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Original Research

Reduced Pain and Edema Following Delayed Therapy for Flexor Tenolysis

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Purpose: Traditionally, therapy has been initiated 1 day after surgery following flexor tenolysis to prevent the development of early adhesions. Pain and edema are limiting factors in the initial days after surgery and can interfere with the opportunity to effectively initiate a home therapy program. The purpose of this study was to demonstrate the safety and effectiveness of delaying the initiation of therapy to 3 days post-op following flexor tenolysis.
Methods: 10 patients undergoing flexor tenolysis initiated therapy at 3 days post-op. Pain, edema, and range of motion were measured at baseline, day 3 post-op, day 12 ± 2, and weeks 3, 4, 8, and 12. Functional limitations and level of anxiety were assessed at the initial post-op visit, as well as week 4 and week 12.
Results: Most range of motion improvements occurred in the first 2–3 weeks. Mean total active motion of the interphalangeal joints increased from 64.0° ± 24.9° at baseline to 142.5° ± 24.6° at 3 weeks post-op. Differences in interphalangeal joint total active motion were significant between baseline and 3 weeks, and these improvements were maintained through the 8-week follow-up visit. At 8 weeks post-op, five patients had excellent results, three had good, and two had fair, according to the Original Strickland Classification system.
Conclusions: Early and effective management of pain and edema is critical to ensuring a positive outcome. Patients with less initial postoperative edema had better range of motion at 3 weeks post-op. Results were maintained through 8 weeks, and the patients required fewer therapy visits. Delaying the initiation of therapy to 3 days post-op following flexor tenolysis can yield favorable results and is safe for clinical practice.
Clinical relevance: This case series demonstrates that delaying initiation of therapy to 3 days post-op following flexor tenolysis can yield favorable results. Delaying therapy can mitigate the ill effects of surgery and allow reduction of pain and edema for improved range of motion and overall outcome.

For decades, surgeons have performed flexor tenolysis procedures to restore maximum active flexion and function of the hand. The procedure has been recommended when the passive range of motion far exceeds active flexion. Patients considered to be favorable candidates fully understand the postoperative course of therapy and the time commitment to the home therapy program, and they have a strong desire to improve motion.[1–3]

The most common indication for flexor tenolysis is the presence of tendon adhesions, typically following flexor tendon repairs or fractures of the hand. Fortunately, advances in flexor tendon repair strength that can permit early active flexion programs, as well as the evolution of screw and plate fixation for hand fractures, allowing early range of motion, have decreased the need for this procedure. With passive flexor tendon repair programs, the incidence of flexor tenolysis is approximately 14%.[4] With early active motion programs, the flexor tenolysis rate decreases to 5%.[1,5–7] With respect to hand fractures, prolonged immobilization can lead to the need for flexor tenolysis, while early motion for digital fractures has more favorable outcomes.[8–10] A 2022 systematic

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Table 1
Original Strickland Classification System

Category	Percent	Total active IP motion
Excellent	85%–100%	>150°
Good	70%–84%	125°–149°
Fair	50%–69%	90°–124°
Poor	<50%	<90°

review demonstrated that in studies using the Strickland criteria (see Table 1), 68% of patients report good or excellent outcomes after flexor tenolysis.[11]

Traditionally, therapy has been initiated 1 day after surgery following flexor tenolysis.[3,8,12,13] Patients are frequently in pain, edematous, draining from the incision site, and feeling the ill effects of surgery and postoperative pain medication. Each of these factors interferes with the opportunity to initiate therapy and effectively administer a home therapy program.

Flexor tendon research shows that edema peaks at post-op day 3.[14–16] Initiating range of motion before edema has started to taper off can cause increased friction on the flexor tendons and bleeding into the wound bed, furthering the formation of scar tissue.[17] The literature defines varying time frames (ranging from 9 to 14 days after surgery) whereby filmy adhesions begin to form and could interfere with the opportunity for tendon gliding. In 2008, Cao et al found no adhesion formation at 3, 5, or 7 days post flexor tendon repair. Granulation tissue or filmy adhesions were seen in the tendons at day 9, but no well-formed adhesions around the tendons were detected. At day 14, loose adhesions were found around the repaired tendons, which were restrictive to tendon gliding.[15] In a separate work on tendon healing by Wu and Tang,[14] the authors indicate the proliferative phase exhibits a sharp incline at 4 days post repair, peaking at approximately 10 days post-op, and remaining at this level until 28 days post-op. It is at this 10-day point that there is an initial development of adhesions.[14]

The literature is deficient in recommending a postoperative flexor tenolysis therapy regimen whereby therapy is delayed to accommodate postoperative edema decrease and overall surgical recovery. The purpose of this study was to demonstrate the safety and effectiveness of delaying the initiation of therapy to 3 days post-op following flexor tenolysis.

