Patterns of Recontracture After Surgical Correction of Dupuytren Disease

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Purpose To study the evolution of deformity of the proximal interphalangeal joint over 5 years after good surgical correction of Dupuytren-induced contracture.

Methods We assessed 63 patients (72 fingers; 69 hands) with Dupuytren disease for the degree of contracture, its correction after surgery, and the range of movement at the proximal interphalangeal joints at 3 and 6 months, and 1, 3, and 5 years after fasciectomy with or without the use of a firebreak graft. We investigated associations between the recurrence of contracture and preoperative patient and surgical factors.

Results There were 4 patterns of evolution of contracture after surgical correction. A total of 31 patients (33 hands) showed good improvement that was maintained for 5 years (minimal recontracture group). Twenty patients (23 hands) showed good initial improvement, which mildly worsened ($< 20°$) but was then maintained over 5 years (mild early recontracture group). Four patients (5 hands) worsened in first 3 months after surgery ($> 20°$) but there was no further worsening (severe early recontracture group). Eight patients (8 hands) worsened progressively over 5 years (progressive recontracture group). Worsening of contracture more than 6° between 3 and 6 months after surgery predicted progressive recontracture at 5 years.

Conclusions Recurrence of contracture (not disease recurrence) could be predicted as early as 6 months after surgery for Dupuytren disease. *(J Hand Surg 2013;38A:1987–1993. Copyright © 2013 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Disability, deformity, Dupuytren disease, recurrence, outcome.

Recurrent contracture of the proximal interphalangeal (PIP) joint after good initial correction for Dupuytren disease is unpredictable. The PIP joint can contract after surgery as a result of either to recurrent Dupuytren disease or postoperative scarring or joint contracture. Authors have previously discussed patterns of recontracture after surgery for Dupuytren disease. Hueston[1] reported 3 patterns of recurrence after surgical correction based on age distribution. He found 62 of 224 cases (27%) had reappearance of new Dupuytren tissue within the area cleared at operation in the little finger, but only 24 cases (11%) developed progressive deformity. The author described the early recontracture and late extension of disease in this personal examination and focused on the rate and the age distribution of recurrence.

Ritchie et al[2] noticed mild and severe patterns of recontracture after fasciectomy and sequential release of the PIP joint of the little finger. Of 19 fingers, 8 achieved full correction by fasciectomy with little further worsening over 3 years. Of the remaining 11 fingers, 9 had severe initial PIP joint contracture, which reduced with capsulo-ligamentous release, but the contracture recurred within 3 months and then remained

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stable up to 3 years. Misra et al[3] also studied the recontracture pattern after limited Dupuytren fasciectomy in 49 PIP joints in 37 patients over a 4-year period.

In the present study, we investigated the patterns of evolution of finger deformity more than 5 years after surgery. We also looked for associations between the recurrence of contracture and preoperative patient and surgical factors, and investigated whether and when the recurrence of finger contracture could be predicted.

MATERIALS AND METHODS

We initially recruited 82 patients with primary Dupuytren contracture of PIP joint greater than 30°, including those with several affected fingers in the same hand. A total of 63 patients (72 fingers; 69 hands) returned for follow-up at 5 years, and these are reported in this article. Patients were excluded preoperatively if they had previous surgery on the affected hand, were unable to complete the questionnaire, were unable to give consent, were unable to attend follow-up, or were receiving anticoagulation therapy, because bleeding under a graft would increase the risk of failure.

We have previously reported this group of patients in a randomized study comparing fasciectomy with or without firebreak graft[4] for Dupuytren contracture of the PIP joint. The degree of recontracture of the PIP joints of the operated fingers was similar in the 2 groups, and both were comparable in terms of demographics, grip strength, range of movement, and disability. Progressive recontracture of the PIP joint over the 3 years was seen in 11 fingers (12%). Five had a fasciectomy with z-plasty, and their contracture recurred within 5 months, compared with 8 months for those with a full-thickness skin graft ($P = .600$). We combined the 2 previous groups because there was no evidence of a difference between them based on the randomized trial at 3 years. These patients were further reviewed at more than 5 years after surgery to investigate the patterns of evolution of finger deformity.

