EDITOR'S CHOICE

Outcomes and Direct Costs of Needle Aponeurotomy, Collagenase Injection, and Fasciectomy in the Treatment of Dupuytren Contracture

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Purpose The aims of our study were to evaluate the rates and predictors of reinterventions and direct costs of 3 common treatments of Dupuytren contractures—needle aponeurotomy, collagenase injection, and surgical fasciectomy.

Methods A retrospective review identified 848 interventions for Dupuytren contracture in 350 patients treated by a single surgeon from 2005 to 2016. The treatments included needle aponeurotomy (NA) (n = 444), collagenase injection (n = 272), and open fasciectomy (n = 132). We collected information on demographics, contracture details, and comorbidities. Outcomes included reintervention rates, time to reintervention, and direct cost of treatments. Standardized costs were calculated by applying 2017 Medicare reimbursement to professional services and cost-to-charge ratios to hospital charges.

Results Demographics were similar among the 3 treatment groups. The fifth finger was the most commonly affected digit including 43% of the NA, 60% of the collagenase, and 45% of the fasciectomy groups. The 2-year rates of reintervention following NA, collagenase, and fasciectomy were 24%, 41%, and 4%, respectively, and the 5-year rates were 61%, 55%, and 4%, respectively. Younger age and severity of preintervention proximal interphalangeal (PIP) joint contracture were predictive of reintervention in the NA and collagenase groups. The standardized direct costs for NA, collagenase, and fasciectomy were $624, $4,189, and $5,291, respectively. Including all reinterventions, the cumulative costs per digit following NA, collagenase, and surgery at 5 years were $1,540, $5,952, and $5,507, respectively.

Conclusions Treatment with collagenase resulted in the highest rate of reintervention at 2 years, comparable reintervention rates to NA at 5 years, and the highest cumulative costs. The NA was the least expensive and resulted in longer duration before reintervention compared with collagenase. More severe PIP joint contractures and younger age at time of initial intervention were predictive of reintervention after collagenase and NA. Fasciectomy has a high initial cost but the lowest reintervention rate. *(J Hand Surg Am. 2019;44(11):919–927. Copyright © 2019 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Collagenase, Dupuytren, fasciectomy, needle aponeurotomy.

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Dupuytren contracture is a relatively common disorder affecting mostly individuals of northern European ancestry. It is characterized by a slowly progressive fibroproliferative disease of the palmar fascia, leading to permanent flexion contractures of the fingers and palm, painful nodules, and functional decline. The etiology is not completely understood, but there are several established risk factors including genetic predisposition, ethnicity, sex, and age, as well as environmental factors including smoking, alcohol intake, diabetes, hand trauma, and manual labor. Contractures have a propensity to recur.[1–8] Multiple treatment strategies have been described. Although open fasciectomy has historically been the gold standard treatment, less invasive procedures including percutaneous needle aponeurotomy (NA) and collagenase injection have gained popularity.

Needle aponeurotomy and collagenase injections have the benefits of being minimally invasive office-based procedures, providing fast recovery, low complication rates, and relatively low costs compared with surgery. However, they are both associated with high recurrence rates, ranging from approximately 30% to 80% at 2- to 5-year follow-up.[9–14] There remains a paucity of information on the likelihood of reinterventions and cumulative costs following NA and collagenase injection compared with open fasciectomy.

The primary aims of our study were to evaluate the rates and predictors of reinterventions and costs of 3 common treatments of Dupuytren contractures—NA, collagenase, and surgical fasciectomy. A better understanding of the success of treatments and associated costs could help guide the decision-making process for physicians and their patients.

MATERIALS AND METHODS

After institutional review board approval, we performed a retrospective review examining a series of 848 interventions for Dupuytren contracture in 350 patients treated by a single surgeon (M.R.) from 2005 to 2016 at our institution. The treatments included NA (n = 444), collagenase injection (Xiaflex; Endo Pharmaceuticals Inc. Malvern, PA) (n = 272), and open fasciectomy (n = 132). The decision for treatment was multifactorial and patient-driven. The senior author (M.R.) would inform him or her of the treatment and the risks/benefits, recovery post-intervention, costs, and recurrence information to help them decide their preferred option. All of the patients gave approval for their medical records to be used for research in accordance with the Minnesota Research Authorization Statute.