Materials and Methods

Study population

Ten patients intending to undergo a flexor tenolysis procedure were identified, recruited, and enrolled in this study. Patients were screened before surgery to ensure they met the inclusion criteria. All patients attended therapy at one of the practice's office locations and were treated by specialized hand therapists from March 2019 to August 2022. All therapists received extensive training on the study protocol, including rehabilitation guidelines and measurement techniques to ensure good interrater reliability.

Inclusion criteria consisted of (1) a digital level injury to the index through small finger (single digit injury) requiring a flexor tenolysis with or without a combined volar metacarpophalangeal or proximal interphalangeal joint capsulectomy to restore extension; (2) preoperative supple passive flexion; (3) tenolysis performed a minimum of three months after the initial surgery/injury; and (4) age >18 years old.

Exclusion criteria consisted of (1) limited passive flexion before surgery; (2) persistent wound issues; (3) malunion or nonunion of fractures; (4) pulley reconstruction (excluded because of the need for protected motion protocols that differ from standard tenolysis rehabilitation); (5) additional surgeries performed between the initial surgery and flexor tenolysis; (6) non-English speaking; and (7) a current or past history of upper extremity lymphedema.

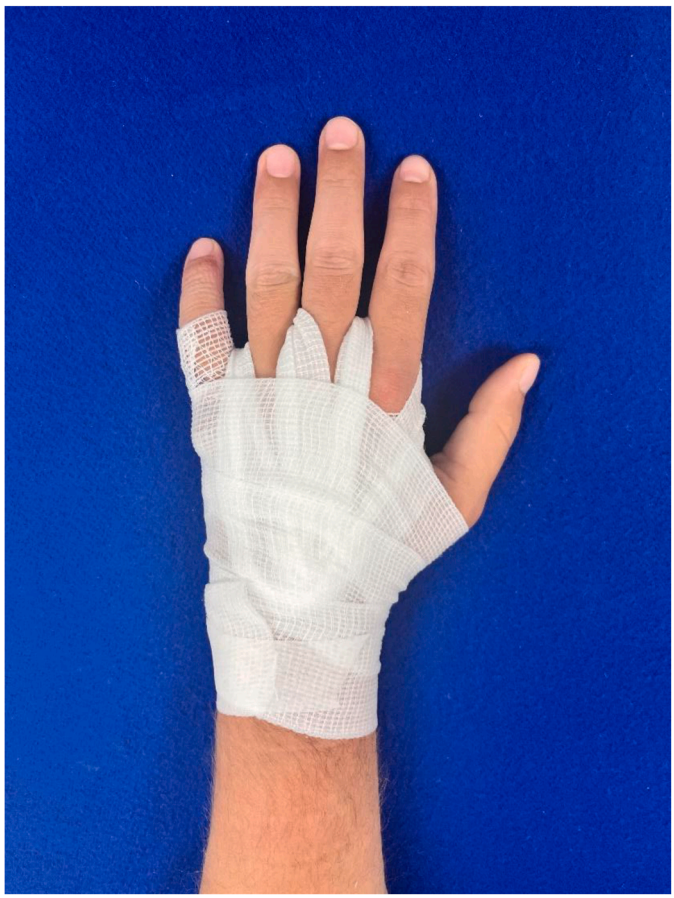

Figure 1. Light compressive dressing—1-inch sterile gauze and 2-inch sterile gauze between the webspaces.

All potential patients were informed of the purpose of the study, its risks and benefits, and their rights to withdraw from the study at any time. Institutional Review Board approval was obtained prior to enrolling patients and collecting data. Informed consent and Health Insurance Portability and Accountability Act authorization were obtained for each patient prior to collecting data.

Intervention

Patients enrolled in the study underwent a flexor tenolysis procedure. Patients were immobilized in their postoperative bulky dressings for 3 days and initiated therapy on post-op day 3.

The Diagnosis and Treatment Manual for Physicians and Therapists was used to guide treatment.[18,19] Patients were initially placed in a light compressive dressing (Figs. 1, 2) and immobilized in a hand-based extension orthosis (Fig. 3) between exercises and at night to rest soft tissues and decrease edema. A hand-based extension orthosis was chosen to place soft tissue structures on a gentle stretch and maintain flexor tendon length as scar forms. Active and passive exercises were performed at 2-hour intervals during the day, emphasizing differential tendon gliding as well as

