

# Dupuytren's disease: current state of the art

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## Abstract

**Background** This review article critically examines the current literature for Dupuytren's disease.

**Methods** Five procedures are considered: dermofasciectomy, limited fasciectomy, segmental aponeuroctomy, needle aponeurotomy, and collagenase injection. Studies regarding the efficacy of these treatments focus primarily on the initial degree of correction, rate of recurrence, and complications.

**Results** No one treatment has been declared superior and substantial controversy exists. Comparison between studies has been hampered by the absence of uniform definitions for clinical success and measurable disease progression. Traditional post-operative care includes formal therapy and night splinting, but recent studies have questioned the value of these adjuncts.

**Conclusion** The extent of involvement at which the surgeon should intervene was previously well accepted by convention, but as the paradigm shifts towards less invasive procedures, treatment may be offered at an earlier stage. Future research should be structured to recognize the value-based decision making used by patients when selecting treatment.

**Keywords** Dupuytren's disease · Dermofasciectomy · Limited fasciectomy · Segmental aponeuroctomy · Needle aponeurotomy · Collagenase injection

## Introduction

Dupuytren's disease (DD) is an inherited disorder (autosomal dominant with variable penetrance) that presents worldwide but is more prevalent with northern European ancestry [20]. A sample of 23,103 individuals, considered representative of the United States population, yielded a prevalence estimate of 1 % using physician diagnosis as the standard and 7 % using self-

reported features matching the appearance of DD [21]. Annual incidence was estimated to be 3 per 10,000 [21]. The incidence increases with advancing age, and DD is 4–6 times more common in males than females [30, 51]. In a sample of 1,177 patients, the most commonly involved digit was the small (49 %) followed by ring (32 %), noting 17 % bilateral involvement and only a single digit involved in 60 % [22].

The formation of nodules and cords progresses from an initial cellular proliferative stage, through an intermediate fibrocellular stage, to a terminal fibrotic stage [7]. Non-invasive treatments have yet to demonstrate efficacy in reversing or retarding disease progression, but surgery performed at an earlier, more cellular stage predicts a higher recurrence rate [7]. Based on the results of limited fasciectomy (LF) titrated against the morbidity of the procedure, consensus opinion has traditionally cited the threshold for intervention as the patient's perception of functional impairment plus metacarpophalangeal (MP) joint contracture of 30° or more and/or any degree of proximal interphalangeal (PIP) joint contracture [20]. As the treatment paradigm continues to shift towards less morbid procedures, the consensus for intervention may also shift.

## Definition of Terms

The terms Dupuytren's contracture and Dupuytren's disease are interchangeable and refer to the common clinical presentation familiar to hand surgeons. The term Dupuytren's diathesis refers to a subset of patients with a worse prognosis who were originally identified as having: early onset of disease, bilateral involvement, positive family history, and ectopic lesions. Subsequent studies using demographic variables to statistically predict worse outcomes have modified the diathesis to: plantar fibromatosis, Garrod's nodules (dorsal PIP fibromatosis), radial side involvement, early onset (<50 years of age), male sex, and the small finger requiring surgery [1, 30]. Normal fascial structures in the hand change name from band to cord once pathologically thickened and contracted. Longitudinal cords in the midline axis of the ray are termed "pre-tendinous" in the palm and "central" in the digit. "Nativity" cords are the pathological

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contractions of the former natatory ligaments at the margins of the web commissure. "Spiral" cords (contributions from the pretendinous cord, Grayson's ligament, and the lateral digital fascia) run longitudinally from midline proximal to lateral distal, deep to the neurovascular bundle and can displace the neurovascular bundles in a volar, midline, and distal direction as contraction progresses. Other notable cords are "retrovascular" within the digit and the "ADM cord" that runs from the abductor digiti minimi (ADM) to the middle phalanx, contracting both the MP and PIP joints of the small finger.