The electronic medical records of patients treated from 2005 to 2016 were reviewed. Dates of last follow-up ranged from March 2006 to December 2016. Median follow-up was 2.0 years (interquartile range [IQR], 2.4 months–4.2 years). Data collected included the degree of pretreatment contracture at the metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints of the fingers undergoing treatment, the type of treatment performed, the number of reinterventions, and the time (in years) to reintervention. Demographic data including sex, handedness (right vs left), age, current smoking status, current alcohol use, and diabetes were collected.

Overall, demographics were similar among the 3 treatment groups (Table 1). There was a significant male predominance in our study population, with 82% of the presenting cases involving males. The average age at initial treatment was 64.4 years (63.8 years for NA, 65.8 years for collagenase, and 63.7 years for fasciectomy). The dominant hand was involved in 53% of cases. The little finger was the most commonly affected digit at initial presentation including 43% (157 cases) of NA, 60% (92 cases) of collagenase, and 45% (52 cases) of the fasciectomy groups. This was followed by the ring finger including 36% (133 cases), 22% (34 cases), and 28% (32 cases), respectively. The thumb was the least frequently involved digit.

Techniques

Needle aponeurotomy: In clinic, the patient undergoes ultrasound mapping of the affected digit before surgery to identify the neurovascular bundle. Following injection of 1% lidocaine without epinephrine, the needle (typically, 19–22 gauge) is utilized to sever the cord at evenly spaced intervals (~ 1 cm apart) while holding the finger in extension. The patient then meets with a hand therapist once and is given orthosis instructions. Compliance is variable, but we recommend 3 months of orthosis use. All patients receive a hand-based extension orthosis to be worn at night only. Those with PIP contractures also receive a dynamic extension orthosis (DeRoyal LMB Dynamic Wire-Foam Extension Finger Spring; Alimed, Dedham, MA) to be worn for 30 minutes, 3 to 5 times daily.

Collagenase: In clinic, collagenase *Clostridium histolyticum* (Xiaflex; Endo Pharmaceuticals, Malvern, PA) 0.58 mg is injected within the cord, typically at

TABLE 1. **Demographics and Contracture Characteristics**

	NA (n = 367)	Collagenase (n = 153)	Fasciectomy (n = 116)
Female	53 (14%)	38 (25%)	24 (21%)
Male	314 (86%)	115 (75%)	92 (79%)
Age	63.8 (9.9%)	65.8 (10.2%)	63.7 (9.8%)
Comorbidities			
Active smoking	43 (12%)	23 (15%)	19 (16%)
Diabetes	37 (10%)	25 (16%)	12 (10%)
Alcohol use	71 (43%)	41 (46%)	21 (36%)
Contracture characteristics			
Dominant hand involved	198 (54%)	76 (50%)	60 (52%)
Thumb (1)	17 (5%)	3 (2%)	2 (2%)
Index (2)	18 (5%)	6 (4%)	5 (4%)
Middle (3)	42 (11%)	18 (12%)	19 (16%)
Ring (4)	133 (36%)	34 (22%)	32 (28%)
Little (5)	157 (43%)	92 (60%)	52 (45%)
Palm	0	0	6 (5%)
Number of interventions			
Number of initial treatments at our institution	367	153	116
Number of subsequent treatments at our institution within 5 years	77	119	16
Total number of treatments at our institution	444	272	132
Preintervention contracture before each treatment			
MCP	34.1° (24.8°)	30.1° (26.0°)	33.6° (26.5°)
PIP	31.5° (29.4°)	47.0° (28.5°)*	33.2° (30.8°)
DIP	6.8° (13.3°)	10.1° (15.9°)†	11.1° (17.8°)

*$P < .001$ (collagenase > NA).
†$P = .049$ (collagenase > NA).

multiple sites. One to 7 days after the injection, the patient returns to clinic to have the finger forcibly extended to release the cords, often using local anesthetic to facilitate release. The patient then meets with a hand therapist once and undergoes the same orthosis protocol as described previously.

