A systematic review of outcomes of fasciotomy, aponeurotomy, and collagenase treatments for Dupuytren's contracture

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Abstract

Background Needle aponeurotomy and collagenase injection are alternative treatments of Dupuytren's contracture to open partial fasciectomy; however, reported data are difficult to interpret without a formal systematic review.

Methods A Medline, EMBASE, and Cochrane database search was performed, and 277 articles were identified. Articles were stratified by level of evidence, and those of the highest level for each technique were included. Evidence available for needle aponeurotomy was of low quality so only cohorts larger than 100 patients were included.

Results The sample size of patients for open partial fasciectomy ranged from 37–261. The recurrence rate ranged from 12–39%, with mean follow-up time of 1.5–7.3 years. The complication rate ranged from 14–67%. Complications included nerve division (2–5%), infection (4–12%), neurapraxia (0.4–52%), and regional pain syndrome (2–13%). For needle aponeurotomy the sample size

ranged from 117–211. The recurrence rate ranged from 50–58%, with mean follow-up time of 3–5 years. With regard to collagenase injection, the sample size ranged from 13–204. The recurrence rate ranged from 10–31%, with mean follow-up time of 120 days to 4 years. For the two latter procedures, adverse effects consisted primarily of skin tears (9–25%). Kruskal–Wallis testing demonstrated that the recurrence rate was significantly higher for needle aponeurotomy than for open partial fasciectomy ($p=0.001$), and the recurrence rate was significantly higher for open partial fasciectomy than for collagenase injection ($p=0.001$).

Conclusions The recurrence rates and types of complications differ between open partial fasciectomy and needle aponeurotomy or collagenase injection. Long-term outcomes have not been well reported.

Keywords Systematic review · Dupuytren's contracture · Complications · Outcomes · Evidence

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Introduction

Dupuytren's contracture is a common disease for which traditional management has consisted of observation, fasciotomy, or fasciectomy. These management techniques have been in evolution, and new innovations have arisen such as needle aponeurotomy and collagenase injection. With the growing interest in these new treatments, it is important to understand the outcomes of these techniques when compared to the more established techniques such as fasciotomy or partial fasciectomy. The complications associated with each of these procedures may be markedly different for the open surgical procedures when compared to cutting cords percutane-

ously or injecting enzyme into a cord. The comparative effectiveness emphasis in American healthcare demands new technologies to be compared to the traditional approaches in a critical appraisal [13].

There is a large body of literature regarding the management of Dupuytren's contracture; however, the literature describes various techniques, and there is much heterogeneity in the results. Consequently, the understanding of outcomes and complications of Dupuytren's contracture treatments are confounded by the sheer volume of lesser-quality data mixed in with the higher-quality data. Recently, a systematic review by Becker et al. found that the recurrence rate for Dupuytren's ranges from 20% to 80% for all interventions that have been reported in the literature to date [6]. Although this type of general review helps characterize the global literature, it does not segregate data by intervention type, length of follow-up, or quality of data.

The specific aim of this study is to perform a systematic review of the highest level of evidence studies available on the outcomes and complications of various treatments for Dupuytren's contracture by focusing on fasciectomy, needle aponeurotomy, and collagenase injection.

Methods

We performed a search of the English and non-English articles using Medline, EMBASE, and the Cochrane Database of Systematic Reviews published from September 1, 1960 until December 1, 2010. A hand search of the past 6 months was performed to include any articles that had not yet been electronically registered in their respective databases. Four search fields were used (results subsequently listed): "Dupuytren's" AND "fasciectomy" (Medline=138, EMBASE=201, and Cochrane=0); "Dupuytren's" AND "aponeurotomy" (7, 10, 0); "Dupuytren's" AND "fasciotomy" (36, 106, 1); and "Dupuytren's" AND "collagenase" (24, 19, 0). Duplicate listings were eliminated, resulting in a total of 277 peer-reviewed articles. An additional bibliography hand search resulted in 12 more articles, resulting in a total of 289 articles. Twenty-one basic science articles, 21 case reports, and 56 review articles were excluded. Articles

were then segregated by level of evidence as prescribed by the Centre for Evidence-Based Medicine (Oxford, U.K.) using information from the abstract or from the article text (Table 1). There were 9 level I, 14 level II, 11 level III, 124 level IV, and 33 level V articles (Fig. 1). These studies were reviewed by three independent surgeons (N.C.C., R.C.S., and K.C.C.).