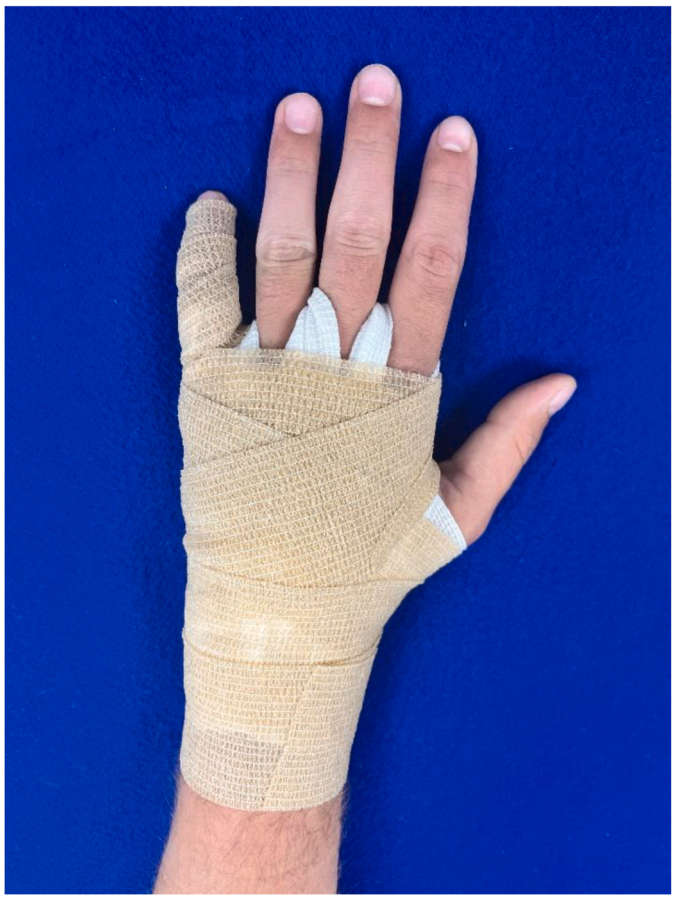

Figure 2. Light compressive dressing—1-inch and 2-inch self-adherent wrap, distal to proximal.

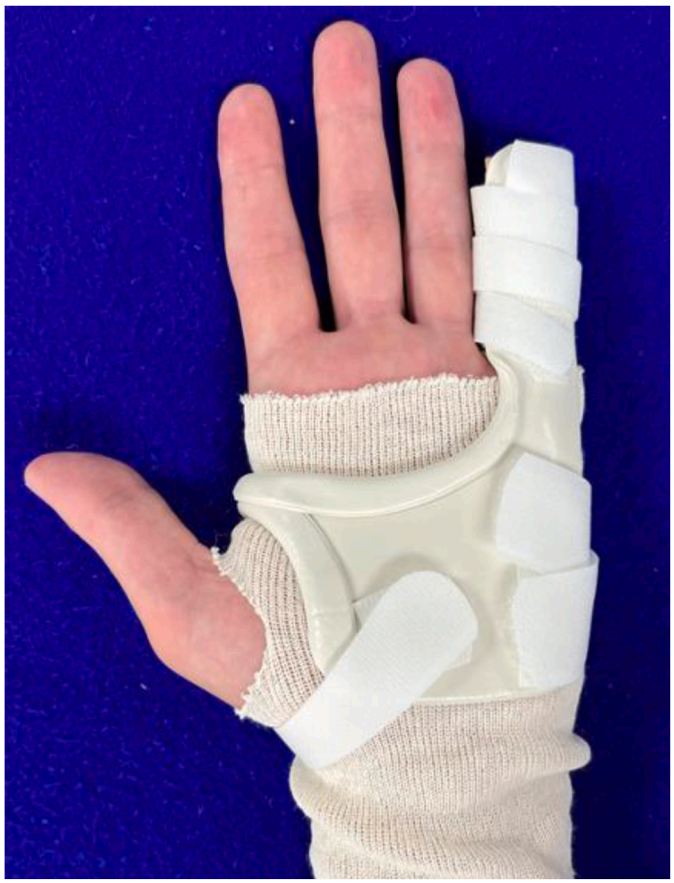

Figure 3. Hand-based extension resting pan orthosis.

composite flexion and extension (Figs. 4, 5). Flexor digitorum superficialis and profundus blocking, as well as place and hold exercises, were added at the discretion of the treating therapist. Sutures were removed at 10–14 days, and the orthosis was gradually weaned to night only for 8 weeks, unless the presence of a proximal interphalangeal (PIP) lag or contracture was noted. Edema control was reduced to 1 inch Coban at the 10–14-day visit. Scar management (massage with lotion) began 72 hours after suture removal, assuming complete wound closure. No patients required the use of neuromuscular electrical stimulation or dynamic flexion orthoses. Light hand strengthening was initiated at 8 weeks post-op with soft putty or light resistance on a hand exerciser.

Measures

Baseline demographics included age, sex (male or female), affected and unaffected digit assessment, mechanism of injury, diagnosis, surgical procedure, medical history, and assessments of pain at rest and with motion, edema, scar, total active motion (TAM), and total passive motion (TPM) of the interphalangeal joints (IPJs).

Outcome measures consisted of the *Quick*DASH and PROMIS Emotional Distress: Anxiety Short Form 7a, which were obtained at the initial post-op visit, as well as the 4-week and 12-week visits. Pain, edema, wound/scar status, and range of motion were collected before surgery, at day 3, day 12 ± 2 (suture removal time frame), and weeks 3, 4, 8, and 12. The total number of therapy visits was also tracked.