The term "recurrence" appearing in the Dupuytren's literature lacks a consistent definition and may be biologically inaccurate. Earlier treatments for DD approached the condition as if the nodules and cords were tumor formations. The capacity to form recurrent tumor is harbored in the altered DNA of incompletely excised tumor cells that are surrounded by cells with a normal genetic composition. By contrast, the genetic basis for DD is present in the DNA of all the patient's cells, and so it is not possible to surgically excise the medical condition from the patient's body. Use of the term "extension" to denote further cord formation outside the original surgical zone partially recognizes the problem. However, "extension" still implies that the new cord spread into the adjacent territory from the original site, like an infection spreading up the limb. There is no definitive evidence that the tissue previously excised (or not excised) directly influences worsening contracture. Until we can conclusively prove otherwise, we should assume that progressive cord formation is simply a further "expression" of the patient's inherent genetic capacity. This conceptual model is important because it translates directly into strategic treatment decision making. That said, the remainder of this article will report the literature findings using the same terminology chosen by the authors of the original work.

### Classification

The most commonly employed classification is from Tubiana, grouped by the initial total passive extension deficit (TPED — the sum of degrees by which the MP, PIP and DIP fall short of neutral, 0° extension): stage I (45° or less), stage II (46–90°), stage III (91–135°), stage IV (over 135°) [40]. While not denoted as formal classifications, other key features that readers of a study should note are: the percentage of patients with Dupuytren's diathesis, the ratio of males to females (higher recurrence rate for males), and the contribution to TPED coming from the MP joint vs. the PIP joint [51]. Two cohorts of patients, who appear to be matching populations with the same mean initial TPED, would actually be quite different if one group's TPED came primarily from the MP joint and the other group's primarily from the PIP joint since MP correction is much more successful than at the PIP. Given that the majority of the Dupuytren's literature consists of level IV studies, readers should remain attuned to key differences

between study populations when attempting to draw conclusions.

### Outcomes Data for Each Treatment Option

#### Dermofasciectomy

In dermofasciectomy (DF), full thickness skin grafts are planned from the outset, which permits the resection of dermal segments that are intimately bound to adherent cords. A well-accepted practice in revision Dupuytren's surgery, the role of DF in primary Dupuytren's surgery has yet to be defined. Based on the observation that new cords did not seem to form at sites of prior skin grafting, the anticipated benefit of DF over LF is a lower recurrence rate. At a mean of 5.8 years following DF, recurrence was seen in 11.6 % of 103 patients and 8.4 % of 143 digits [2]. In a second study, 90 digits in 67 patients experienced 8 % recurrence by 24–100 months following DF [29]. Thirty patients treated with an open palm technique (40 days to healing with a 50 % recurrence rate) were compared to 20 patients receiving a skin graft (28 days to healing with an apparent 0 % recurrence rate), but the study failed to provide a definition for the measurement of recurrence [43]. These case series portray the recurrence data as favorable; suggesting a role for DF in primary Dupuytren's. However, a prospective trial randomizing 90 digits in 79 fasciectomy patients to either a skin graft (13.6 % recurrence) or Z-plasty (10.9 % recurrence) found no statistically significant difference when followed up to 3 years [44]. In the setting of revision surgery, eight digits treated by DF with full thickness skin grafting went from a pre-operative total active motion (TAM) of 175° to a worse final TAM of 150° at a mean of 4 years [41]. In the same revision surgery study, 13 patients treated with fasciectomy and local flaps maintained improvement from the pre-operative TAM of 205° to a final TAM of 230°; the two groups were not comparable [41].

#### Limited Fasciectomy

LF, despite its title, is the most invasive primary Dupuytren's procedure in common practice today. The adjective "limited" distinguishes the removal of only the macroscopically diseased fascial tissues from the palm, as opposed to the, now abandoned, practice of "total" fasciectomy, where the entire palmar fascia was exenterated. LF encompasses many variations in surgical approach and wound closure techniques. The surgical objectives are the complete removal of the pathologic tissue and the maximum correction of contracture possible.

