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Early Postoperative Results of Percutaneous Needle Fasciotomy in 451 Patients with Dupuytren Disease

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Background: Percutaneous needle fasciotomy is a minimally invasive treatment modality for Dupuytren disease. In this study, the authors analyzed the efficacy and complication rate of percutaneous needle fasciotomy using a statistical method that takes the multilevel structure of data, regarding multiple measurements from the same patient, into account.

Methods: The data of 470 treated rays from 451 patients with Dupuytren disease that underwent percutaneous needle fasciotomy were analyzed retrospectively. The authors described the early postoperative results of percutaneous needle fasciotomy and applied linear mixed models to compare mean correction of passive extension deficit between joints and efficacy of primary versus secondary percutaneous needle fasciotomy.

Results: Mean preoperative passive extension deficits at the metacarpophalangeal, proximal interphalangeal, and distal interphalangeal joints were 37, 40, and 31 degrees, respectively. Mean preoperative total passive extension deficit was 54 degrees. Results were excellent, with a mean total passive extension deficit correction of 85 percent. Percutaneous needle fasciotomy was most effective for metacarpophalangeal joints and less effective for proximal interphalangeal and distal interphalangeal joints. Secondary percutaneous needle fasciotomy was as effective as primary percutaneous needle fasciotomy. Complications were rare and mostly minor.

Conclusion: The results of this study confirm that percutaneous needle fasciotomy is an effective and safe treatment modality for patients with mild to moderate disease who prefer a minimally invasive procedure. (*Plast. Reconstr. Surg.* 139: 1415, 2017.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

Percutaneous needle fasciotomy is a minimally invasive treatment modality for Dupuytren disease, which was first described by Henry Cline in 1777.¹ He proposed to section the cords percutaneously using a small, slender surgical knife with a sharp point (bistoury). Astley Cooper was the first to actually perform the procedure in 1822, which is why it was first called Cooper's fasciotomy.² In the late 1970s, the procedure was reinvented by French rheumatologists, who introduced the use of a disposable needle.³ Since then, the procedure has gained popularity, primarily because of its minimal invasiveness and short recovery period.

Percutaneous needle fasciotomy is not the only minimally invasive treatment modality for Dupuytren disease. In 2000, collagenase clostridium histolyticum was first used on Dupuytren disease patients for enzymatic lysis of cords.⁴ However, the efficacy and patient satisfaction of percutaneous needle fasciotomy and collagenase are similar.^{5,6}

Several studies have reported good outcomes of percutaneous needle fasciotomy, especially in patients with mild to moderate disease.⁷⁻¹⁰ Nerve laceration and tendon rupture are potential and the most feared complications, although most studies report very low complication rates.^{7,9,11} A disadvantage of percutaneous needle fasciotomy is the high recurrence rate. In a randomized

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clinical trial by van Rijssen et al., the 5-year recurrence rate of percutaneous needle fasciotomy was 85 percent, compared to a 5-year recurrence rate of limited fasciectomy of 21 percent.¹² It is important to realize that the definition of recurrence in this study was an increase in total passive extension deficit of the complete ray of 30 degrees. Such an increase does not necessarily mean that secondary treatment is necessary at that point. Therefore, for patients who are willing to accept this possibility of early recurrence, percutaneous needle fasciotomy is an effective method to at least postpone more aggressive procedures.^{7,13,14}

In this article, we describe the early postoperative results of percutaneous needle fasciotomy for patients with Dupuytren disease. Data were analyzed for correction of passive extension deficit between joints and efficacy of primary and secondary percutaneous needle fasciotomy using multilevel analysis, which is a statistical method that takes correlation of multiple measurements from the same patient into account.