The local ethics committee approved the study and the protocol was carefully explained to the patients, who were also given an information sheet. They provided written and specific consent that was confirmed on admission. One of the senior authors (J.J.D. or B.B.) operated on all patients. The procedure steps were agreed upon beforehand. Our method has been described previously.[4] The finger was explored by a longitudinal incision under tourniquet control. All fibrous bands and nodules were identified and recorded before excision. Of the 72 fingers, 10 (14%) required checkrein ligament release, but none of the remaining fingers required tendon sheath or palmar capsule release. After correction of the contracture, a z-plasty was performed. In half of the patients, at random, a full-thickness fenestrated skin graft (firebreak graft) was sutured in place with 5-0 Vicryl Rapide (Ethicon, Livingston, UK). A compressive bandage with a plaster-of-paris slab was applied for a week. The hand was elevated in a sling overnight, and patients were then discharged. All patients received an identical supervised program of hand therapy with use of removable thermoplastic splint only at night for 3 months.

A single observer assessed the degree of initial joint contracture, its correction, and the range of movement at the metacarpophalangeal and PIP joints preoperatively. Recontracture was measured in the operated digits at 3 and 6 months, and 1, 3, and more than 5 years after correction using a finger goniometer. Because of the difference in interventions, it was not possible to mask the study protocol from the observer, who did not perform the surgery. We scored the functional outcome using the Patient Evaluation Measure (PEM),[5] and any postoperative complications were recorded. The higher the score on the PEM, the greater is the disability. All measurements were recorded on a standardized optical mark recognizable *pro forma*. The postoperative evolution of the PIP joint contracture and PIP joint flexion (means and standard error of the mean [SEM]) was plotted against time (Figs. 1, 2).

When distribution of PIP joint finger contracture in the patients was represented graphically with a smoothed spline histogram, it revealed 4 peaks at 6 months (Fig. 3). It prompted further study of these patterns over time, and this distribution was maintained for 5 years (Fig. 1). These 4 peaks represent the 4 patterns of recontracture. We also investigated whether there was an association between recurrence of deformity and preoperative PEM, demographic data, preoperative PIP joint contracture, operation time, and disease duration.

Most conventional statistical analyses cannot be used when studies involve multiple hands, digit, rays, or joints rather than patients, because they violate the assumption that observations are independent.[6] Because there were 63 patients, 69 hands, and 72 fingers, we used generalized estimating equations to assess associations between recurrence and factors related to recurrence (eg, bilateral involvement, family history, diabetes, epilepsy, smoking, alcohol intake [units/wk]). The Jonckheere-Terpstra test was used to investigate the relationship between the recurrence of deformity and parameters such as age, preoperative PEM, preoperative PIP joint contracture, duration of disease, and