Pain was evaluated using the numeric rating scale and was assessed both at rest and with active exercises. Edema was evaluated using a flexible tape measure, determining the circumference of the proximal phalanx of both the affected and unaffected (opposite) digit. At the initial postoperative visit, patients had a very light layer of 1" sterile gauze in place (Fig. 6), so the risk of contamination was very low. Measuring tapes were cleaned with rubbing alcohol before and after each use. Composite active and passive range of motion (flexion and extension) was assessed using a standard goniometer. The TAM and TPM of the IP joints were calculated. All patients were assessed with standardized, calibrated measurement tools and questionnaires to avoid potential sources of bias.[20]

Statistical analysis

Basic descriptive statistics were calculated on all independent and dependent variables. For normally distributed continuous data, means and standard deviations are reported; for ordinal data, median and interquartile range are reported. Paired-samples *t* tests measured differences between time points in continuous outcomes; two-tailed significance values are reported. Simple linear regression models estimated the effect of pain and edema on range of motion outcomes. Spearman's rank correlation estimated the strength of association between nonparametric variables. All tests performed met statistical assumptions; normality is described using Shapiro-Wilk tests. It was also assessed using quantile-quantile and probability-probability plots for visual fit to a theoretical distribution, and skewness and kurtosis were

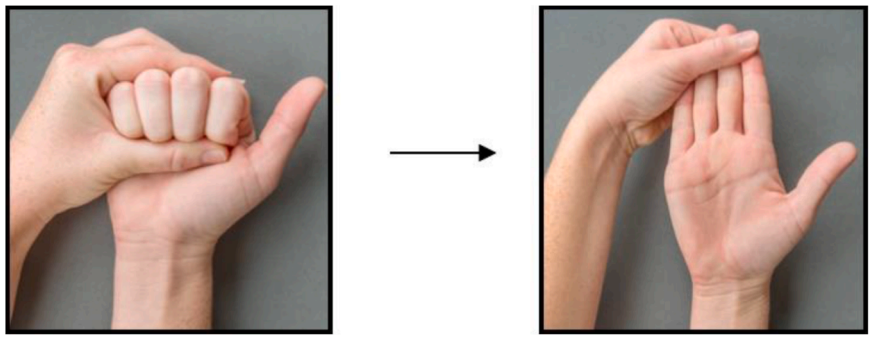

Figure 4. Passive composite ROM.

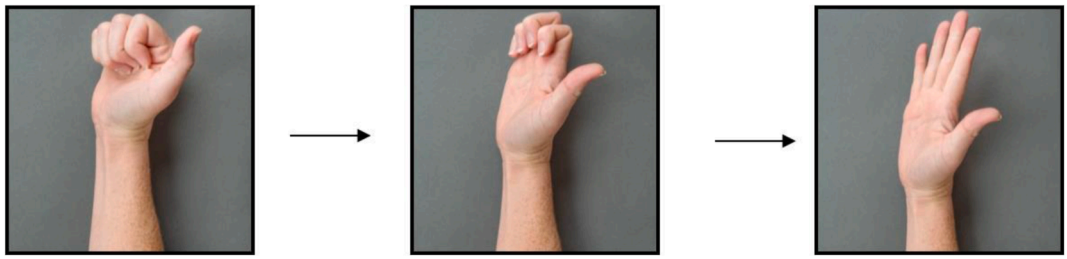

Figure 5. Differential tendon gliding.

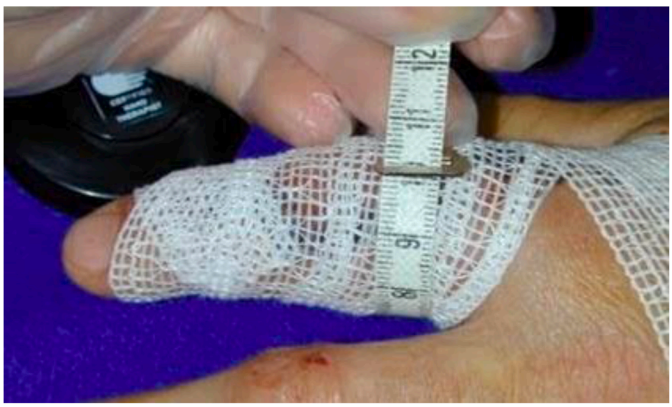

Figure 6. Circumferential edema measurement over a light layer of 1-inch sterile gauze.

assessed for absolute values within 1 and 2, respectively.[21] Heteroscedasticity was tested using the White test, Breusch-Pagan test, modified Breusch-Pagan test, and the F test; significance in any of the four tests was considered a violation of the assumption. We recorded complete data on all patients through 8 weeks; one patient failed to follow-up at the 12-week visit, resulting in missing data. *Quick*DASH was only conducted at three time points, including week 12, so 12-week analyses were explored. All other assessments use complete-case analyses, evaluating patients through week 8. Significance was set at $P < .05$; because of the small sample, statistical trends were considered at $P < .08$.