PATIENTS AND METHODS

In this retrospective study, we analyzed data of 953 rays from 569 patients who underwent percutaneous needle fasciotomy for Dupuytren disease between 2004 and 2014. All procedures were performed by the senior author (J.D.M.). No institutional review board approval was required according to our national guidelines, because this retrospective study was the evaluation of standard care.¹⁵

We included all patients with primary Dupuytren disease who chose to undergo percutaneous needle fasciotomy and had a total passive extension deficit of at least 15 degrees. Total passive extension deficit was calculated by summing the passive extension deficit of all joints per ray. Thumbs were excluded because of the difference in anatomy. Rays with missing data regarding preoperative and postoperative passive extension deficits were also excluded. In total, 237 rays had to be excluded because they did not exhibit primary Dupuytren disease or total passive extension deficit was lower than 15 degrees. Furthermore, the data of 246 rays had to be excluded because of an incomplete case record form. From the remaining 471 rays, one thumb had to be excluded. Because all cords that were treated caused flexion contractures of the affected fingers, it is most likely that they consisted of longitudinal fibers.

Efficacy of treatment was calculated by subtracting preoperative (total) passive extension

deficit data with postoperative data. All patients who were found to have undergone percutaneous needle fasciotomy at the same ray for a second time during our study period (recurrent disease) were entered into a different database.

Procedure

Before treatment, the passive extension deficit per joint was measured using a goniometer and registered on a case record form. Subsequently, patients underwent ultrasonographic assessment of the hand, to gain information about the spatial relation of the cords to the flexor tendons and the neurovascular bundles. For the first two patients, ultrasonographic assessment was not part of the procedure. It was introduced after a tendon rupture had occurred during the second procedure.

Percutaneous needle fasciotomy was performed in an outpatient setting using a similar technique as described by Lermusiaux and Debeyre.³ Lidocaine without adrenaline was used as a local anesthetic for the skin only. The cord was palpated and the level of the needle was aligned perpendicular to the cord. In case ultrasound showed close proximity of the cord to the flexor tendons or neurovascular bundle, the needle was inserted with extra caution. Then, the finger was flexed and extended to ensure no simultaneous movement of the needle was induced, which would indicate tendon contact. Cords were sectioned at multiple levels in the palm and finger, depending on the extent and location of the contracture, using a 25-gauge, 16-mm needle and making a perforating maneuver. During the procedure, the patients were asked whether they felt any electric discharge along the finger, indicating proximity of the neurovascular bundle.¹⁶ Finally, the cords were ruptured using passive extension. A small dressing was applied for 24 hours. Patients were reviewed after an average of 8 weeks postoperatively. They were asked whether any postoperative complications had occurred and postoperative passive extension deficits were measured.

Statistical Analysis

Passive extension deficit corrections were distributed normally; thus, linear mixed models could be applied to compare mean correction of passive extension deficit between metacarpophalangeal, proximal interphalangeal, and distal interphalangeal joints. Hands, rays, and joints were entered as different subject levels within this multilevel structure. Type of joint was used as a fixed effect and patient as a random effect. The effect of joint was corrected for the baseline value

of passive extension deficit, because baseline passive extension deficit correlates with the outcome (passive extension deficit correction) and the predictor (joint). An unstructured covariance structure was chosen, and robust parameter estimate covariance was used. Parameters were estimated using restricted maximum likelihood.

To compare the efficacy of primary percutaneous needle fasciotomy versus secondary percutaneous needle fasciotomy, linear mixed models were applied again. Total passive extension deficit correction was used as an outcome variable. Percutaneous needle fasciotomy (primary or secondary) was entered as a fixed factor, and its effect was corrected for baseline total passive extension deficit. All statistical analyses were performed using IBM SPSS Version 22 (IBM Corp., Armonk, N.Y.). Significance was set at $p < 0.05$.

RESULTS

In total, 470 rays from 451 patients met our inclusion criteria. This led to the patient characteristics listed in Table 1. In total, 669 joints were treated: 373 metacarpophalangeal joints, 274 proximal interphalangeal joints, and 22 distal interphalangeal joints. Mean preoperative passive extension deficit was 37 degrees at the metacarpophalangeal joint, 40 degrees at the proximal interphalangeal joint, and 31 degrees at the distal interphalangeal joint. Mean preoperative total passive extension deficit was 54 degrees (Table 2). It should be noted that most patients had contractures involving one or two joints, which is why mean preoperative total passive extension deficit does not correspond to the sum of the mean preoperative passive extension deficit of the three joints.