Fasciectomy: In the operating room, typically under regional anesthesia, a Bruner-type incision is utilized to expose and remove the diseased fascia, while protecting the neurovascular bundles and tendons/pulleys. The patient is then placed in a bulky dressing and an orthosis maintaining finger extension. Three to 7 days later, the patient returns for examination and meets with occupational therapy to have an extension orthosis fabricated and to initiate range of motion (ROM) and edema control measures. She or he then returns 10 to 14 days later for suture removal and often another visit with therapy. At that visit, the patient begins scar treatment and massage as well as continued work on edema control and ROM. Subsequent visits are variable based on progression of improvement.

Direct costs

All billed services for patients with an index treatment of only 1 digit were examined by Current Procedural Terminology (CPT) and internal charge master codes (Table 2). The cost summation did not consider multiple fingers treated in a single setting. Single fingers that received palmar fasciotomy and ultrasonic guidance for NA as identified by CPT codes 26040 and 76942 were selected to model the cost of NA (n = 27). Single fingers that received collagenase injection and manipulation (20527, 26341, and J0775) were selected to model the cost of collagenase treatment (n = 41). The surgery group included fingers treated with fasciectomy (26121 and 26123) (n = 25). All services provided to these patients within the treatment window (NA, −4 days to +4 days around treatment; collagenase, −4 days

TABLE 2. Services Used to Calculate 2017 Standardized Costs (CPT Codes for Professional Services)

NA
Fasciotomy (26040)
Ultrasound guidance (76942)
Hand and finger orthotics (L3913 and L3925)
Office/outpatient visits with orthopedics or physical medicine and rehabilitation (99201−99499)
Collagenase
Injection (20527 and J0775)
Manipulation (26341)
Hand and finger orthotics (L3808, L3912, L3913, L3921, and L3925)
Office/outpatient visits with orthopedics or physical medicine and rehabilitation (99201−99499)
Fasciectomy
Fasciectomy (26121, 26123, and 26125)
Anesthesia (01810)
Ultrasound guidance (76942 and 76956))
Surgical pathology (88304 and 88305)
Hand and finger orthotics (L3808, L3913, and Q4051)
Physical therapy—3 sessions (97110)
Office/outpatient visits with orthopedics or physical medicine and rehabilitation (99201−99499)
Operating room
Surgical supplies
Pharmaceuticals (propofol, cefazolin, clonidine, lidocaine, fentanyl, bupivacaine, midazolam, oxycodone, granisetron)

to +10 days; and surgery, −4 days to +6 weeks) were reviewed to select those related to treatment.

Standardized direct costs (Table 3) were created for these treatments using widely accepted health services research methodology. Services billed on a professional bill identified by CPT4 codes such as fasciotomy, office visits, orthotics, ultrasound guidance, collagenase injection, and anesthesia were assigned 2017 Medicare reimbursement. Services provided and billed by the hospital for the fasciectomy approach are typically reimbursed by Medicare as ambulatory payment classification payments for bundles of services. In order to create a standardized cost for individual hospital services, the 2017 charges for these services such as supplies, drugs, and the operating room facility fee were multiplied by the appropriate cost-to-charge ratio from the 2017 Medicare cost report.[15] This cost-to-charge ratio approach is similar to that used by the Healthcare Cost and Utilization Project to create costs for the National Inpatient Sample database. Per-finger total 2017 standardized costs were averaged within the 3 treatments groups to determine the costs used in the model. Costs including out-of-pocket expenses, time lost from productivity and recreational activities, and those related to complications of treatment were not considered in our analysis.