A prospective randomized trial of 100 fasciectomy patients found no difference between a longitudinal incision closed by Z-plasty (57° pre-operative to 24° post-operative) and a Bruner incision (56° pre-operative to 25° post-operative) [15]. Another prospective, pseudo-randomized study of open

fasciotomy (not fasciectomy) patients found recurrence in 2 years for 7/14 treated with direct closure and in 2/13 closed with a Z-plasty [14].

Particular attention should be given to the status of the PIP joint. A worse outcome in 37 patients followed at greater than a year correlated with a pre-operative PIP contracture greater than 60° but not the digit involved or the need for a capsuloligamentous release [36]. A prospective study found no statistically significant difference in final contracture at 6-month follow-up, 15° for the 32 patients without capsuloligamentous release of the PIP joint and 16° for the 11 patients with additional release [9]. Some have misinterpreted this study and others to conclude that there is no benefit to additional capsuloligamentous release. The 32 patients corrected their original mean 70° contracture to 2° intra-operatively by cord excision alone. Cord excision alone only permitted the 11 patients to go from 78° pre-operatively to 62° intra-operatively; additional capsuloligamentous release was required to achieve the mean intra-operative correction of 2° equal to the other group [9]. A different retrospective study of 42 PIP joints in 28 patients with initial contractures greater than 60° found no differences with or without the use of capsulectomy for intra-operative correction (7–8°), post-operative contracture (37°), and post-operative flexion (83–92°) [50]. The conclusion from both studies is the same: if a capsuloligamentous release is required to optimize PIP extension intra-operatively, it can be done without compromising the post-operative result.

### Segmental Aponeurectomy

Segmental aponeurectomy (SA) recognizes that the pathological cord of DD is not a tumor and that removal of all the identifiable cords cannot cure the patient of having DD. Further expression of the patient's fundamental genotype is an inherent feature of DD. Patients value a reduction in the contracture, but seek to minimize associated surgical morbidity, optimizing net functional gain. SA uses multiple small incisions, strategically targeted to remove those segments of the cord most responsible for the contracture while intentionally leaving behind the intercalary fragments [42]. The surgical objective is the degree of contracture correction, not the extent of tissue removal [37]. Eighty SA patients assessed at a minimum of 1 year demonstrated only a 6 % recurrence rate for well localized palmar cords [16]. In another study, a mean follow-up of 7.3 years for 261 SA patients found an overall complication rate of 26 % with a 7.7 % rate of nerve injury, noting worse results for recurrent disease and at the PIP joint [17].

### Needle Aponeurotomy

Needle aponeurotomy (NA) shares the same conceptual framework as SA in recognizing both the incurability of DD and the anticipated ongoing expression of the inherent genetic

trait. The surgical objective is purely the degree of contracture correction, as no pathologic tissue is removed from the body. SA removes some, but not all, of the pathologic tissue. LF seeks to remove all the pathologic tissue. Various authors report different techniques for NA, but all share: the lack of a formal scalpel incision, no visually controlled dissection of tissue planes, and reliance upon the sharp bevel of a needle (usually 25-gauge) to sever the pathologic cord at one or more locations [24]. One technique includes the injection of fat into the aponeurotomy sites [31].

The modern era of NA was largely heralded by the 2003 publication of 3.2 years follow-up on 100 patients treated with a 19-gauge needle, from distal to proximal, at an average of two release points per joint [27]. A mean total pre-operative contracture of 52° was reduced to 14° immediately, returning to 16° at final follow-up. A mean pre-operative MP contracture of 38° was reduced to 8° immediately, returning to 10° at final follow-up. A mean pre-operative PIP contracture of 26° was reduced to 11° immediately, returning to 17° at final follow-up. Overall, MP correction remained relatively successful with worse results at the PIP joint. The authors noted "recurrence" (without a specific definition) in 58 %, "extension" of disease activity in an additional 11 %, and a 24 % rate of revision surgery.

