suitable for the described technique. The ideal conditions are Dupuytren's flexion contracture in the Tubiana stage I and II, starring a good definable/visible cord without arthrogenic contractures and a patient who needs to return to work quickly.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** This article does not contain any studies with human participants or animals performed by any of the authors.

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