Passive Manipulation for Proximal Interphalangeal Joint Extension Contractures

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Purpose We investigated closed passive manipulation as an alternative to surgery for certain proximal interphalangeal (PIP) joint extension contractures.

Methods We retrospectively reviewed all patients with PIP joint extension contractures treated with passive manipulation at our institution between 2015 and 2019. The included patients were a minimum of 12 weeks from their initial injury/surgery (median 179 days; interquartile range: 130−228 days), had plateaued with therapy, and underwent a 1-time passive manipulation. All included fingers had congruent PIP joints and no indwelling hardware that could have had direct adhesions. Most (80%) patients had a direct injury to the finger ray(s) that led to the contractures. Most (75%) patients had the manipulation performed under local anesthesia in the office. Available measures of passive range of motion (PROM) and active range of motion (AROM) immediately, within 6 weeks, between 6 and 12 weeks, and at >12 weeks after the manipulation were recorded.

Results Twenty-eight patients and 46 digits met the criteria. The median PIP joint PROM improved from 50° to 90° immediately following the manipulation. The median PROM values within 6 weeks, between 6 and 12 weeks, and at >12 weeks following manipulation were 80°, 85°, and 85°, respectively. The median AROM immediately after the manipulation improved from 40° to 90°, and the median AROM values within 6 weeks, between 6 and 12 weeks, and at >12 weeks were 70°, 50°, and 60°, respectively. None of the patients experienced worsening of PIP joint range of motion. One patient who had 4 fingers manipulated had a 45° distal interphalangeal joint extension lag for one of the fingers after the manipulation. Eight fingers underwent later flexor tenolysis or reconstruction to improve AROM after the gains in PROM via manipulation were maintained.

Conclusions Passive manipulation is an alternative to surgical release for select PIP joint extension contractures. *(J Hand Surg Am. 2023;48(7):737.e1-e10. Copyright © 2023 by the American Society for Surgery of the Hand. All rights reserved.)*

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PROXIMAL INTERPHALANGEAL (PIP) joint stiffness remains an unsolved problem in hand surgery. Finger stiffness may result from injuries to the skin, subcutaneous tissues, muscles, tendons, capsule, ligaments, cartilage, and bones. Such injuries can lead to PIP joint flexion or extension contractures.[1] The inflammation, edema, pain inhibition, and immobilization following a traumatic injury contribute to the development of PIP joint stiffness.[2]

Restoration of anatomy, edema control, and proper immobilization and mobilization following an injury is paramount; however, despite best practices, the PIP joint may still develop limitations after direct or indirect trauma.[3] Nonsurgical management via hand therapy is the first-line treatment for PIP joint extension contractures.[1–5] Surgical management is reserved for patients who have plateaued after several months of nonsurgical care and still have unacceptably restricted motion.

Curtis[6] published their experience with surgical management of flexion and extension contractures of the interphalangeal joints in 1954, reporting moderate success in improving range of motion (ROM). Since then, authors have conveyed variable results following surgical management of PIP joint extension contractures.[7–15] Some studies have reported that patients did not demonstrate any improvement or even worsened after surgery.[6,7,10–12,14,15] These findings suggest that surgical release has risk, and additional inflammation, edema, and scarring associated with surgery can lead to worse stiffness in some cases. Furthermore, recent literature on treatment options and outcomes for PIP joint extension contractures is lacking in general. Preoperative risk versus benefit discussions should take these elements into account.

At our institution, some surgeons consider that passive manipulation of PIP joint extension contractures is an alternative for persistently symptomatic patients who have plateaued with nonsurgical management. Our approach is to apply gentle passive PIP joint manipulation, with goals of improving motion and avoiding injuries that could occur with an overly aggressive manipulation. This is akin to the passive manipulations performed for knee extension contractures.[16] Such manipulations may allow patients to avoid surgery for PIP joint extension contractures and induce less inflammation and scarring than after surgical release. Our goal with manipulation is to achieve as much passive ROM (PROM) as possible, especially passive PIP flexion, similar to the primary purpose of extensor tenolysis and dorsal joint releases. In our experience, patients with adequate and sustained PROM following manipulation, similar to traditional surgical treatment, fall into 2 categories: (1) those who also have sufficient gains in the active PIP flexion and do not need additional interventions; and (2) those who do not achieve gains in the active PIP flexion and are offered flexor tenolysis and/or flexor tendon reconstruction.

Passive manipulation has been reported to successfully treat finger stiffness secondary to reflex sympathetic dystrophy, also known as complex regional pain syndrome type I, and persistent PIP joint flexion contracture following fasciectomy for Dupuytren contracture.[17–22] It has also been used as an adjunct to surgical release for certain contractures.[23,24] Although not an entirely novel concept, passive manipulation for PIP joint extension contractures has not been extensively studied or implemented in practice. We hypothesized that PIP joint manipulation in certain clinical situations would lead to clinically relevant improvements in PIP joint flexion. Our primary goal was to compare our patients' premanipulation PROM to immediate postmanipulation PROM. Our secondary goals were to compare the same patients' premanipulation PROM to later-term postmanipulation PIP joint PROM and to assess changes in the active ROM (AROM) at all available time points.