Statistical analysis

The data are reported using standard summary statistics, including means and SDs for continuous data and counts and percentages for categorical data. Baseline data were compared among the 3 treatment groups using analysis of variance in a linear mixed model to account for the correlation within subjects with multiple digits treated. Reintervention was analyzed as a time-to-event outcome using survivorship methodology, including Kaplan-Meier estimation and Cox proportional hazards regression. Because the data comprised 848 procedures among 350 patients, the observations were not independent; patient-specific characteristics result in correlation across different observations for a given individual. If unaccounted for, the inference from the analysis of such data would be biased. Therefore, the robust (sandwich) variance was used in the Cox models to account for the correlation owing to multiple digit involvement and repeated treatments within subjects. In these analyses, the censoring date was the date of last clinical follow-up or 5 years after initial treatment, whichever came first. The association of potential risk factors and reintervention is expressed as a hazard ratio (the risk of reintervention for patients with one level of the risk factor relative to the risk for patients with another level of the risk factor). In the

TABLE 3. Average Standardized Costs

	NA (n = 367)	Collagenase (n = 153)	Fasciectomy (n = 116)
Initial treatment costs per finger	$624	$4,189	$5,291
Costs after initial treatment ($*number of fingers)			
NA	$624*55	$624*19	$624*3
Collagenase	$4,189*62	$4,189*54	$4,189*3
Fasciectomy	$5,291*8	$5,291*6	$5,291*2
Follow-up treatment costs per finger	$916	$1,763	$216
Overall cumulative cost	$1,540	$5,952	$5,507

analysis of cumulative costs, the cost of all interventions was summed over 5 years, stratified by the initial intervention at our institution. All statistical tests were 2-sided and P values less than .05 were considered statistically significant.

RESULTS

Contractures

Preintervention contractures were measured with a finger goniometer prior to each treatment and described in Table 1. Those treated with collagenase had the lowest preintervention MCP contracture at 30.1°, compared with 34.1° in the NA group, and 33.6° for the fasciectomy group. However, the collagenase group had the highest PIP contractures at 47.0°, compared with 31.5° in the NA group, and 33.2° in the fasciectomy group ($P < .05$). The DIP contractures were also higher in the collagenase group (10.1°) than in the NA group (6.8°) ($P < .05$). Postintervention contracture data were not specifically reported in our study, unless the patient presented to the clinic owing to recurrence, in which case, the contractures were measured again as preintervention contractures for the subsequent reintervention.

Reinterventions

The rates of reintervention at 2 years and 5 years across the 3 treatment types are shown in Table 4. Within 2 years of a collagenase injection, 41% of fingers underwent a reintervention of any type, compared with 23% following NA and 4% following fasciectomy. By 5 years, 61% of NA procedures, 55% of collagenase injections, and 4% of fasciectomies resulted in a reintervention. Sixteen of the 153 fingers initially treated with collagenase required 2 or more interventions within the 5-year time window, compared with 22 of 367 fingers initially treated with NA. Furthermore, patients treated with collagenase had a shorter time to recurrence necessitating reintervention as well. The average time to reintervention was 1.8 years for NA compared with 0.95 years for collagenase. There were only 4 fasciectomy cases requiring reintervention, with a mean time to reintervention of 0.92 years.

Predictors of reintervention

Given the low number of reinterventions after fasciectomy, predictors of reintervention were evaluated only for the NA and collagenase groups. In the NA group, younger age, involvement of the little finger, and larger PIP and DIP contractures were predictors of reintervention (Table 5). The risk of reintervention (expressed as a hazard ratio [HR]) was 1.05 (95% confidence interval [95% CI], 1.02−1.07; $P < .05$) for every year younger the patient was at initial treatment and 1.58 (95% CI, 1.27−1.97; $P < .05$) for every 10 years younger. Contracture involving the little finger (compared with the ring finger) had an HR of 1.56 (95% CI, 1.02−2.39; $P < .05$). At the PIP and DIP joints, for every 10° increase in contracture, the HR was 1.13 (95% CI, 1.03−1.23; $P < .05$) and 1.18 (95% CI, 1.08−1.27; $P < .05$), respectively.

