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Severe contractures of the proximal interphalangeal joint in Dupuytren's disease: Results of a prospective trial of operative correction and dynamic extension splinting

In a prospective study, 23 proximal interphalangeal joints that were severely contracted (≥ 45 degrees) as a result of Dupuytren's disease underwent operative correction and 6 months of dynamic extension splinting. Proximal interphalangeal joint extension was measured preoperatively and postoperatively at 3-month intervals for 1 year and at 6-month intervals thereafter. Mean follow-up was 2 years (minimum, 1 year). Overall, at 2 years, 44% improvement in proximal interphalangeal joint extension was noted. Mean improvement of 59% in proximal interphalangeal joint extension was noted in patients who complied with the postoperative dynamic extension splinting program. Patients who were noncompliant demonstrated a 25% improvement in proximal interphalangeal joint extension. The difference in values between patients who were compliant and those who were not was statistically significant. Other factors—severity of contracture, digit involved, and the necessity for capsular release—were not significantly related to outcome. This study suggests that soft tissue responds to continuous dynamic extension stresses and can be remodeled over time. (*J HAND SURG* 1992;17A:1153-9.)

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Operative correction of severe contractures of the proximal interphalangeal joint in Dupuytren's disease has been considered uniformly poor.¹⁻⁶ Recurrent proximal interphalangeal joint deformity has been reported in as many as 55% of operatively treated patients within 12 to 18 months of surgery.⁷⁻⁹ In 1987 we instituted a prospective clinical trial of immediate postoperative dynamic extension splinting to improve the results achieved by fasciectomy, with or without capsular release of the proximal interphalangeal joint.^{10, 11} The dynamic splint, designed to position the metacarpophalangeal joint in 70 degrees of flexion, applies a dorsally directed force on the middle phalanx to concentrate maximal stresses on the capsular fibers of the proximal interphalangeal joint. This position has been shown to relax the flexor tendons, digital sheaths, and neurovascular bundles.¹¹

This report describes the results achieved in 23 consecutively treated proximal interphalangeal joints with severe contractures that underwent operative release followed by 6 months of dynamic extension splinting.

Materials and methods

In 1987 a prospective protocol was developed for all patients with Dupuytren's disease who had severe contractures of the proximal interphalangeal joint. From 1987 to 1990, 20 patients with 23 primary proximal interphalangeal joint contractures greater than 45 degrees were operated on. Digits of hands with recurrent disease were excluded from the study. There were 15 men and 5 women in the study. Ages ranged from 44 to 79 years (mean, 60 years). Contractures ranged from 45 degrees to 110 degrees (mean, 66 degrees; median, 77 degrees). Joint angles were measured preoperatively and postoperatively at intervals of 3 months for 1 year and thereafter at 6-month intervals. Mean follow-up was 2 years (minimum, 1 year; range, 1 to 3½ years).

The operative procedure used in all cases was the McCash open-palm technique combined with Bruner zigzag incisions extended into the palmar aspects of each digit.¹⁰ Contracted pretendinous cords were identified, as well as digital arteries and nerves. Involved fascia, including superficial and deep transverse fibers, were divided sharply.^{12, 13} If proximal interphalangeal joint extension was limited after selective fasciectomy, the checkrein ligaments, accessory collateral ligaments, and palmar plate were released sequentially. Each of the proximal interphalangeal joints extended fully at the end of surgery.