Results

Ten patients were treated by 15 therapists. Across the study duration, patients received a mean of 17 therapy visits (median: 16, interquartile range: 7). There were six females and four males; the average age was 41.6 ± 14.9 years. The dominant hand was involved in four patients and the nondominant hand in six patients. Two index fingers, one long finger, three ring fingers, and four small fingers were involved. The mechanism of initial injury consisted of five flexor tendon lacerations and five proximal phalanx fractures. A volar PIP joint capsulectomy was performed in 2 of the patients. Baseline demographic data are shown in the Table 2.

There were no ruptures or infections. One patient experienced an allergic reaction to the absorbable suture material. At day 3, two patients reported experiencing nausea within the past 12 hours.

At baseline, patients had a mean IPJ TAM of 64.0° ± 24.9° and a mean IPJ TPM of 135.5° ± 33.5°. After undergoing flexor tenolysis, the mean TAM of the IP joints increased to 142.5° ± 24.6° at 3 weeks post-op and 142.5° ± 26.3° at 8 weeks. Differences in TAM were significant between baseline and 3 weeks ($P < .001$), but there was no difference between 3 weeks and 8 weeks ($P > .99$). Assumptions for paired-samples *t* tests were met; the distributions were normal for the differences between each pair of observations (Shapiro-Wilk significance: $P = .676$ and $P = .870$, respectively). Mean TPM increased to 167.0° ± 21.4° at 3 weeks; there was no further improvement at 8 weeks (166.0° ± 22.5°). The distributions were approximately normal (as measured by the Shapiro-Wilk tests) for the differences between each pair of observations: baseline to 3 weeks ($P = .424$) and 3 weeks to 8 weeks ($P = .584$). Similar to TAM, paired-samples *t* tests revealed an improvement in TPM from baseline to 3 weeks ($P = .009$), but no difference between 3 weeks and 8 weeks ($P = .855$). At 8 weeks post-op, five patients had excellent results, three had good, and two had fair, according to the Original Strickland Classification system[20] (see Tables 1, 3, and 4).

Before the operation, edema in the affected digit exceeded the unaffected digit by 0.3 ± 0.3 cm. The difference was normally distributed (Shapiro-Wilk significance: $P = .939$) and the paired-samples *t* test revealed the difference to be significant ($P = .034$). From baseline to day 3, edema in the affected digit increased by 1.0 ± 0.2 cm, reaching a peak of 7.2 ± 1.0 cm; this difference was normally distributed (Shapiro-Wilk significance: $P = .845$) and

Table 2
Demographics

Patient	Age	Sex	Affected Digit	Mechanism of Injury	Capsulectomy Performed	Tendon(s) involved in Tenolysis	Medical History
1	18	Female	Right middle	Flexor tendon laceration	Yes, volar Proximal interphalangeal joint	Flexor digitorum Superficialis (FDS) and Flexor digitorum Profundus (FDP)	None
2	25	Male	Right small	Flexor tendon laceration	No	FDP	None
3	42	Female	Left small	Proximal phalanx fracture	No	FDS and FDP	None
4	55	Male	Right ring	Proximal and middle phalanx fractures	No	FDS and FDP	High blood pressure
5	70	Female	Left ring	Middle phalanx fracture	Yes, volar Proximal interphalangeal joint	FDS and FDP	High blood pressure, diabetes, heart condition, bleeding
6	45	Male	Right small	Flexor tendon laceration	No	FDS and FDP	None
7	47	Female	Left index	Flexor tendon laceration	No	FDS and FDP	Bleeding
8	35	Female	Left small	Proximal phalanx fracture	No	FDP and FDS	None
9	33	Male	Left ring	Flexor tendon laceration	No	FDS and FDP	Anxiety, depression
10	46	Female	Left index	Proximal phalanx fracture	No	FDP	None

Table 3
Total Active Motion of the IP Joints

Patient	Baseline	Day 3	Day 12 ± 2	Week 3	Week 4	Week 8	Week 12
1	95°	85°	140°	145°	135°	165°	165°
2	95°	70°	140°	155°	160°	160°	155°
3	80°	95°	155°	155°	165°	160°	170°
4	65°	40°	80°	90°	95°	105°	95°
5	45°	85°	130°	150°	150°	145°	135°
6	65°	65°	100°	110°	90°	95°	85°
7	40°	85°	130°	140°	140°	130°	125°
8	15°	115°	155°	175°	175°	175°	160°
9	70°	55°	145°	150°	145°	166°	N/A
10	70°	90°	115°	155°	155°	135°	145°
Mean:	64°	78.5°	129.0°	142.5°	141.0°	142.5°	137.2°

Table 4
Range of Motion Values Preoperation and Postoperation

Variable	Value	Shapiro-Wilk Sig. (P)
TAM (baseline)	64.0 ± 24.9°	.502
TAM (3 d)	78.5 ± 21.5°	.868
TAM (3 wk)	142.5 ± 24.6°	.053
TAM (8 wk)	142.5 ± 26.3°	.344
TPM (baseline)	135.5 ± 33.5°	.267
TPM (3 d)	127.5 ± 23.7°	.520
TPM (3 wk)	167.0 ± 21.4°	.267
TPM (8 wk)	166.0 ± 22.5°	.002

TAM, total active motion; TPM, total passive motion.

significant ($P < .001$). After day 3, the average edema in the affected digit gradually tapered (Fig. 7 and Table 5).