The mean correction of passive extension deficit was 95 percent at the metacarpophalangeal joint, 75 percent at the proximal interphalangeal joint, and 74 percent at the distal interphalangeal

Table 2. Efficacy of Percutaneous Needle Fasciotomy per Joint*

Joint	Preoperative PED (degrees)	Postoperative PED (degrees)	Correction of PED (degrees)
MCP	37 ± 19	2 ± 7	35 ± 18
PIP	40 ± 20	11 ± 12	30 ± 17
DIP	31 ± 9	8 ± 13	23 ± 15
TPED	54 ± 35	8 ± 15	46 ± 28

PED, passive extension deficit; MCP, metacarpophalangeal; PIP, proximal interphalangeal; DIP, distal interphalangeal; TPED, total passive extension deficit.

*Values are mean ± SD.

Table 3. Comparison of Mean Correction of Passive Extension Deficit between Joints

Joints	<i>p</i>
MCP vs. PIP	<0.001
MCP vs. DIP	0.008
PIP vs. DIP	0.697

MCP, metacarpophalangeal; PIP, proximal interphalangeal; DIP, distal interphalangeal.

joint. Mean correction of total passive extension deficit was 85 percent (Table 2).

Linear mixed models showed us that correction of metacarpophalangeal joint contractures was significantly more effective than correction of proximal interphalangeal joint contractures ($p < 0.001$) and correction of distal interphalangeal joint contractures ($p = 0.008$). There was no statistically significant difference between correction of proximal interphalangeal and distal interphalangeal joint contractures ($p = 0.697$) (Table 3).

Most patients were classified as Tubiana stage I or II.¹⁷ Efficacy of the correction declined progressively from a preoperative Tubiana stage I to IV, as shown in Table 4.

A total of 21 patients underwent secondary percutaneous needle fasciotomy of a previously treated ray during our study period. The median durability of the primary percutaneous needle fasciotomy was 32 months (range, 9 to 97 months). Mean reduction of total passive extension deficit was 46 degrees for primary and 36 degrees

Table 1. Patient Characteristics

Characteristic	No. (%)
Sex	
Male	345 (77)
Female	106 (23)
Mean age at the time of PNF (yes)	66
Associated diseases (diabetes, liver disease)	41 (9.1)
Rays	470 (100)
Index	5 (1)
Middle	39 (8)
Ring	185 (40)
Little	241 (51)

PNF, percutaneous needle fasciotomy.

Table 4. Total Passive Extension Deficit Corrections According to the Tubiana Classification

Tubiana Stage	No.	TPED Correction (%)
I (TPED 0–45 degrees)	252	94
II (TPED 46–90 degrees)	150	87
III (TPED 91–135 degrees)	53	80
IV (TPED >135 degrees)	15	69

TPED, total passive extension deficit.

Table 5. Efficacy of Primary and Secondary Percutaneous Needle Fasciotomy

PNF (<i>n</i> = 21)	Preoperative TPED (degrees)	Postoperative TPED (degrees)	Correction of TPED (degrees)	<i>p</i>
Primary	51 ± 39	5 ± 11	46 ± 34	0.134
Secondary	44 ± 27	8 ± 13	36 ± 23	

PNF, percutaneous needle fasciotomy; TPED, total passive extension deficit.

*Values are mean ± SD.

for secondary percutaneous needle fasciotomy (Table 5). Linear mixed models showed no significant difference between the efficacy of the two procedures ($p = 0.134$) when correcting for preoperative total passive extension deficit.

Complications occurred in 56 (11.9 percent) of the treated rays. Most of these were skin tears, which occurred in 43 rays (9.1 percent). All tears healed without intervention. Five procedures (1.1 percent) were complicated by a superficial wound infection, which was treated using antibiotics. Temporary paresthesia was found in six rays (1.3 percent), and there was one case of permanent sensory loss, which was attributed to a partial nerve laceration (0.2 percent). One tendon rupture occurred (0.2 percent), for which surgical intervention was necessary.

In the group with recurrent disease, complications occurred in three of the re-treated rays (14.3 percent). All of these were skin tears that healed without further intervention.