The rehabilitation protocol involved the first 6 postoperative months. On the first postoperative day, bulky dressings were removed and light compressive dressings were applied. A customized dorsal plastic splint was fabricated with the metacarpophalangeal joint flexed to 70 degrees and the proximal and distal interphalangeal joints in complete extension (Fig. 1).^{14, 15} With the use of a dynamic rubber-band device, a 200 gm extension force was applied to the proximal interphalangeal joint. The splint was specifically designed for application to the ulnar aspect of the hand and forearm to obtain accurate positioning of the ulnar two digits. Physicians and therapists closely monitored each patient's progress, giving instructions in splint application and use, evaluating the fit of the splint, and modifying the splint as swelling and size of the dressing decreased and wear increased. The amount of force applied to the proximal interphalangeal joint was monitored and adjusted periodically by increasing the tension of the rubber bands. Patients were instructed to wear the dynamic splints continuously during the day and at night while sleeping. If a patient was unable to tolerate nighttime wear, a static night splint was fabricated with the hand maintained in the same position. For the first 4 weeks, patients performed active and active assisted range-of-motion exercises of the metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints out of the splint for 15 minutes five times a day. At 10 days sutures were removed and active range-of-motion exercises with blocks were started.

At 4 weeks, a palmar pancake splint for nighttime use was fabricated with the wrist at 20 to 30 degrees of extension and with the metacarpophalangeal, proximal interphalangeal, and distal interphalangeal joints in neutral position. The dynamic splint was worn during the day and removed only for therapy and for independent exercise. When the palmar wound closed, a silicone elastomer insert was positioned beneath the palmar splint.

At 8 to 12 weeks, patients decreased dynamic splint wear to 2-hour periods three times a day. During the night a pancake platform splint was used. The same protocol was continued for the next 3 to 6 months.

Results

Postoperative results were determined at intervals for 3½ years. Overall correction for the 23 digits was 44% at 2 years. Mean percent improvement over time was as follows: 1 month, 83%; 3 months, 65%; 1 year,

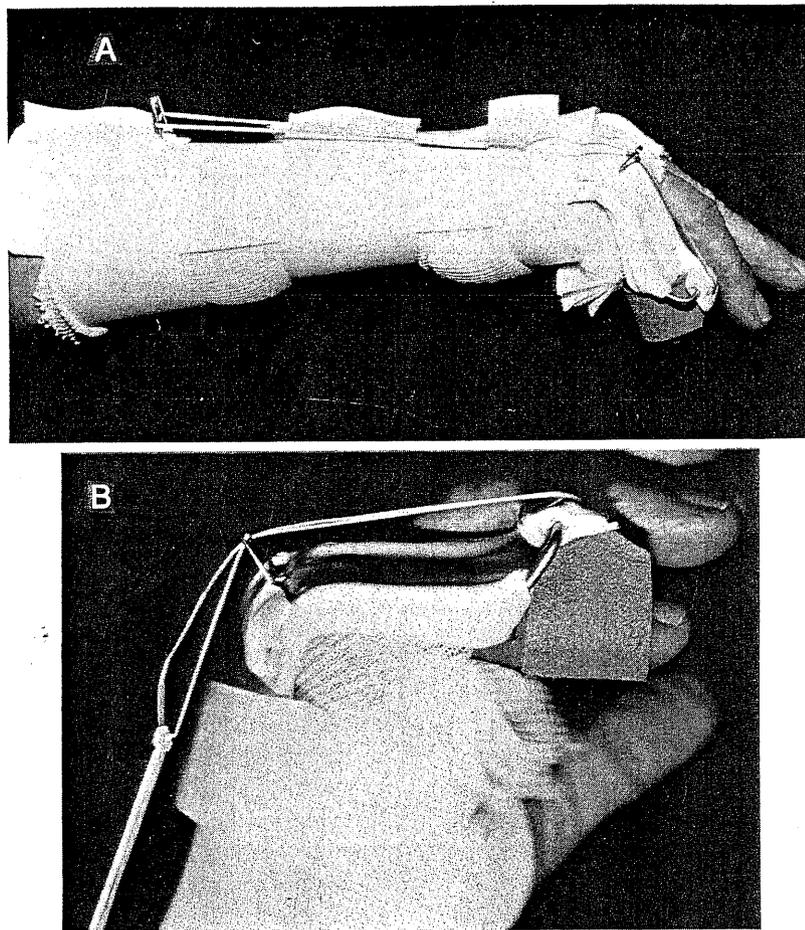


Fig. 1. Dynamic extension splint with metacarpophalangeal joint flexed 70 degrees and proximal and distal interphalangeal joints extended. A 200 gm extension force is applied to the proximal interphalangeal joint through a rubber band tension device.