Procedures of interest were predefined as: (1) open partial fasciectomy, (2) percutaneous needle aponeurotomy, and (3) collagenase *Clostridium histolyticum* injection. Criteria for exclusion were: (1) adjunct pharmacologic therapy to the primary procedure, (2) adjunct external fixation, and (3) concomitant procedures that do not directly address cord release. To better refine our final lists of articles for review, we used a hierarchical system of study inclusion: The highest-level evidence available to a particular technique was included. Levels I and II data were available for open partial fasciectomy and collagenase injection; however, for needle fasciotomy, only levels III and IV data were available. In the case of level IV data, only series with cohorts larger than 100 patients were included. The quality of the study was not evaluated other than the classification of level of evidence based on evidence-based guidelines.

Study characteristics included numbers of patients in the study, gender, and age. Outcomes recorded included length of follow-up, major complications (nerve division and arterial division), minor complications (neurapraxia, wound complications, infection, and complex regional pain syndrome or reflex sympathetic dystrophy), and recurrence.

Statistical analysis was performed on reported recurrence rates. Because the data were not normally distributed, a Kruskal–Wallis test was performed. Post hoc testing between groups was performed with a Mann–Whitney *U* test. In the Kruskal–Wallis and Mann–Whitney *U* test, results are ranked and then statistical analysis is performed on groups of rankings. If there is a tie, an adjustment to the test statistic must be performed. The *H* test statistic in this study included an adjustment that corrected for the number of ties. Significance was defined as $p < 0.05$. Analysis was not performed on other outcomes because of the variability in reporting.

Table 1 Levels of evidence

Level	Therapeutic studies	Prognostic studies
I	High-quality randomized controlled trial	High-quality prospective study
II	Lesser-quality randomized controlled trial	Retrospective study
	Prospective comparative study	Lesser-quality prospective study
III	Retrospective comparative study	Case–control study
IV	Case series	Case series
V	Expert opinion	Expert opinion

Fig. 1 Method used in the search of English and non-English articles using Medline, EMBASE, and the Cochrane Database of Systematic Reviews

Results

Study Characteristics

Six studies on open partial fasciectomy met the inclusion criteria. Two studies were prospective, therapeutic randomized studies (level I), and four were prognostic studies based on retrospective data (level II) [5, 7–9, 12, 14, 16]. There was variation with regard to how wounds were managed after fasciectomy. Four studies utilized Z-plasty for skin management whereas two performed dermatofasciectomy with local wound care.

Three studies describing needle aponeurotomy met the inclusion criteria [4, 10, 17]. One study was a comparative study with a needle aponeurotomy arm (level III), and two studies were retrospective cohort studies (level IV). All three studies were of European origin. Although these studies were of a lower level of evidence, the aponeurotomy technique described in each paper was more

uniform than the open partial fasciectomy or collagenase injection studies.

Four studies describing collagenase injection met the inclusion criteria [1–3, 11]. Two studies were prospective, double-blind, placebo-controlled randomized studies (level I), and two were prognostic, prospective studies (level II). Mean follow-up ranged from 120 days to 4 years. The study with 120-day follow-up was intended to examine complications and the success rate of injection. The injection concentration varied among studies, ranging from 2,500 U to 10,000 U. Patients initially treated with a placebo in the 2007 Baldamente et al. study were enrolled in an open label phase after the initial injection series [2].

The study samples of all the included studies were relatively homogeneous. Study subjects were predominantly male, and the mean age among the three groups of studies was similar, ranging from 55 years to 67 years. The length of follow-up was variable. The shortest follow-up was 6 weeks whereas the longest follow-up time was 7.3 years (Table 2).