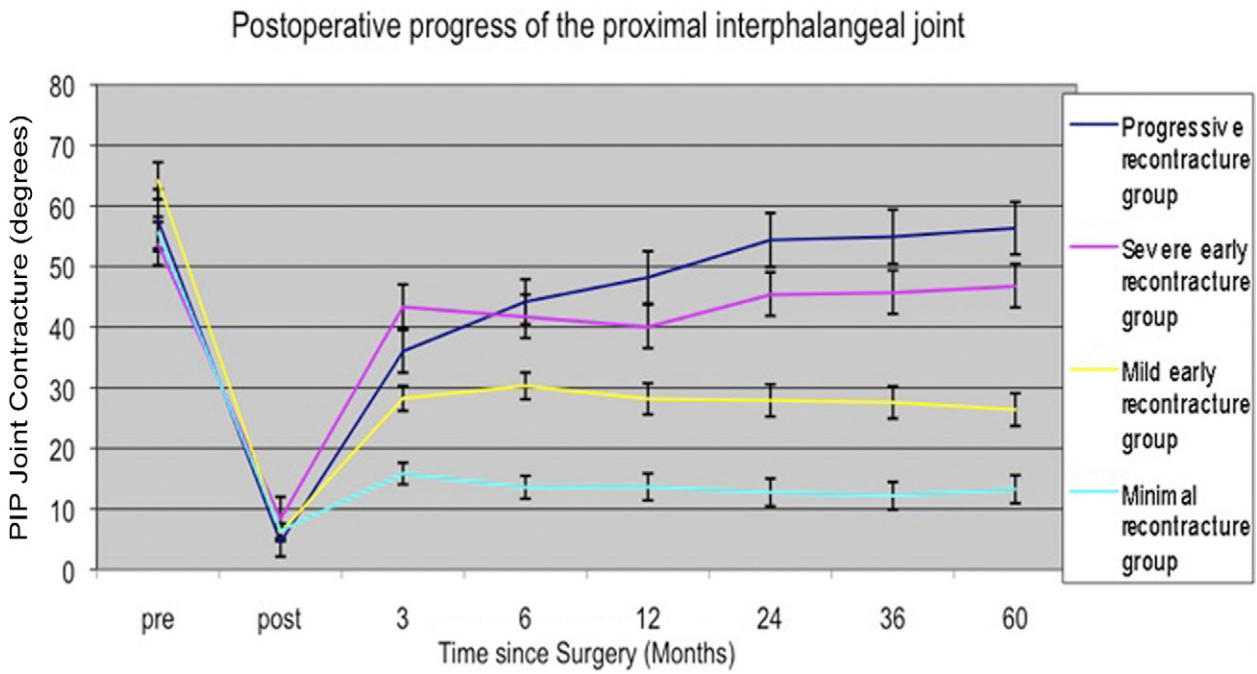

FIGURE 1: Postoperative progress of PIP joint recontracture in the 4 groups. Error bars represent the SEM.

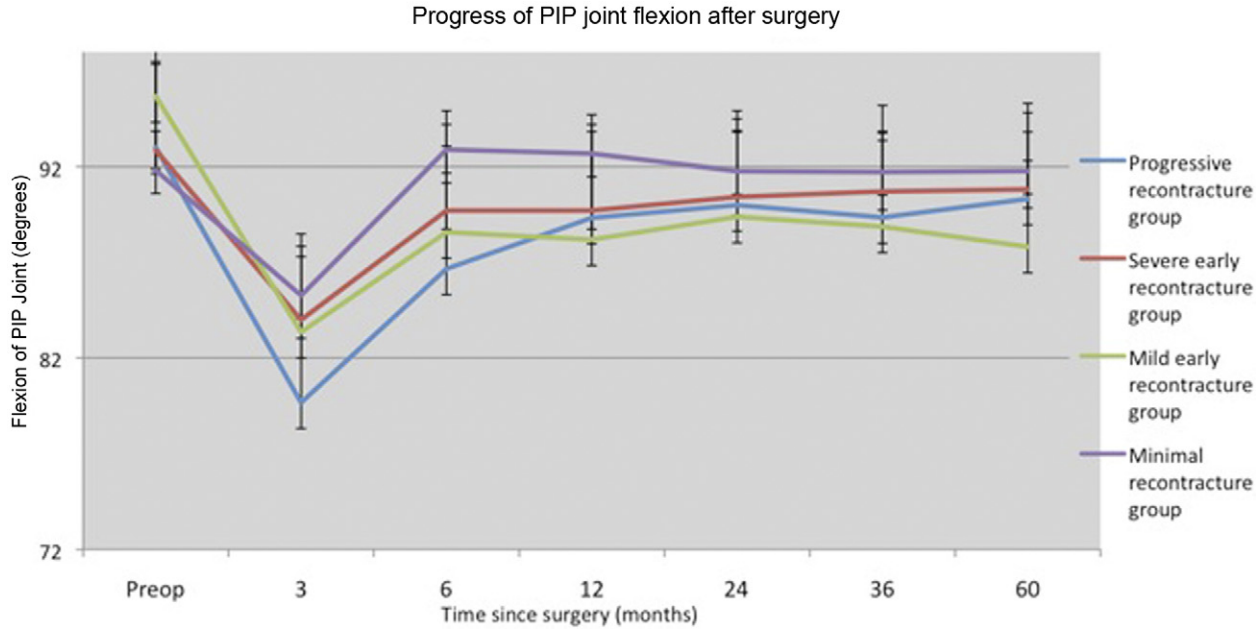

FIGURE 2: Postoperative progress of flexion of the PIP joint.

duration of surgery. This test is a nonparametric trend test and does not depend on normal data distribution. We used the data at 6 months to classify outcomes between 3 months and after 5 years.