58%; and 2 years, 44%. Evaluation of results was based on several variables: digit involved, severity of contracture, necessity for capsular release to obtain full extension, and compliance with the splinting program. All analyses were nonparametric. Differences were tested by means of the Wilcoxon test with two-sided p values.

Digit involved. The 23 digits studied included 16 small fingers, 6 ring fingers, and 1 long finger. Results were categorized according to digit involved (Table I). Small fingers gained an average of 44% of extension compared with 47% for the ring and long fingers. There was no significant difference between the small finger and the other digits in results achieved by operative correction ($p > 0.05$).

Severity of contracture. There were 9 contractures of 45 to 60 degrees (mean 49 degrees) and 14 contractures ranging from 60 to 100 degrees (mean, 81 degrees). Overall correction for less severe contractures (45 to 60 degrees) was 44%, and overall correction for contractures greater than 60 degrees was also 44% (Table II).

Capsular release. Capsular release was performed on 18 digits. Capsular release was not affected by the variables of age, sex, preoperative angle of deformity, and finger involved. Release of the checkrein and accessory collateral ligaments and palmar plate was necessary in 16 of the 18 digits that required capsular release (Table III). In two digits, complete extension was obtained after checkrein and accessory collateral

Table I. Proximal interphalangeal joint improvement (in percent) over time

Digit	1 mo	3 mo	12 mo	24 mo
Small finger (n = 16)	86	70	64	44
Other digits (n = 7)	77	62	48	47

Table II. Proximal interphalangeal joint improvement (in percent) over time

Severity of contractures (degrees)	1 mo	3 mo	12 mo	24 mo
45-59 (n = 9)	85	66	65	44
60-110 (n = 14)	82	64	52	44

Table III. Fasciectomy alone versus fasciectomy with capsular release: Proximal interphalangeal joint improvement (in percent) over time

	1 mo	3 mo	12 mo	24 mo*
Fasciectomy alone (n = 5)	81	67	57	67
Fasciectomy with capsular release (n = 18)	84	64	58	46

*After 12 months, the number of digits treated by fasciectomy alone is too small to be compared with the fasciectomy with capsular release group.

ligament release only. Overall improvement in digits that required capsular release in addition to fasciotomy to achieve full proximal interphalangeal joint extension was 46% at final follow-up. Overall improvement in extension in digits undergoing fasciectomy alone was 67%. There was no significant difference between results obtained in the 18 digits that had capsular releases and the 5 digits that had only fasciectomies ($p > 0.05$) at intervals of 1 year or less. After the first year, the number of digits treated with fasciectomy alone was insufficient for comparison.

Patient compliance with the splinting program.

Determination of the degree of compliance was based on discussions with patients and the therapists who supervised them. Only those patients who voluntarily stated that they discontinued splinting or reduced time in the splint to less than 50% of the recommended time were classified as noncompliant. Patients fell into two distinct groups: those who tolerated the splinting program and those who did not. Thirteen patients (14 digits) complied with the program, wearing the splint at least 50% of the recommended time. Seven "noncompliant" patients (9 digits) did not wear the splints half the time.

In the compliant group mean improvement was 59%. Eleven of 14 digits maintained an average of 75% improvement in proximal interphalangeal joint extension at 2 years. The three digits that did not maintain this degree of improvement were small fingers with severe

contractures of either the metacarpophalangeal or the distal interphalangeal joint, or both, in addition to the proximal interphalangeal joint. While each of these three digits demonstrated full extension of the metacarpophalangeal joint and improved extension of the distal interphalangeal joint at 2 years, only 24% to 47% improvement in proximal interphalangeal joint extension was noted.