In the collagenase group, younger age and larger PIP contracture were predictive of reintervention. The HR was 1.04 (95% CI, 1.02−1.07; $P < .05$) for every year younger the patient was and 1.54 (95% CI, 1.26−1.88; $P < .05$) for every 10 years younger. For every 10° increase in PIP joint contracture, the HR was 1.17 (95% CI, 1.05−1.29; $P < .05$).

Cumulative costs

The standardized direct costs of treatment of a single finger by NA, collagenase, and fasciectomy were $624, $4,189, and $5,291, respectively. We then estimated the average cumulative treatment costs (Table 3). During follow-up of the 153 fingers in the collagenase group, there were 19 subsequent NA, 54 subsequent collagenase injections, and 6 subsequent fasciectomies resulting in a cumulative cost of $5,952

TABLE 4. Reinterventions

	NA	Collagenase	Fasciectomy
Reinterventions after initial treatment	n = 367*	n = 153*	n = 116*
1+ subsequent treatments	92	54	4
2+ subsequent treatments	22	16	2
3+ subsequent treatments	8	4	1
4+ subsequent treatments	2	2	1
Rate of reintervention†	n = 444‡	n = 272‡	n = 132‡
Any reintervention at 2 y	23% (18%, 29%)	41% (34%, 48%)	4% (0%, 8%)
Any reintervention at 5 y	61% (51%, 69%)	55% (46%, 63%)	4% (0%, 8%)
Mean time to reintervention (y)	1.8	0.95	0.92§
5-y rate of reintervention type†	n = 444‡	n = 272‡	n = 132‡
NA	42% (31%, 51%)	13% (6%, 19%)	1% (0%, 3%)
Collagenase	29% (18%, 38%)	46% (36%, 54%)	1% (0%, 4%)
Fasciectomy	5% (1%, 9%)	6% (1%, 11%)	2% (0%, 5%)

*Number of initial treatments.
†Estimates derived from Kaplan-Meier analyses.
‡Total number of treatments (see Table 1 for more information).
§Based on only 4 fingers requiring reintervention.

per digit. Of the 367 fingers in the NA group, there were 55 subsequent NA, 62 subsequent collagenase injections, and 8 subsequent fasciectomies resulting in a cumulative 5-year cost of $1,540. Similarly, of the 116 fingers in the fasciectomy group, 3 subsequent NA, 3 subsequent collagenase injections, and 2 subsequent surgeries resulted in a cumulative cost of $5,507.

DISCUSSION

The treatment options for Dupuytren disease are currently varied, but there remains uncertainty related to reintervention rates and cumulative direct costs. Surgical fasciectomy has historically been the treatment of choice, particularly for advanced contractures. In the 1970s, Rodrigo et al[8] suggested that fasciectomy more reliably provided long-term improvement compared with fasciotomy. Studies have reported wide ranges of recurrence rates, from 20% up to 60%.[8,11,16] Others have described more extensive resection including the skin, radical dermofasciectomy, with recurrence rates as low as 8%.[17,18]

This collective accumulation of historical studies has led to fasciectomy being established as the gold standard treatment for Dupuytren disease. This was reinforced in Van Rijssen et al's[19] trial that showed fasciectomy provided better outcomes than NA, particularly for severe contracture of the MCP joints. However, patients treated with NA reported significantly less postoperative pain. With the increasing desire to try less invasive measures, many surgeons and patients prefer office-based procedures as an initial treatment. Therefore, our study was designed to compare these less invasive interventions to each other, and to open fasciectomy, assessing both reintervention risk and cumulative costs.

Relatively good short-term results for lesser degrees of contracture have been described with NA and collagenase injections.[20] However, recent randomized trials have reported recurrence rates of up to 42% to 68% with NA.[9,13,14] Skov et al[14] reported superior results in terms of maintained clinical improvement with NA compared with collagenase (32% vs 8%, respectively) at 2-year follow-up. Foucher et al[21] noted a reintervention rate of 24% after NA at a mean follow-up of 3.2 years.