A large single surgeon NA series of 1,013 digits in 474 patients using a 5/8-inch 25-gauge needle achieved a minimum 3-year follow-up for 91 % of their patients [39]. NA was primarily directed at the MP joint (61 % of joints treated), less so the PIP joint (39 % of joints treated); releases were performed from proximal to distal, 5 mm apart. Patients were given a home exercise program and night splints for 4 months. A mean pre-operative MP contracture of 35° was reduced to 1° immediately, returning to 11° at final follow-up for a long-term correction of 72 %. A mean pre-operative PIP contracture of 50° was reduced to 6° immediately, returning to 35° at final follow-up for a long-term correction of 31 %. Worse results were obtained in patients under 55 years at the time of surgery. Complications included skin tears (3.4 %) and temporary neuropraxia (1.2 %), with only one nerve laceration in the series (0.1 %).

NA in 74 patients with an initial TPED of 62° yielded an early correction of 77 % to a TPED of 18° that, by 32 months, had recurred in 65 % of cases (defined as an increase of TPED by 30° or more) [47]. Two-year follow-up of 130 rays in 92 NA patients demonstrated an overall improvement of 42 % [40]. The authors found the same relative effect in final correction when separating the patients by Tubiana stage I (44 %), II (40 %), III (45 %), and IV (41 %). The same relative effect by stage was seen at 6 weeks post-operatively where the TPED dropped to roughly 1/3 of the original value but then doubled over the course of the next 2 years [40].

Forty seven NA patients were randomized to receive three triamcinolone injections (intra-operative, 6 weeks, and 3 months) or no injection [35]. No statistically significant

differences were seen in the total active extension deficit except for the PIP joint at the 6-month follow-up, the latest time point assessed.

NA was used to treat recurrent DD in 40 digits of 30 patients where the improvement from a mean initial TPED of 50° was 76 % overall, 93 % at the MP joint and 57 % at the PIP joint, with no differences between patients initially treated with NA or LF [48]. Fifty percent of patients demonstrated no recurrence during 4.4 years of follow-up, with the other 50 % recurring, on average, by 1.4 years (defined as an increase in 30° TPED). The overall prolongation in time before the need of a third total intervention was 2.9 years.

#### Collagenase Clostridium Histolyticum Injection

Just as NA cuts the cord at one or more locations without a scalpel incision, collagenase clostridium histolyticum (CCH) injection lyses the cord at one or more locations, avoiding any incision. Combined open-label multicenter studies of 879 joints (531 MP and 348 PIP) in 587 patients allowed up to three CCH injections per cord and defined clinical success as reduction in contracture to within 0° to 5° of full extension 30 days following the last injection [53]. Clinical success was achieved in 57 % of joints, 70 % MP (mean improvement 33°) and 37 % PIP (mean improvement 25°). Patients from five previous CCH studies were combined to assess the 3-year recurrence (defined as contracture worsening of 20° or more) in 623 joints (451 MP and 172 PIP) that had achieved the clinical success criteria of correction to 0° to 5° of full extension [38]. The study also assessed disease progression (defined as contracture worsening of 20° or more) in 301 joints previously injected with CCH that had not achieved clinical success. Previous clinical successes recurred 35 % overall, 27 % at MP and 56 % at PIP. Previous clinically unsuccessful CCH patients progressed 50 % overall, 38 % at MP and 62 % at PIP. Eight-year follow-up was obtained for six MP joints (57° pre-injection, 11° at 1 year, 23° at 8 years) and two PIP joints (45° pre-injection, 15° at 1 year, 60° at 8 years) [49].

A randomized, placebo-controlled, double-blind study of 35 patients resulted in up to three CCH injections being administered to 16 MP joints overall (12/14 "primary" cases initially corrected to within 5° of full extension from a contracture of 51°) and 14 PIP joints overall (9/9 "primary" cases initially corrected to within 5° of full extension from a contracture of 46°) [4]. Some question arises regarding the measurements that define clinical success. Photos used to depict exemplary results and labeled with the figure captions "normal with full range of motion" and "responded to 0°" clearly demonstrate that the captions are not accurate [3, 5]. One must wonder if other patients whose hands achieved the results depicted in the photos were scored as full corrections during data collection. Another prospective, randomized, placebo-controlled, double-blind study of 66 patients resulted in up to three CCH injections being administered to 45

digits (20 MP and 25 PIP) for an overall initial clinical success rate of 44.4 % (correction to 0° to 5° of full extension 30 days after the last injection) [28]. Successful corrections occurred in 13/20 MP joints (65 %) and 7/25 PIP joints (28 %).