Simple linear regression revealed that the amount of edema on the third day after operation predicted TAM at the same session ($R^2 = 0.845$; $P < .001$). This relationship persisted for 8 weeks: edema at day 3 predicted TAM at week 8 ($R^2 = 0.478$; $P = .027$). Each additional millimeter of edema corresponded to 20.1° less range of motion at day 3 (95% CI of β: −27.1 to −13.1) and 1.8° less range of motion (95% CI of β: −3.4 to −0.3) at week 8. All values assessed were normally distributed, and each regression model met the assumption of homoscedasticity. When controlling for baseline range of motion (dependent variable is baseline degrees subtracted from week 8 degrees), this relationship persisted. Each millimeter of edema in the affected digit at day 3 predicted 2.3° lower TAM at week 8 ($R^2 = 0.413$; $P = .045$; 95% CI of β: −4.6 to −0.1). The dependent variable was normally distributed (Shapiro-Wilk significance: $P = .282$), and the model met the assumption of homoscedasticity (see Table 5).

Relationships were similar with TPM: edema on day 3 predicted lower TPM at the same session ($R^2 = 0.543$; $P = .015$; 95% CI of β: −31.1 to −4.5); values were normally distributed, and the assumption of homoscedasticity was met. At week 8, TPM values were not normally distributed; Spearman rank correlation revealed a trending relationship ($\rho = -0.616$; $P = .058$).

Similar to edema, pain with motion peaked at day 3 and showed a gradual decline (see Fig. 8 and Table 6). At each testing session, pain with motion was related to TAM. At day 3, each additional point of pain corresponded to a reduction in IPJ TAM of 6.1° ($R^2 = 0.408$; $P = .047$; 95% CI of β: −12.0 to −0.1). At week 3, each additional point of pain predicted a reduction of 8.3° ($R^2 = 0.612$; $P = .008$; 95% CI of β: −13.7 to −2.9). At week 8, each additional point of pain predicted a reduction of 10.7° ($R^2 = 0.640$; $P = .005$; 95% CI of β: −17.2 to −4.1). For each of the three regressions, predictor and dependent variables were approximately normal in their distribution (TAM at week 3 was borderline abnormal; Shapiro-Wilk significance was $P = .053$, and the skewness was −1.3); each model met the assumption for homoscedasticity.

*Quick*DASH was captured at baseline (18.5 ± 12.6), postoperation day 3 (74.0 ± 15.9), week 4 (26.8 ± 15.7), and week 12 (11.6 ± 9.0). All combinations of differences between time points for the *Quick*DASH score were normally distributed (Shapiro-Wilk tests for each combination: $P > .230$), permitting paired-samples t tests of day 3 to week 4 (Shapiro-Wilk $P = .278$) and baseline to week 12 (Shapiro-Wilk $P = .429$). From day 3 to week 4, *Quick*DASH score decreased by 45.0 ± 17.2 points ($P < .001$) (see Table 7). At week 12, the average score was 37.1% less than the preoperative average, but this difference did not reach significance ($P = .146$).