Results in the noncompliant group were far poorer than in the compliant group. Twenty-five percent improvement in proximal interphalangeal joint extension over preoperative values was noted at 2 years (Fig. 2). The 7 patients (9 digits) in this group reported a variety of reasons for discontinuation of the splinting program. One patient stopped wearing the splint for 2 months after surgery because she found it uncomfortable, 2 patients were unable to undergo routine assessment and splint adjustment by the therapist because they lived a long distance from a rehabilitation center, and 1 patient had a myocardial infarction during the third postoperative month.

The longer the patient participated in the splinting program, the better the results appeared to be in the short term. Specifically, in the group of patients who strictly adhered to the formal splinting program, average values were as follows: 1 month, 94%; 3 months, 80%; 12 months, 78%; and 2 years, 69%. Corresponding values for those patients who discontinued the splint at 1.5 to 3 months (mean, 10 weeks) were as follows: 1

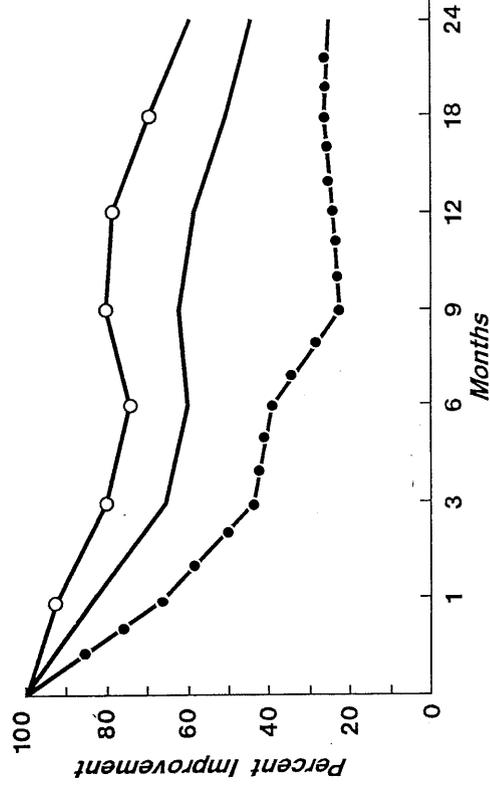


Fig. 2. Percent improvement in extension of proximal interphalangeal joints. Solid line denotes data obtained in all patients. Broken line with open circles denotes data obtained in patients who complied with the splinting program more than 50% of the time. Broken line with closed circles denotes data obtained in patients who did not comply with the splinting program.

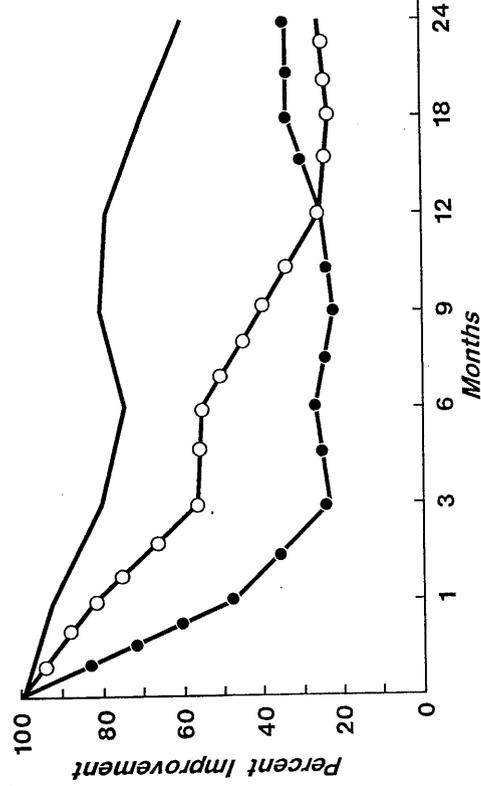


Fig. 3. Percent improvement in extension of the proximal interphalangeal joint. Solid line denotes data obtained from patients who complied with the splinting program more than 50% of the time. Broken line with closed circles denotes data obtained from patients who discontinued splinting within the first month after surgery. Broken line with open circles denotes data obtained from patients who discontinued splinting from 45 days to 3 months after surgery.