Injection of collagenase has more recently been utilized as a nonsurgical treatment of Dupuytren cords. Recurrence rates remain high and appear to be time-dependent. A systematic review by Chen et al in 2011[22] revealed a recurrence rate with collagenase injections of 10% to 31%, but the studies' follow-up ranged from just 120 days to 4 years. More recently, Scherman et al[13] reported that 33% of patients had a recurrence, defined as 30° or greater passive extension deficit, at 3-year follow-up after collagenase injection. In contrast, Skov et al[14] reported 83% recurrence, defined as 20° or greater passive

TABLE 5. Predictors of Reintervention

	NA		Collagenase	
	HR (95% CI)	*P* Value	HR (95% CI)	*P* Value
Age				
Per every y younger	1.05 (1.02−1.07)	< .05*	1.04 (1.02−1.06)	< .05*
Per every 10 y younger	1.58 (1.27−1.97)	< .05*	1.54 (1.26−1.88)	< .05*
Male gender	2.13 (0.92−4.93)	.08	1.23 (0.74−1.06)	.43
Dominant hand involved	1.42 (0.97−2.07)	.07	1.02 (0.71−1.37)	.91
Active smoking	0.81 (0.27−2.45)	.70	1.21 (0.62−2.34)	.58
Alcohol use	1.20 (0.56−2.56)	.64	0.96 (0.55−1.68)	.89
Diabetes	1.35 (0.69−2.63)	.38	1.03 (0.53−2.01)	.92
Anticoagulant use	1.35 (0.64−2.86)	.44	0.49 (0.23−1.06)	.07
Little finger (compared with ring finger)	1.56 (1.02−2.39)	< .05*	1.14 (0.72−1.80)	.58
MCP contracture				
Per 1° increase	1.0 (0.99−1.01)	.98	1.00 (0.99−1.01)	.59
Per 10° increase	1.0 (0.91−1.10)	.98	1. 03 (0.93−1.14)	.59
PIP contracture				
Per 1° increase	1.01 (1.00−1.02)	< .05*	1.02 (1.01−1.02)	< .05*
Per 10° increase	1.13 (1.03−1.23)	< .05*	1.17 (1.05−1.29)	< .05*
DIP contracture				
Per 1° increase	1.02 (1.01−1.02)	< .05*	0.98 (0.96−1.01)	.57
Per 10° increase	1.18 (1.08−1.27)	<.05*	0.97 (0.86−1.09)	.57

*$P \leq .05$.

extension deficit, at 2 years following collagenase injection. The CORDLESS (Collagenase Option for Reduction of Dupuytren Long-Term Evaluation of Safety Study) reported a 5-year overall recurrence rate of 47% after collagenase injection and an 18% rate of reintervention.[12] Surgical fasciectomy was the most common reintervention, followed by repeat collagenase injection.[12]

In our study, both NA and collagenase injections had high recurrence rates, compared with fasciectomy. However, it is important to highlight that those who underwent collagenase had a more severe preintervention PIP contracture. The authors are uncertain as to the true reason for this. This may have contributed to a patient's decision to pursue collagenase as a treatment choice and may have contributed to the increased reintervention rates.

In this study, we found that younger age at presentation and larger PIP contracture was a risk factor for reintervention in the NA and collagenase groups (Table 5). Previous studies have also indicated that PIP contractures can be more difficult to treat and that anatomical differences leave this joint more susceptible to blistering and tendon rupture.[23–26] Potentially, disease severity is also correlated with a younger age of onset, explaining the increased risk of recurrence in these patients. Those with larger DIP contractures and contractures involving the little finger had a higher incidence of recurrence after NA, but not collagenase. We do not have an explanation for these findings.