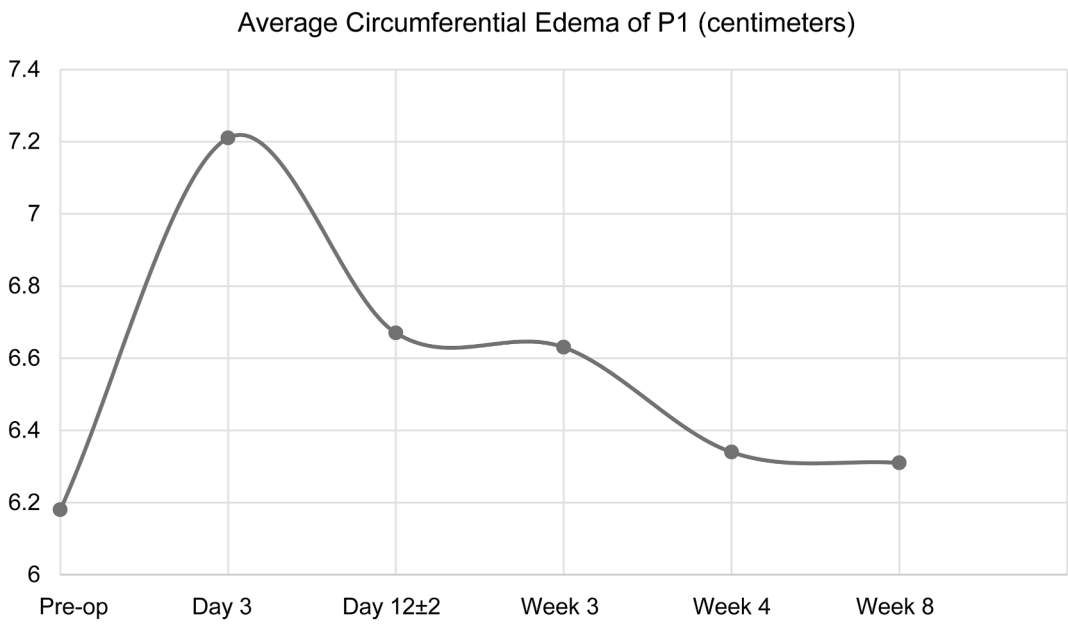

Figure 7. Average circumferential edema of P1 (centimeters).

Table 5
Edema Measurements Preoperation and Postoperation

Variable	Value	Shapiro-Wilk Sig. (*P*)
Baseline injured digits	6.2 ± 0.9 cm	.751
Baseline contralateral digit	5.9 ± 0.9 cm	.580
Postoperation 3 d	7.2 ± 1.0 cm	.505
Postoperation 10–14 d	6.7 ± 0.9 cm	.544
Postoperation 3 wk	6.7 ± 0.9 cm	.325
Postoperation 8 wk	6.5 ± 0.9 cm	.194

Anxiety scores on the PROMIS Emotional Distress scale also decreased by 14.6% between day 3 (53.4 ± 6.3) and week 4 (45.6 ± 8.4; $P = .008$), with only one patient exhibiting mild anxiety at week 4 (see Table 8). Assumptions were met for the paired-samples t test; the change between time points was normally distributed (Shapiro-Wilk significance: $P = .227$). The number of therapy visits patients had was related to the excess swelling in the affected digit at baseline ($\rho = 0.844$; $P = .002$), pain with motion at week 3 ($\rho = 0.783$; $P = .007$), and passive range of motion ($r = -0.768$; $P = .010$).

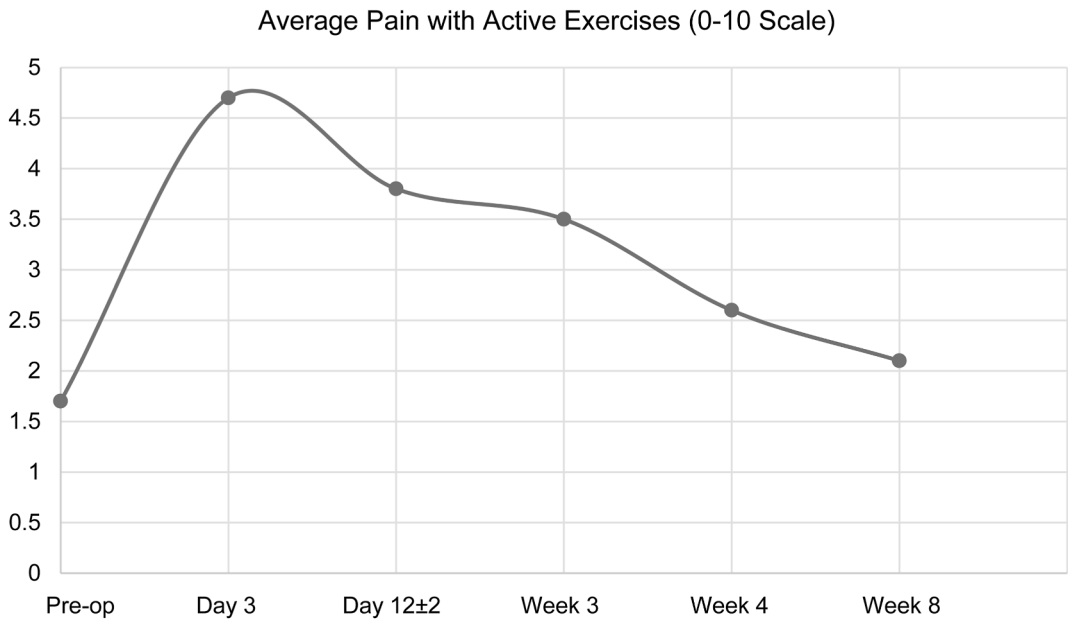

Figure 8. Average pain with active exercises (0–10 scale).