No difference in efficacy was found for CCH injection comparing previously operated (422 hands) to unoperated (660 hands) cases, achieving a mean correction of 32° (75 %) in both groups at the MP joint [6]. At the PIP joint, correction averaged 24° (52 %) in operated hands and 26° (50 %) in unoperated hands.

#### Comparison Between Treatments by Each Outcome Measure

Hereafter, the three open-excision procedures (DF, LF, SA) will be discussed collectively. In general, drawing meaningful conclusions about treatment differences requires delving through the subtleties of the articles just presented. However, two systematic reviews have recently been published that yield overall results for initial correction, recurrence, and complications for NA and open fasciectomy, but not CCH injection [8, 18]. A third systematic review included CCH injection but reported only percentages for recurrence and complications with no data regarding treatment efficacy [13]. Heterogeneity in the source articles and the absence of agreed upon definitions substantially limit any conclusions for all three studies. The most useful treatment comparison to date comes in the form of 6-week and 5-year data from a randomized, prospective trial of LF and NA [45, 46]. No study has yet directly compared CCH injection to surgery.

#### Initial Correction

Initial correction may be the most important single variable to consider as a greater degree of initial correction has been shown to predict maintenance of correction [23]. The objective improvement in contracture can be quantified and reported by various means. The simplest measure is TPED. A critical point to keep in mind when reviewing TPED data is that the deficit is compared to neutral not to normal; a normal patient has hyperextension at the MP joint, some patients at the PIP joint. The problem encountered when comparing final TPED between level IV studies is heterogeneity in the study populations, both in terms of the initial severity of contracture as well as the relative proportion of MP to PIP contribution to TPED. Correction of PIP deficits has consistently proven less successful than MP deficits, and so a study population whose TPED numbers were primarily attributable to the MP will demonstrate more success than a group with advanced PIP contractures.

Another means of reporting initial correction is by the change in contracture. Some authors report change in absolute degrees of correction. Other authors report the percentage

change, which, in isolation, is one of the least comparable measures. To best compare studies regarding initial correction, one must consider at least three major outcome data points: change in TPED, final TPED, and the balance of MP to PIP contribution. A large sample of 1,177 patients showed that, although a near full correction is less likely to be achieved from a greater initial deformity, if achieved, the correction is more likely to be maintained [22]. A structured review of 46 European studies found contracture improvements ranging from 32° to 81° or 40 % to 97 % for fasciectomy (mean of 94 % at MP, 66 % at PIP) [18]. The same structured review identified contracture improvements ranging from 44° to 53° for NA, with a mean of 77 % correction (80 % at MP, 49 % at PIP) [18].

A randomized, prospective study of 166 rays found the mean percentage improvement in TPED to be statistically significantly better for LF (79 %) than for NA (63 %) at 6 weeks [45]. The statistical difference at 6 weeks was due to a better correction at the MP joint but without significance at the PIP joint. Also, there was no statistically significant difference for patients with Tubiana stage I or II disease (TPED <90°). No hand therapy was used for NA patients, but some LF patients received hand therapy. By 6 weeks, no NA patient had an active flexion deficit, but 19 of 78 LF patients had flexion deficits (two with deficits of greater than 1.5 cm tip to palm). Statistically significant differences were also found between groups for the DASH scores that, in NA patients, started at 16, rose to 19 by 1 week, and then fell to 12 by 2 weeks and 9 by 6 weeks. For LF patients, DASH scores started at 14, rose to 49 by 1 week and did not reach within the near pre-operative level of 16 until 5 weeks post-operatively. There were no major complications in the NA group; the LF group had three major complications of infection, hematoma, and digital nerve injury [45].