Table 2 Study characteristics

	Open partial fasciectomy	Needle aponeurotomy	Collagenase injection
Patient demographic data			
Age range (years)	55 to 67	58 to 65	61 to 65
% Male	78 to 86	82 to 88	79 to 91
Study characteristics			
Level of evidence	I to II	III to IV	I to II
Number of patients	37 to 261	117 to 211	13 to 204
Follow-up range	1.5 to 7.3 years	6 weeks to 5 years	120 days to 4 years

Outcomes

Recurrence rates reported are highly dependent on the time of follow-up examination, percent loss to follow-up, and definition of recurrence. Despite this heterogeneity, the recurrence rate was relatively consistent for each intervention with occasional outliers (Table 3). Kruskal–Wallis testing for the three groups demonstrated that the recurrence rates between groups were significantly different (adjusted H , 18.69; $p=0.001$). Post hoc Mann–Whitney U testing demonstrated that the recurrence rate after open partial fasciectomy was significantly less than that of needle aponeurotomy (adjusted H , 17.25; $p=0.001$). The recurrence rate after open partial fasciectomy was significantly greater than that of collagenase injection (adjusted H , 14.95; $p=0.001$).

Extension was defined individually by each study, but in general, means the progression of the Dupuytren's contracture beyond the immediate area of intervention. Data regarding extension were more commonly reported for open partial fasciectomy as the length of follow-up was generally longer, and it is a concept that is established in the surgical literature, but may not be as well codified in the rheumatologic literature.

In general, the complications of open partial fasciectomy are different than those of collagenase injection or needle

aponeurotomy; however, it is important to note that complications of complex regional pain syndrome were reported in both procedures, and tendon rupture was reported in two patients who received a collagenase injection (Table 4). The definition of complex regional pain syndrome is variable among practitioners and may explain the high rate of 13% in the study by Citron et al. [8].

Discussion

There are copious amounts of published data on Dupuytren's contracture, to the point in which the sheer volume is difficult to interpret. In order to make this data accessible, we systematically reviewed all peer-reviewed publications available in three electronic databases, hierarchically filtered data by level of evidence guidelines and then performed data extraction by three independent reviewers.

Advantages of this methodology are that studies with lower quality data—either through collection methods, bias, or smaller cohorts—are eliminated. Ultimately, the data presented are distilled into a form that is more readily processed. Disadvantages are that this methodology excludes studies that contain important clinical information but do not meet the primary inclusion based on the level of evidence classification. There are large cohorts with long-term follow-up reported in textbooks that by definition are not peer-reviewed and cannot be included. In addition, comparison of extracted data is limited because the data collection process varies among studies.

The greatest limitation of this systematic review is the quality of the existing literature.

Few articles report validated patient-rated outcomes, and most articles center on digital range of motion as an outcome. The length of follow-up time is limited, which can affect the recurrence data.

Open partial fasciectomy is the most common treatment for Dupuytren's contracture. Fasciectomy involves excising the diseased fascial structures; however, there are various methods of addressing adjacent tissues, including using skin grafts, healing by secondary intention, and alternative incisions, and wound management techniques. In severe cases, fusion of the proximal interphalangeal (PIP) joint has been described. Open fasciotomy has been used as an alternative, but enthusiasm for it has diminished because of the higher recurrence rate. In Europe, needle aponeurotomy has gained popularity in the rheumatology literature because of its relatively lower morbidity and success for certain indications.

More recently, there has been an increased interest in collagenase injection for the treatment of Dupuytren's contracture. The procedure involves injecting collagenase into the diseased cord and then applying force to the

Table 3 Recurrence rates

Study	Recurrence	Extension ^a
Open partial fasciectomy ^{b,c}		
Balauget et al. [5]	31%	16%
Bulstrode et al. [7]	30%	nr
Citron and Nunez [8]	27%	9%
Coert et al. [9]	nr	nr
Misra et al. [12]	0%	nr
Rombouts et al. [14]	39%	32%
Ullah et al. [16]	12%	nr
Needle aponeurotomy ^b		
Badois et al. [4]	50%	nr
Foucher et al. [10]	58%	11%
van Rijssen et al. [17]	nr	nr
Collagenase injection ^c		
Badalamente et al. 2000 [1]	10%	nr
Badalamente et al. 2002 [3]		
Cohort 1	12%	nr
Cohort 2	31%	nr
Badalamente et al. 2007 [2]	15%	nr
Hurst et al. 2009 [11]	nr	nr

nr not reported

^a Progression of disease beyond initial area

^b Different recurrence rates ($p=0.001$)