Table 6
Pain With Motion as Reported by the Numeric Rating Scale

Variable	Mean ± SD	Median	IQR	Shapiro-Wilk (*P*)
Baseline	1.7 ± 2.0	1.5	3	.046
3 d	4.7 ± 2.3	4.0	4	.081
3 wk	3.5 ± 2.3	3.0	3	.690
8 wk	2.1 ± 2.0	2.0	3	.307

Table 7
*Quick*DASH

Patient	3 D	4 Wk	Difference
1	86.3	47.7	↓ 38.7
2	84.1	18.2	↓ 65.9
3	43.2	15.9	↓ 27.3
4	81.8	13.6	↓ 68.2
5	90.9	40.9	↓ 50
6	77.3	52.3	↓ 25
7	81.8	15.9	↓65.9
8	59.1	22.7	↓ 36.4
9	63.6	38.6	↓ 25
10	61.0	13.7	↓47.4
Mean	72.92	27.94	↓ 44.98

Table 8
PROMIS Emotional Distress: Anxiety Short Form 7a

Patient	3 D	Category—Anxiety	4 Wk	Category—Anxiety
1	52.6	None to slight	36.3	None to slight
2	58.8	Mild	36.3	None to slight
3	42.1	None to slight	36.3	None to slight
4	44.7	None to slight	36.3	None to slight
5	60.0	Moderate	52.6	None to slight
6	58.8	Mild	51.3	None to slight
7	52.1	None to slight	47.8	None to slight
8	52.6	None to slight	48.4	None to slight
9	52.6	None to slight	57.6	Mild
10	60.0	Moderate	52.6	None to slight

Discussion

The majority of patients recovered well when initiating therapy on day 3 post-op. Mean TAM reached 142.5° at 3 weeks post-op, and that improvement was maintained without change at week 8. On average, patients recovered 91% of their 8-week motion by the second follow-up appointment (10–14 days) and 100% of their 8-week motion by week 3. Because range of motion gains were predominantly made during the first 2–3 weeks, it is critical to emphasize the importance of initial post-op therapy to the patients. If patients are not doing well at 2–3 weeks, they will likely require more therapy visits to obtain their desired range of motion. In our sample, there were two patients who were categorized as poor at the 3-week assessment; these patients required the most therapy sessions.

Total active motion is expected to increase an average of 55°–60° after flexor tenolysis.[12,22] Patients in our study gained an average of 79° of IP range of motion, demonstrating the safety of delaying therapy to day 3 and achieving superior active motion. In flexor tenolysis studies using the Strickland criteria, 68% report good or excellent outcomes.[11] Eighty percent of the patients in our study achieved good or excellent results, demonstrating superior results by waiting 3 days to initiate range of motion. Of the 10 patients in our study, 2 scored in the fair category at 8 weeks post-op according to the Original Strickland Classification system. Both patients had documented issues of compliance early in the rehabilitation process and formed thick, dense scar tissue. It is imperative that patients are made aware of the time requirements that postoperative flexor tenolysis demands. All patients pending a flexor tenolysis would benefit from a pre-op therapy assessment to evaluate baseline pain, edema, and range of motion, as well as provide critical education on the guidelines after surgery.[23] Patients are often unaware of optimal exercise frequency and how critical the first 3 weeks are to long-term outcomes. While providing preoperative and initial postoperative patient education, therapists can emphasize the importance of the first 3 weeks to achieving the best overall outcome.

In this study, persistent pain and edema in the early weeks of therapy were found to be associated with decreased total active and passive IP range of motion. Pain can be managed through medication and therapy interventions where indicated, along with the resting orthosis. Patients with increased edema at day 3 post-op were more likely to have decreased range of motion, and the decrease in motion was observed through 8 weeks post-op. Edema generates tension on the skin and internal digital structures, which leads to decreased active motion.[24] Persistent edema can be managed with compressive dressings, elevation, and the resting orthosis. Early and effective management of pain and edema is critical to ensuring a positive outcome. Similar to flexor tendon repair research, delaying the initiation of therapy following flexor tenolysis can reduce pain and edema, allowing better tendon gliding and increased range of motion.[14–16] These findings may also apply to other surgical procedures where therapy is traditionally started the day after surgery. Delaying therapy can mitigate the immediate ill effects of surgery (eg, pain, edema, nausea, wound separation/infection) and provide quality outcomes for patients undergoing this procedure.

Limitations

This is a pilot study with a sample of 10 patients. Typical of small samples, modest overdispersion was characteristic in multiple variables; however, all data used in parametric analyses passed the Shapiro-Wilk test for normality. Although all models met the homoscedasticity assumption using all four employed tests, homoscedasticity testing is underpowered in small samples. Additionally, without a control group, we were unable to perform comparative analyses. The timing of our data collection also presents limitations. We investigated delaying therapy until 3 days post-op, but there may be a more optimal duration of delay, which future research can confirm (eg, post-op day 5 in cases of notable edema). The precise time course of change in pain, edema, and function remains unknown because of the limited number of data collection sessions in our study. Lastly, there were 15 therapists treating and evaluating the patients because of the large size of the main clinic and the number of satellite offices. We attempted to minimize the magnitude of this limitation by providing all therapists with detailed training to ensure the rehabilitation guidelines were followed, and all patients were evaluated in a similar manner. Although statistical significance was achieved in numerous analyses, further research with larger samples is necessary to confirm the strength and directionality of our findings.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Ethical Approval

This study was approved by our institutional review board.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Conflicts of Interest

No benefits in any form have been received or will be received related directly to this article.

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