We used the receiver operating characteristics curve to determine the optimal cutoff point of recontracture that could predict the final recurrence at 5 years using data from same subjects but at different time points. Significance was achieved when P was less than or equal to .050.

RESULTS

The little finger was most commonly affected (52 digits), followed by the ring finger (19 digits) and index finger (1 digit). The middle finger and thumb were not involved. The minimum follow-up for all the patients

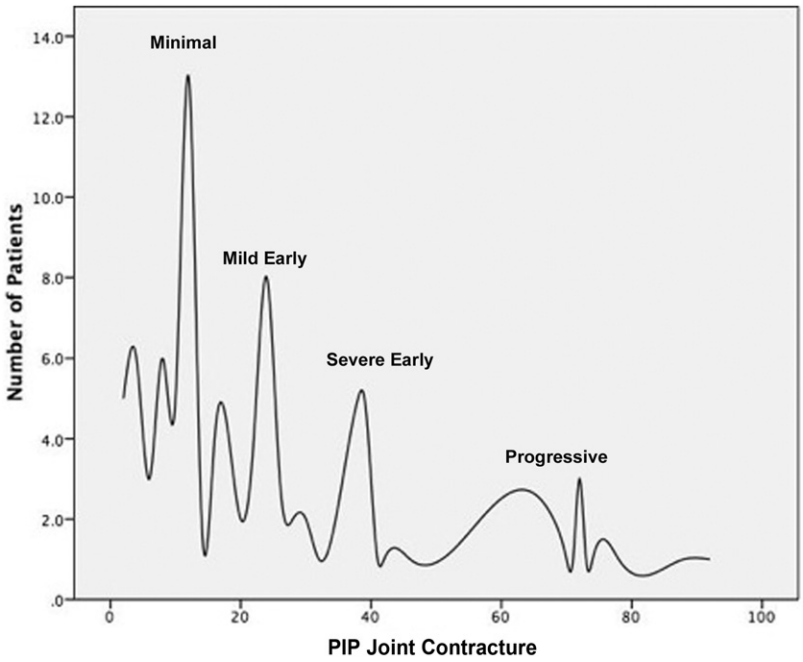

FIGURE 3: Smoothened spline histogram displays distribution of PIP joint contracture (in degrees) versus the number of patients at 6 months.

was 5 years (range, 5–8 y). A total of 31 patients (33 hands; 49%) showed good improvement after surgery that was then maintained for 5 years (group 1, minimal recontracture group). Twenty patients (23 hands; 32%) showed initial good improvement tat mildly worsened by less than 20° up to 3 months, but the position was then maintained over 5 years (group 2, mild early recontracture group). Four patients (5 hands; 7%) showed immediate moderate to severe worsening of contracture by more than 20° in the first 3 months after surgery to almost the preoperative position, but this was then stable and did not become worse with time (group 3, severe early recontracture group). Eight patients (8 hands; 12%) showed immediate worsening with further gradual but progressive worsening in the range of PIP joint contracture over the next 5 years (group 4, progressive recontracture group) (Fig. 1).

Of the initial cohort of 82 patients, 79 were reviewed at 3 years (Fig. 4). Of 79 patients, 11 (14%) had recontracture of PIP joint with increasing recurrence of Dupuytren disease in the form of palpable cords indicating true recurrence[7] (progressive recontracture group). At 5 years, 8 of these 11 were reviewed, and in these the PIP joint contracture had continued to worsen (progressive recontracture group) (Fig. 1). Seven fingers in this group showed cord formation. Two fingers in the mild early recontracture group also showed palpable cords.

For the final cohort of 63 patients, preoperatively the mean contracture of the 72 fingers was 59° at the PIP joint, 21° at the metacarpophalangeal joint, and 6° at the distal interphalangeal joint. The preoperative contracture at the PIP joint was similar in the 4 groups (Table 1).

We calculated the change in the PIP joint contracture between 5 time points (3 and 6 mo, and 1, 3, and 5 y). Receiver operating characteristics curve analysis showed that the worsening of contracture between 3 and 6 months more than 6° could predict recurrence of contracture, and a cutoff point of 6° would correctly classify 93% of patients with progressive recurrence of contracture at 5 years (Fig. 5).