#### Rate of Recurrence/Time to Recurrence

Similar to assessment of initial correction, comparing level IV studies for rate of recurrence and time to recurrence is hampered by heterogeneity and inconsistent definitions. Although most authors are reporting the same statistic: the percentage of patients in the study that experienced recurrence by a certain time point (time point reported varies substantially between studies), the definition of recurrence has not been standardized. A systematic review of 69 articles found no agreed definition of recurrence and only 72 % of the papers even reported recurrence [8]. Variably, authors have cited recurrence for: any visible or palpable cord, increase in TPED of 20°, increase in TPED of 30°, and other observations. Further complicating the matter is often the lack of identification as to whether the cord responsible for increased TPED occurred at the site of the prior surgery or at a different site. This site specificity is part of the problem in distinguishing between "recurrence" and "further disease expression" and is germane to interpreting the effectiveness of the interventions.

A randomized, prospective study demonstrated the 5-year recurrence data (defined as a worsening in TPED of 30°) for 115 hands to be statistically significantly better for LF (20.9 %) than NA (84.9 %); still the patients preferred NA [46]. A recent systematic review identified the range of recurrence rates to be 12–39 % for fasciectomy, 50–58 % for NA, and 10–31 % for CCH injection [13]. Recurrence may be difficult to predict as one study of 103 patients followed to a mean of 4 years found an overall 50 % recurrence (20 % in the first 6 months) that could not be predicted by: sex, age at onset, number of operations, heredity, diabetes, or six different immunohistochemical markers [52].

#### Complications

Surgeons abandoned the original total palmar fasciectomy, not because the operation failed to achieve improvement in the contracture, but due to the excessive morbidity of the additional dissection. The current trend is to seek even less invasive treatments than the well-accepted LF, presumably to realize the benefits of fewer or less severe complications. Comparison between treatments on the basis of complications is inherently problematic. Each author is left to determine what threshold of abnormality is scored as a true complication. The two most common categories are wound healing and nerve injury. One study may count transient paresthesias as a complication whereas another may only recognize complete transection of a digital nerve as a complication.

Mailed questionnaire responses from 1,177 fasciectomy patients identified a 46 % self-reported complication rate, including 36 % numbness, 19 % wound infection, 12 % circulatory disturbance, and 9 % reporting a worse deformity than pre-operative [22]. The incidence of each complication increased with greater initial deformity. Complications were identified in 46 of 253 fasciectomy patients at a mean of 3.6 years, 35 patients with a single complication and 11 with multiple [11]. Complications included nerve laceration (2.0 %), infection (9.6 %), skin slough (2.4 %), and sympathetic dystrophy (2.4 %). An interesting and unexpected finding was no difference between primary surgery (17.8 %) and revision surgery (19.3 %). A structured review of the literature found an equal rate (20 %) of adverse events in fasciectomy and fasciotomy patients [18]. A 20-year review of the literature specifically for complications found reported rates to range from 3.6 % to 39.1 %, with major complications accounting for 15.7 % (nerve injury 3.4 %, infection 2.4 %, hematoma 2.1 %, CRPS 5.5 %, flare reaction 9.9 %, and wound healing problems 22.9 %) [19]. Complications associated with CCH are primarily injection site flare reactions (97 %), skin tears (9–15 %), and a 1 % major complication rate including CRPS and flexor tendon rupture [13, 32]. The chief complication of NA is a skin tear (9–25 %) [13].

## Cost-effectiveness

The ratio of contracture improvement titrated against the morbidity of the procedure is one type of value analysis patients make when selecting Dupuytren's treatment. As an ever increasing percentage of the total cost of care is allocated to the patient instead of the insurance company or government, patients are making another type of value analysis titrating contracture improvement against hard-earned dollars. The cost-effectiveness of open partial fasciectomy, NA and collagenase injection was studied using a threshold of \$50,000 per quality-adjusted life years (QALY) gained [12]. The cost of open partial fasciectomy was \$820,114 per QALY gained compared to no treatment. The cost of collagenase injection was \$166,268 per QALY gained at current pricing for the injection, falling to \$49,995 per QALY if the injections were to be priced at \$945. NA, assuming a lower success rate, was \$96,474 per QALY, falling to \$49,631 if more successful. This type of analysis requires numerous assumptions but produces data that at least demonstrates relative value between the treatments. It is interesting to note by what a large margin the costs of open partial fasciectomy outstripped the less invasive treatments considering that LF is still called the "gold standard" for treatment of DD by most authors [20]. With the clinical course for LF well established, its cost is not likely to change. With refinement of surgical technique and efficiency in care delivery, the success rate of NA will likely improve to bring the cost per QALY under \$50,000. The charges for a CCH injection could always be lowered by the vendor to meet the same criteria.