month, 82%; 3 months, 58%; 12 months, 25%; and 2 years, 25%. The corresponding values for those who discontinued the splint in the first few weeks were as follows: 1 month, 47%; 3 months, 23%; 12 months, 25%; and 2 years, 33% (Fig. 3). For patients who underwent the full 6-month splinting program, improvement at 2 years was 59%. The difference between these

groups at 1, 3, 12, and 24 months was statistically significant ($p < 0.05$) for each comparison. A rank analysis of covariance was used to jointly determine the effect of capsular release, affected digit, severity of contraction, and compliance with the splinting program on the postoperative improvement of proximal interphalangeal joint deformity. Through month 24, the only

factor that significantly affected outcome was compliance with the splinting program ($p < 0.05$).

Discussion

Although operative correction of severely contracted proximal interphalangeal joints in Dupuytren's disease is generally successful, maintaining correction is difficult.^{7, 8, 16-18} It is uncommon that as much as 50% of improvement in extension is maintained after operative treatment of the proximal interphalangeal joint. Results published by McFarlane, Honner, Millesi, Hueston, and Legge confirm the failure to maintain even short-term improvement after fasciectomy, with or without capsular release of the proximal interphalangeal joint.^{5-7, 16, 19} Our data confirm the observations that the severely contracted proximal interphalangeal joint in Dupuytren's disease constitutes a difficult management problem. With operative methods similar to those used by previous authors, coupled with a 6-month dynamic extension splinting program, we noted an average of 44% improvement 2 years after surgery. Improved values were noted in compliant patients (59% improvement over preoperative values).

Our findings are limited to the first 2 postoperative years (mean follow-up). Others have reported that recurrence and/or extension of disease generally occurs during this interval.⁵

In addition to the degree of compliance with the splinting program, other variables were studied: digit involved, severity of proximal interphalangeal joint contracture, and the necessity for capsular release. It has been noted that maintenance of correction of the proximal interphalangeal joint is more difficult in the small finger than in other digits. Sennwald⁶ noted that only 20% of the proximal interphalangeal joints were improved by treatment, whereas 55% showed no change and 25% were worse. There were 16 small fingers in our study, 6 ring fingers, and 1 middle finger. Results were not significantly different in small fingers than in the other digits. Nine of 12 small fingers in patients who complied with the splinting program achieved greater than 60% improvement in extension at 2 years.

We also examined the severity of proximal interphalangeal joint contracture and its relationship to joint correction seen at late follow-up. There were 9 digits with contractures of 45 to 60 degrees and 14 digits with contractures ranging from 60 to 100 degrees. There were no significant differences between the results obtained in these two groups. Similarly, capsular release in severely contracted digits did not yield significantly different results than fasciectomy alone.

The only variable that was significant with regard to results was patient compliance with a 6-month splinting program. Loss of correction in three patients who had concomitant metacarpophalangeal and/or distal interphalangeal joint contractures supports the findings of Legge and McFarlane,¹⁶ who predicted that results obtained after operative release of the proximal interphalangeal joint were affected by the severity of metacarpophalangeal and distal interphalangeal joint contractures.

Although our study lacked a formal control group, the data compare favorably with those reported in the literature.^{2, 6, 7, 17, 18} The splinting program is an intensive one for the patient, the surgeon, and the hand therapist. Before entering the program, patients should be made aware of the demanding rehabilitation schedule and the necessity for strict compliance if improved results are to be achieved after operative release of the proximal interphalangeal joint.

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