The mean disease duration since the onset of Dupuytren contracture was 6 years and was different (generalized estimating equation, $P = .030$) in the 4 groups. This suggests a shorter duration of disease in the progressive recontracture group at 3.2 years (SEM, 0.7 y) compared with 7.1 years (SEM, 0.9 y) in the minimal recontracture group (Table 1). When only preoperative PEM and disease duration are included in the regression equation, patients with high preoperative PEM ($P = .010$) and low mean disease duration ($P = .020$) were more likely to lie in the progressive contracture group. Mean operation time was similar in the 4 groups on the generalized estimating equations ($P = .130$). However, using the Jonckheere-Terpstra test, mean operation time showed a significantly ordered difference ($P = .030$) between groups, in which the worst performing groups with higher recurrence rate took significantly longer during surgery (Table 1). Recurrence was associated

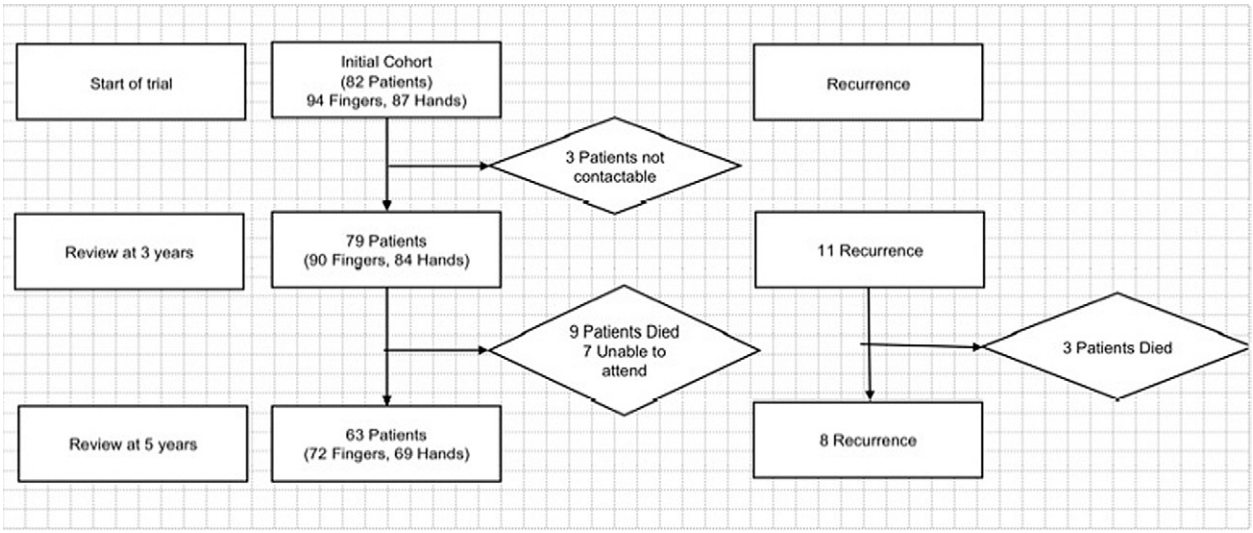

FIGURE 4: Attrition diagram demonstrating follow-up of recruited patients over 5 years. The column on the right side shows patients with progressive recontracture over 5 years.

TABLE 1. Demographics for Recurrence Groups

Recurrence Group (Number of Fingers), Number of Patients	Sex		Age, y (Mean ± SEM)	Disease Duration, y (Mean ± SEM)	Preoperative PIP Joint Extension Lag, degrees (Mean ± SEM)	Preoperative PEM (Mean ± SEM)	Operation Time, min (Mean ± SEM)
	M	F					
Minimal recontracture group (34), 31	28	3	62 ± 1.6	7.1 ± 0.9	55 ± 3	31 ± 0.7	69 ± 3
Mild early recontracture group (25), 20	17	3	63 ± 2.2	5.9 ± 0.8	64 ± 3	36 ± 1.5	74 ± 4
Severe early recontracture group (5), 4	2	2	63 ± 3.7	4.4 ± 0.9	55 ± 6	37 ± 3.9	84 ± 12
Progressive recontracture group (8), 8	7	1	57 ± 2.4	3.2 ± 0.7	57 ± 4	40 ± 2.6	86 ± 6
Total 63 (72)	54	9	62 ± 1.2	5.9 ± 0.5	59 ± 2	34 ± 0.8	74 ± 2
Generalized estimating equations	$\chi^2 = 1.1$		1.4	5.4	4.1	11.6	5.7
P	$P = .77$		.690	.140	.250	.010	.030
Jonckheere-Terpstra test							
P			.240	.030	.620	.020	.020