DISCUSSION

Although limited fasciectomy remains the most often used treatment for patients with Dupuytren disease, similar outcomes of less invasive procedures such as percutaneous needle fasciotomy have been reported for patients at Tubiana stage I and II.^{7,9–11,18} It has been shown to be an effective procedure with a low complication rate and short recovery period.^{7,9,11} The main disadvantage is the high recurrence rate. However, when patients prefer a minimally invasive procedure instead of limited fasciectomy, percutaneous needle fasciotomy can also effectively be performed for recurrent disease.¹⁹

The number of studies regarding the results of percutaneous needle fasciotomy with a large sample size is limited. Also, most previous studies have enlarged their sample size by treating rays or even joints as subjects, without sufficiently describing what statistical method was used to compare these multiple measurements from the same patients.^{7,8,10,11,20} However, including multiple measurements from the same patient without the use of an appropriate statistical method violates the assumption that observations must be independent, and results in underestimation of within-group variability and inflation of sample size.²¹ Both effects may lead to unrealistically low p values, which increases the chance of a type I error.²²

In this study, we present an overview of the postoperative results of percutaneous needle fasciotomy in a large population using linear mixed models. With the use of this statistical method, we were able to take the multilevel structure of our data into account.

The results of previous studies regarding the early postoperative results of percutaneous needle fasciotomy are shown in Table 6. In our study, immediate correction of total passive extension deficit was 85 percent, which is slightly higher than the number reported by Foucher et al. and van Rijssen and Werker.^{7,10} The other did not report mean total passive extension deficit correction. The mean correction at the metacarpophalangeal joint found in our study (95 percent) falls within the range reported in the literature (79 to 99 percent). Numbers regarding proximal interphalangeal joint correction found by others vary widely (46 to 89 percent). We found a mean correction of 75 percent at the proximal interphalangeal joint, which also falls within this range.^{7,8,10,11} Furthermore, 22 of our patients were treated for a distal interphalangeal joint contracture, and mean correction was 74 percent. Van Rijssen and Werker reported on only one case of a distal interphalangeal joint contracture in which they achieved a correction of 75 percent.⁷ Other studies do not report percentages regarding distal interphalangeal joint contractures. Our results show that percutaneous needle fasciotomy is an effective treatment modality for all joints.

Table 6. Previous Studies on Results of Percutaneous Needle Fasciotomy

Reference	No. of Patients	No. of Rays	MCP Joint Correction (%)	PIP Joint Correction (%)	DIP Joint Correction (%)	TPED Correction (%)
Foucher et al., 2001 ¹⁰	211	311	79	65	—	76
Van Rijssen and Werker, 2006 ⁷	52	74	88	46	75	77
Pess et al., 2012 ¹¹	474	1013	99	89	—	—
Abe and Tokunaga, 2015 ⁸	51	103	98	89	—	—

MCP, metacarpophalangeal; PIP, proximal interphalangeal; DIP, distal interphalangeal; TPED, total passive extension deficit.

All studies shown in Table 6 reported that correction of metacarpophalangeal joint contractures was significantly more successful than correction of proximal interphalangeal joint contractures. Our results confirm that correction of metacarpophalangeal joint contractures is significantly more effective than correction of proximal interphalangeal joint contractures. They also show that correction of metacarpophalangeal joint contractures is significantly more effective than correction of distal interphalangeal joint contractures, and there is no significant difference between correction of proximal interphalangeal and distal interphalangeal joint contractures.

In the small group that underwent percutaneous needle fasciotomy for recurrent disease, treatment was as effective as the primary intervention. The study by van Rijssen and Werker on the effectiveness of percutaneous needle fasciotomy for recurrent Dupuytren disease supports our finding.¹⁹ We can conclude that secondary percutaneous needle fasciotomy is a good treatment option for patients who wish to postpone limited fasciectomy for a second time.

The median durability of the first procedure was 32 months. However, no definition for recurrence was used in our study. Patients presented with recurrent disease when they experienced enough complaints to be willing to undergo a second procedure. Because this is a very subjective measure, we were not able to calculate a reliable recurrence rate that is comparable to the literature.