Although the degree of contracture, suitability for surgery, and patient preference weigh heavily into the decision-making process, cost should also be an important consideration. There have been retrospective cost studies in France and England, but to our knowledge, none have been reported in the United States. In England, from 2003 to 2008, overall per-patient costs for fasciectomy were $4,575 (£2,885) for outpatient cases and $5,604 (£3,534) for inpatient cases. The costs ranged from $4,339 (£2,736) for a palmar fasciectomy outpatient case to $14,607 (£9,210) for a revision digital fasciectomy outpatient case.[27] In France, the total hospital costs for all elective admissions in 2001 was estimated at $13.3 million.[28]

Our results suggest that, although collagenase injection is minimally invasive and a well-tolerated outpatient procedure, the cumulative cost of treatment exceeds that of open fasciectomy and NA. This is primarily due to the high frequency of reinterventions following use of this relatively expensive medication. In addition, we recognize that not every physician utilizes ultrasound mapping for NA, which would further decrease the cost of an NA intervention. At our institution, ultrasound mapping costs $61.37 per intervention (~ 10% of the total cost).

Collagenase injections resulted in the highest reintervention rates at 2 years, comparable reintervention rates with NA at 5 years, and a higher cost than NA and fasciectomy cumulatively. The NA resulted in higher reintervention rates than fasciectomy, but substantially lower costs than fasciectomy and collagenase injections. Fasciectomy resulted in the lowest reintervention rate overall and was actually less expensive than collagenase in terms of cumulative direct costs.

Our study has limitations. This was an observational retrospective study and treatment and reintervention decisions were primarily based on patient choice. Prospective trials with randomization would be needed to better evaluate the efficacy of these treatments. Final contracture data were not available on all patients, which would be essential in determining the final degree of correction attained by different treatment methods. Finger ROM measurements were made by various members of the senior author's (M.R.) team, including residents rotating through the service, advance practice providers, or the senior author himself. Interventions were not stratified by the specific joint treated, just the specific finger. We did not clinically define recurrence (ie, using objective contracture degree cutoffs) when deciding to proceed with reintervention. Rather, the decision to reintervene was primarily patient-driven, based on their symptomatic and functional impairments, and we acknowledge that this would lead to selection bias. The senior author's intention was to instruct patients on all of the treatment options, including their risks and benefits, in hope of providing them the best information with which to guide their decision. Patients' choices may have been driven by cost or by convenience. For example, collagenase injection may have been cost-prohibitive if their insurance did not cover the cost of the medication. In addition, failure of treatment and reintervention rate are not synonymous. Although it was not our objective to measure failure rates, there may have been patients that considered their treatment a failure but, ultimately, did not elect to undergo a repeat intervention.

From 2005 to 2010, patients did not have the option of collagenase as a treatment because it was introduced in our practice in 2010. Yet, including the pre-2010 data provided additional follow-up when analyzing reintervention rates and costs. Furthermore, the analytical approach used to evaluate reintervention rates assumes that patients who did not return for additional evaluation were not in need of further treatment. This may not necessarily be the case for all patients. Future research could evaluate patient-reported measures of Dupuytren-related hand dysfunction and cost effectiveness. Lastly, in the current study, we did not account for the potential cost differences of treating multiple digits in one sitting. Whereas there might be economies of scale for fasciectomy in that scenario, particularly with respect to anesthesia and operating room costs, the costs of orthotics and collagenase would be doubled for 2 fingers. This would make the collagenase option even more expensive than the other 2 approaches.

This study shares the authors' clinical and cost experiences with 3 common treatments for Dupuytren disease. Collagenase resulted in the highest rate of reintervention at 2 years, reintervention rates comparable with those of NA at 5 years, and the highest cumulative direct cost. Although not certain, this may be associated with this group having a worse initial PIP contracture. The NA had the lowest direct cost overall. More severe PIP joint contractures and younger age at time of initial intervention were predictive of reintervention after collagenase and NA. Fasciectomy has a high initial cost, but the lowest reintervention rate. Based on these findings, in our clinical practice, NA represents the least expensive minimally invasive option, and fasciectomy appears to be the more definitive treatment.

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