Recurrence was assessed using the generalized estimating equation accounting for patients, hands, and fingers. The Jonckheere-Terpstra test examines ordered differences among several independent samples. It tests the hypothesis that as one moves from the Responsive group to the Recurred group, the magnitude of variable changes.

($P = .001$) with the preoperative PEM score (Table 2). We found no association between use of the firebreak graft and recurrence of contracture.

DISCUSSION

Our study showed 4 patterns of evolution of contracture of the joint after surgery for Dupuytren disease. A total of 81% of patients had a good outcome that was maintained over 5 years. Nineteen percent of patients had recurrence of contracture; in 7%, this occurred in the immediate postoperative period but did not worsen thereafter, and 12% showed steady worsening of the contracture of the PIP joint over 5 years. The recurrence of PIP joint deformity could be from true disease re-

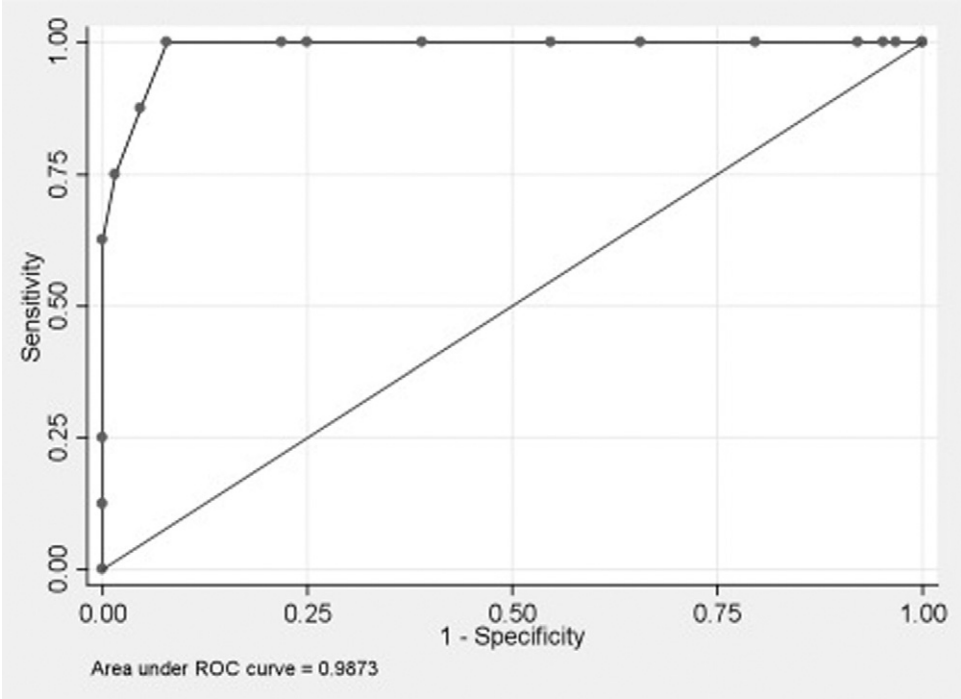

FIGURE 5: Receiver operating characteristics (ROC) curve plotted using change in contracture between 3 and 6 months to predict recurrence.

currence, from joint or skin contracture, or from both in combination.

This pattern became apparent at 6 months after surgery. Worsening of contracture more than 6° between 3 and 6 months after surgery predicted progressive recontracture at 5 years. Using a cutoff point of 6° of worsening correctly classified 93% of patients with good sensitivity and specificity.