^c Different recurrence rates ($p=0.001$)

Table 4 Complications

Study	Nerve division	Neurapraxia	Infection	CRPS	Skin tear
Open partial fasciectomy					
Balauget et al. [5]	nr	nr	nr	nr	nr
Bulstrode et al. [7]	2%	0.4%	9%	2%	2%
Citron et al. [8]	5%	0	0	13%	nr
Coert et al. [9]	nr	8%	4%	5%	nr
Misra et al. [12]	3%	0	8%	0%	nr
Rombouts et al. [14]	nr	nr	nr	nr	nr
Ullah et al. [16]	0%	52%	12%	3%	nr
Needle aponeurotomy					
Badois et al. [4]	nr	2%	2%	nr	16%
Foucher et al. [10]	0.4%	2%	nr	0.4%	9%
van Rijssen et al. [17]	nr	3%	nr	nr	25%
Collagenase injection					
Badalamente et al. 2000 [1]	nr	nr	nr	nr	nr
Badalamente et al. 2002 [3]					
Cohort 1	nr	nr	nr	nr	9%
Cohort 2	nr	nr	nr	nr	nr
Badalamente et al. 2007 [2]	nr	nr	nr	nr	15%
Hurst et al. 2009 [11]	nr	nr	nr	0.3%	10.8%

nr not reported, CRPS complex regional pain syndrome

contracted digit to facilitate rupture of the cord. Initial results have shown promise; however, there is limited long-term follow-up. Watt et al. describe eight patients from the phase II clinical trial of collagenase injection [18]. Although this study did not meet the criteria for inclusion, six of the eight patients had recurrence of contracture. Collagenase injection is growing in popularity and appears to have some advantages over needle aponeurotomy in the literature to date. It is important to remember that this data continue to evolve, and the results may be different as more long-term follow-up becomes available.

Other areas of future research for Dupuytren's contracture include further reporting of long-term outcomes specific to individual techniques and with careful segregation of MP and PIP joint contractures. Strictly assessed, double-blind prospective studies are needed to compare interventions. To supplement these studies, there is a large need for methods to evaluate outcomes of Dupuytren's surgery beyond range of motion measurements, and the responsiveness of current outcome measures should be evaluated.

In addition, there is a need for studies dedicated to revision procedures. Rouch et al. reported the only major series dedicated to revision fasciectomy [15]. It is unclear whether needle aponeurotomy or collagenase injection can be used in the revision of Dupuytren's management. Open partial fasciectomy after collagenase injection could potentially be equally or more difficult than revision fasciectomy. On the other hand, judicious collagenase injection may be worthwhile to treat recurrence after open partial fasciectomy.

A previous systematic review has been performed by Becker et al. [6]; however, our study is substantively different in that it uses stringent criteria for inclusion, stratifies data by treatment, and performs statistical analysis with the numbers available. This methodology has specific advantages in understanding the existing data. By isolating the highest quality data available for these Dupuytren's interventions, it provides some base data to populate decision models for cost-effectiveness or cost-utility analyses. Decision analysis may play a useful role in using current data to approach Dupuytren's contracture in light of different treatment modalities. The utilities of the various treatments after Dupuytren's contracture have not been studied. The data presented from this systematic review could be used to develop a decision tree and subsequently a cost-effectiveness or cost-utility analysis. The costs of the procedure, pharmaceuticals, and rehabilitation vary widely among open surgery, needle aponeurotomy, and injection. Moreover, the complications have associated costs. Decision analysis can help choose which one of these interventions may provide the most societal benefits in light of the rates of recurrence and complications.