Our complication rate was 11.9 percent. Similar to other studies, most of these complications healed without further intervention. Immediately after the beginning of our study, there was one case of a flexor tendon rupture that needed operative repair. This complication was taken very seriously and led to the introduction of preoperative ultrasonographic assessment of the affected ray(s), to gain information about the location of the flexor tendons and the neurovascular bundles. In case ultrasound showed a superficial flexor tendon or neurovascular bundle, the needle was inserted with extra caution. Since the introduction of ultrasound, tendon rupture has not occurred anymore, which may indicate that preoperative ultrasound enhances safety of the procedure. Sakellariou et al. recently published an article in which they describe their positive experience with ultrasound-guided percutaneous needle fasciotomy.²³ However, the hypothesis that ultrasound reduces the perioperative complication rate of percutaneous needle fasciotomy is in need of further research.

Minimum preoperative total passive extension deficit as an inclusion criterion varies in previous studies. Some studies do not report a minimum total passive extension deficit,^{7,10} but most studies use a minimum total passive extension deficit of 20 to 30 degrees.^{8,11,12,20} In this study, we included patients with a minimum total passive extension deficit of 15 degrees. At this point, patients frequently present with a positive tabletop test and start having complaints during daily activities.²⁴ Furthermore, a recent study by Broekstra et al. showed that measurements of total passive extension deficit have a maximum dispersion of 15 degrees.²⁵ By excluding patients with a preoperative total passive extension deficit below 15 degrees from the data set, we excluded the possibility that total passive extension deficit correction was based on a measurement error. For example, a few patients had a preoperative total passive extension deficit of 2 to 6 degrees. In our opinion, it is likely that these values were subjected to data-entry or measurement errors. We decided not to exclude patients with a total passive extension deficit correction below 15 degrees. Note that this variable (total passive extension deficit correction) is different from the preoperative total passive extension deficit. If we excluded the cases with a total passive extension deficit correction below 15 degrees, we would have overestimated the treatment effect.

Our main limitation is the retrospective nature of our study. The data of 246 rays had to be excluded because of missing data regarding preoperative and postoperative passive extension deficits. Furthermore, we do not have detailed information regarding follow-up and recurrence. As previous research has shown us that the longevity of percutaneous needle fasciotomy is limited when comparing it to limited fasciectomy, this would have been valuable information.¹² However, this is the subject of future investigation.

Because of the great number of patients that were treated over several years, we were able to show the results of percutaneous needle fasciotomy in a large population. To ensure reliable results, we have taken the multilevel structure of our data into account. The fact that data of hands, rays, and joints in patients with Dupuytren disease are correlated is underestimated by many researchers. Therefore, we strongly recommend carefully selecting a correct statistical method when starting a new study regarding a disease that affects bilateral or multiple structures in one patient.

CONCLUSIONS

We can conclude that percutaneous needle fasciotomy is an effective treatment modality for patients with mild to moderate Dupuytren disease. Furthermore, our results show that the procedure is significantly more effective for metacarpophalangeal joint contractures than for proximal interphalangeal and distal interphalangeal joint contractures. The complication rate is low, and percutaneous needle fasciotomy is also effective for patients with recurrent disease. It is therefore an excellent treatment modality for patients who wish to postpone more aggressive procedures.

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CODING PERSPECTIVE

Coding perspective provided by Dr. Raymond Janevicius is intended to provide coding guidance.

26040 Fasciotomy, palmar (e.g., Dupuytren's contracture); percutaneous

- Percutaneous palmar fasciotomy is reported with code 26040.
- The fasciotomy procedure includes ultrasound guidance for needle placement. One does not separately report the ultrasound portion of the procedure with code 76885.
- Code 26040 is reported once per digit, even though multiple fasciotomies may be performed on the same cord.
- If more than one digit is treated, code 26040 is reported for each digit. Thus, percutaneous fasciotomies for pre-tendinous and central cords of the right ring and small fingers would be reported as follows:

26040

26040-59

- Some payers may require digit modifiers:

26040-F8

26040-59-F9

- If an open fasciotomy is performed, report code 26045.
- Fasciectomy procedures are reported with codes 26121, 26123, and 26125.

Disclosure: Dr. Janevicius is the president of JCC, a firm specializing in coding consulting services for surgeons, government agencies, attorneys, and other entities

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