Some of these patterns have been previously documented separately in different studies.[8,9] Ritchie et al[2] noticed some of these groups after fasciectomy and sequential release of the PIP joint of the little finger. Of the 19 fingers in the study, 8 (43%) achieved a full correction by fasciectomy alone. In these, the contracture was 6° at 3 months and 8° at 3 years. This group matches our mild early recontracture group, in which contracture worsened less than 20° but then did not increase over 5 years. This group had low disability (PEM) scores, and patients were older when they presented, which suggests slow progression. In these patients, the duration of surgery was shorter. Two fingers showed recurrent palpable cord formation, which suggests milder diffuse form of disease.

The remaining 11 fingers (57%) in the study by Ritchie et al[2] had mean initial PIP joint contracture of 70°. These were left with a fixed flexion deformity of 42° after fasciectomy. It reduced to 7° with capsuloligamentous release, but the contracture increased to 26° at 3 months and then remained relatively stable at 29° after 3 years. The severe early recontracture group in our study showed good improvement at surgery. The contracture recurred early by 3 months, but then there was no further worsening of the contracture. This group constituted 7% of our patients.

The progressive recontracture group (12% of patients) had higher disability (PEM) scores and required longer surgical time, which suggests a more aggressive and greater volume of disease. Of the 8 fingers in this group, 7 showed palpable cords, which suggests recurrence of disease. This group showed progressive recurrence of contracture with Dupuytren band formation over the next 5 years, corresponding to the true recurrence group of Hueston.[1] That author found that 62 of 224 cases (27%) had reappearance of Dupuytren tissue within the area cleared at operation in the little finger at 3 years, but only 24 cases (11%) developed progressive deformity. In our study, the pattern of recontracture remained the same over 5 years. This pattern can be identified at 6 months. Future studies on recurrence after Dupuytren surgery should consider differentiating their subjects into these 4 groups.

Preoperative PEM, operation time, and duration of disease were associated with recurrence of contracture. However, we found no association between recontracture and preoperative PIP joint contracture. The duration of disease was associated with recurrence of con-

TABLE 2. Test of Model Effects (Type 3)

Effect	Generalized Estimating Equation	Degrees of Freedom	*P*
Severity			
Preoperative PEM	10.5	1	.001
Preoperative PIP joint extensor lag	0.6	1	.430
Fingers involved, n	2.1	1	.150
Diathesis			
Bilateral involvement	0.9	1	.340
Family history	20.1	1	.980
Age < 50 y	0.1	1	.870
Other factors			
Diabetic	2.7	1	.090
Smoker	0.3	1	.860
Epileptic	2.6	1	.110
Alcohol intake (units/wk)	4.1	1	.040

The dependent variable was recurrence groups. We assessed data using the generalized estimating equation accounting for patients, hands, and fingers. Because multiple hypotheses were tested, the significance level was adjusted to $P < .010$.

tracture, but our numbers were too small to allow prediction of postoperative recurrence from rate of preoperative disease progression. It has been previously shown that hand function is worsened by increasing deformity in Dupuytren disease and improved by correction of the deformity.[10]

There are limitations to our study. The controlled environment of a randomized trial in our study could have introduced a bias, because only patients with sufficient PIP joint contracture (mean contracture, 59°) were included. In our study, patients who had a skin graft showed no difference (over fasciectomy alone) in correction or recurrence of contracture after surgery.[4] The number of patients in the progressive recontracture group and the severe early recontracture group was small. Larger studies will be required to confirm our findings. Full correction may not be accomplished after surgery in all cases of PIP joint contracture. In our study, only 2 of 72 fingers had persistent contracture between 5° and 10° after surgery (Fig. 1). The recurrence rates could be affected by some residual Dupuytren disease, retrovascular contracture, PIP joint volar capsular contracture, or skin tightness. These could have affected the recurrence rate (12%) in this study, but all cases that recurred were corrected within 5° of normal. Patients receiving skin graft were allowed to move the fingers early, and the mean graft take rate in our study was 88%, with 8 fingers with less than 80% graft take. This partial skin graft loss could make the finger more susceptible to recurrent contracture, but most cases that recurred had 100% graft take. Such an association between graft loss and recurrence was not identified in our study. The number of fingers that had recurrence of contracture was small (8), so it is difficult to be certain about the cutoff point for the receiver operating characteristics curve. We accept that the statistically suggested cutoff of 6°could lie within the error of goniometric measurements, but there is progression of contracture between visits.

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