## Post-operative Care

LF of several adjacent digits, no matter how precisely or delicately performed, leads to a fair degree of swelling and pain-induced motion limitation. Patients have traditionally been sent to formal outpatient therapy and prescribed a night time composite extension splint for up to 4 months. Like many treatment paradigms in medicine, formal therapy and splinting were based more on tradition than well-controlled studies. With the advent of less invasive treatment, the need for both therapy and splinting has been questioned. A retrospective analysis of 76 patients could find no benefit to using a post-operative splint [25]. Another retrospective study of 268 patients concluded that no tension applied post-operatively resulted in a lower incidence of flare reaction, less scarring and better range of motion [26]. A multi-center, randomized, controlled trial of no splinting vs. 6 months of night splinting in 148 patients with a 12-month follow-up found no difference in outcome when measuring DASH score (mean 7), total active flexion (225°), total active extension deficit (30°), and patient satisfaction [34].

## Putting It All Together

A recent systematic review reached a familiar conclusion, that the evidence did not support clear superiority of one treatment over another based on degree of initial correction and percentage recurrence [8]. However, treatment selection should be value-based and take into consideration complications, cost of care (both direct medical and indirect lost productivity costs), and patient satisfaction. Overall satisfaction with the course of care is extremely difficult to measure, but more quantifiable tools, such as DASH scores, may serve as proxy. In 69 patients, DD surgery reduced the TPED by a mean of 68° and the Quick DASH by a mean of 7.14 points, but the change in Quick DASH did not correlate with the change in TPED [10]. An average pre-operative DASH score of 16 in 154 DD patients showed weak to no correlation to their degree of contracture [33]. Nonetheless, some conclusions can be drawn from the literature as a whole:

- Non-incisional treatments (NA, CCH) have a lower complication rate than fasciectomy
- Fasciectomy achieves greater initial correction than non-incisional treatments (NA, CCH)
- Greater degrees of initial correction correlate with lower recurrence rates
- Greater initial correction is more likely from a lesser initial contracture (Tubiana stage I and II)
- Initial correction and recurrence data are superior for the MP joint compared to the PIP joint across all treatments and initial degrees of severity

## Summary

LF remains the treatment standard against which all others are to be measured. Comparison has largely been by the degree of initial correction followed by the rate and extent of recurrence. Using only these objective measures, from a research scientist's point of view, LF performs better than the less invasive treatments of NA and CCH injection. From a public health accountant's point of view, the cost of LF is prohibitive relative to QALYs gained, as is CCH injection at its current pricing. From a patient's point of view, the degree of correction and time to recurrence are important, but the complications and other experiences associated with receiving treatment may carry even more weight. In clinical practice, patients have demonstrated a proclivity to select less invasive treatments, even when fully informed of the inferior data regarding correction and recurrence. This type of value-based decision making is likely to continue in the future, with the corresponding need for improved study design in DD research. The objective measures require uniform standards and reporting criteria. More difficult to quantify and formally

study will be the subjective overall satisfaction with receiving the course of care, and yet it is this experience that motivates patients to undergo further treatment or suggest the same to their friends and family members.

**Statement of Human and Animal Rights** The article is a review of a topic and, as such, the statement of human and animal rights is non-applicable to this submission.

**Conflict of Interest Disclosure** MH declares that he has no conflict of interest.

**Statement of Informed Consent** The article is a review of a topic and, as such, the statement of informed consent is non-applicable to this submission.

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