This systematic review identified the highest-level evidence available and from this data, needle aponeurotomy has a significantly higher recurrence rate than open partial fasciectomy, and partial open fasciectomy has a significantly higher recurrence rate than collagenase injection. In addition, the types of complications of open partial fasciectomy are substantively different than those of needle aponeurotomy and collagenase injection. Future studies should continue to focus

on the long-term outcomes of each intervention and additional treatment procedures required after recurrence.

References

1. Badalamente MA, Hurst LC. Enzyme injection as nonsurgical treatment of Dupuytren's disease. *J Hand Surg Am*. 2000;25:629–36.
2. Badalamente MA, Hurst LC. Efficacy and safety of injectable mixed collagenase subtypes in the treatment of Dupuytren's contracture. *J Hand Surg Am*. 2007;32:767–74.
3. Badalamente MA, Hurst LC, Hentz VR. Collagen as a clinical target: nonoperative treatment of Dupuytren's disease. *J Hand Surg Am*. 2002;27:788–98.
4. Badois FJ, Lermusiaux JL, Masse C, Kuntz D. Non-surgical treatment of Dupuytren disease using needle fasciotomy. *Rev Rhum Ed Fr*. 1993;60:808–13.
5. Balaguer T, David S, Ihrat T, Cardot N, Daideri G, Lebreton E. Histological staging and Dupuytren's disease recurrence or extension after surgical treatment: a retrospective study of 124 patients. *J Hand Surg Eur*. 2009;34:493–6.
6. Becker GW, Davis TR. The outcome of surgical treatments for primary Dupuytren's disease—a systematic review. *J Hand Surg Eur*. 2010;35:623–6.
7. Bulstrode NW, Jemec B, Smith PJ. The complications of Dupuytren's contracture surgery. *J Hand Surg Am*. 2005;30:1021–5.
8. Citron ND, Nunez V. Recurrence after surgery for Dupuytren's disease: a randomized trial of two skin incisions. *J Hand Surg Br*. 2005;30:563–6.
9. Coert JH, Nerin JP, Meek MF. Results of partial fasciectomy for Dupuytren disease in 261 consecutive patients. *Ann Plast Surg*. 2006;57:13–7.
10. Foucher G, Medina J, Navarro R. Percutaneous needle aponeurotomy: complications and results. *J Hand Surg Br*. 2003;28:427–31.
11. Hurst LC, Badalamente MA, Hentz VR, et al. Injectable collagenase *Clostridium histolyticum* for Dupuytren's contracture. *N Engl J Med*. 2009;361:968–79.
12. Misra A, Jain A, Ghazanfar R, Johnston T, Nanchahal J. Predicting the outcome of surgery for the proximal interphalangeal joint in Dupuytren's disease. *J Hand Surg Am*. 2007;32:240–5.
13. Mushlin AI, Ghomrawi H. Health care reform and the need for comparative-effectiveness research. *N Engl J Med*. 2010;362:e6.
14. Rombouts JJ, Noel H, Legrain Y, Munting E. Prediction of recurrence in the treatment of Dupuytren's disease: evaluation of a histologic classification. *J Hand Surg Am*. 1989;14:644–52.
15. Roush TF, Stern PJ. Results following surgery for recurrent Dupuytren's disease. *J Hand Surg Am*. 2000;25:291–6.
16. Ullah AS, Dias JJ, Bhowal B. Does a 'firebreak' full-thickness skin graft prevent recurrence after surgery for Dupuytren's contracture?: a prospective, randomised trial. *J Bone Joint Surg Br*. 2009;91:374–8.
17. van Rijssen AL, Gerbrandy FS, Ter Linden H, Klip H, Werker PM. A comparison of the direct outcomes of percutaneous needle fasciotomy and limited fasciectomy for Dupuytren's disease: a 6-week follow-up study. *J Hand Surg Am*. 2006;31:717–25.
18. Watt AJ, Curtin CM, Hentz VR. Collagenase injection as nonsurgical treatment of Dupuytren's disease: 8-year follow-up. *J Hand Surg Am*. 2010;35:534–9. 9.e1.