MATERIALS AND METHODS

This study was initiated after obtaining approval from the institutional review board. We generated a list of 97 patients via Current Procedural Terminology codes for digital manipulation through our center from 2015 to 2019 and performed a retrospective chart review to determine study eligibility. The included patients with PIP joint extension contractures had reached a shared decision to attempt to improve ROM. The patients were a minimum of 12 weeks from whatever incident led to the contracture and had plateaued in their improvement with therapy, thus traditionally being surgical candidates. The included patients had radiographic confirmation of adequate PIP joint architecture to consider surgical release or, in these cases, manipulation. Moreover, the included patients had premanipulation PROM and, usually, AROM, recorded in their chart. The exclusion criteria were patients with isolated PIP joint flexion contractures, patients undergoing other procedures at the same time as the manipulation (12 patients), insufficient documentation of premanipulation and/or immediate postmanipulation PROM (40 patients), patients with retained hardware that could have direct adhesions (eg, proximal phalanx plates) and were thus deemed not appropriate for manipulation alone and had manipulation in addition to hardware removal (3 patients), and patients who underwent early manipulation before being at least 12 weeks from the contracture-inciting event and/or multiple manipulations in relatively rapid succession with repeat manipulation before reaching another therapy plateau (14 patients). These final exclusion criteria of earlier and repeated manipulations are indicative of a different approach by one of our surgeons. For the current study, we sought to evaluate the manipulation as an alternative to traditional surgery, which is the approach used most often by our providers who offer manipulation. Using the above criteria, we only included patients who were at a point where they could continue as they were without further intervention, pursue a traditional surgical option, or undergo manipulation.

Potential compliance with therapy was deemed part of routine shared decision-making when contemplating whether to proceed with manipulation or surgical release. However, we had no specific inclusion/exclusion criteria regarding potential therapy compliance.

Demographic information and the presence of comorbidities, including body mass index of >30 kg/m^2, coronary artery disease, hypertension, diabetes mellitus, and smoking history, were recorded. In addition, the affected hand and digit(s), mechanism/type of injury, initial treatment, subsequent treatments, and time from initial injury/surgery to manipulation were recorded.

Passive manipulation was performed in either the clinic or the operating room by 1 of 3 attending surgeons. A digital nerve block was given when the manipulation was performed in the office. The PIP joint was manipulated into flexion via gradual, gentle pressure applied by the surgeon to the middle phalanx. This was performed with the metacarpophalangeal joint both in extension and flexion to influence both the intrinsic and extrinsic extensor contributions to the PIP joint contracture. After recording the postmanipulation ROM, one of the surgeons usually gave an injection of corticosteroid into each manipulated PIP joint, whereas the other 2 surgeons did not. The use of steroid injection and complications after the manipulations were recorded.

After the manipulation, patients performed passive and active ROM of the PIP joint, including intrinsic and extrinsic extensor stretches, on their own as directed by their surgeon and/or therapist. Patients were also referred to hand therapy 1−3 times/week, until they were able to transition to a home program or reach a plateau in ROM. No specific postmanipulation orthosis fabrication protocols were used, although orthoses could be used as needed for ROM, unless specifically contraindicated. The available ROM recordings at subsequent visits were collected. Ranges of motion were measured by either the surgical team or therapist using their standard technique, unless the ROM was full and equal to the nonaffected digits and indicated as such.

We defined clinically relevant improvements in ROM as >10°; this also exceeds a reasonable standard error of the mean with goniometric measurements of PIP joints (4° to 6°).[25,26] Our primary outcome was the immediate change in premanipulation to postmanipulation PIP joint PROM. Other outcomes included the immediate change in AROM as well as PROM and AROM at follow-up visits within 6 weeks, between 6 and 12 weeks, and at >12 weeks following manipulation. The other outcomes were the recorded complications, meeting indications for surgical release of PIP joint extension contracture after the manipulation and return to a plateau in improvement, and any additional procedures following manipulation.

Given the nonnormal distribution and unbalanced nature of our available data, we used nonparametric analysis tools. We performed a Skillings-Mack test to determine statistically significant differences for repeated ROM measures over time. Analysis of changes in ROM from premanipulation to each postmanipulation time point was performed with a Wilcoxon matched-pairs signed-rank test, with statistical significance defined as $P < .05$. Bivariate linear regression was used to explore whether independent variables of sex, body mass index >30 kg/m^2, age, smoking, concurrent steroid injection, multidigit involvement, or provider could be associated with an absolute change in the dependent variable of PROM following manipulation at each time point. Our sample size estimates including these variables were determined via Pearson correlation test, seeking sufficient power to demonstrate a moderate-grade correlation coefficient of 0.50 with regard to association with the change in PROM, if present, using a 2-sided hypothesis test with a significance level of 0.05.[27] This analysis revealed that a sample size of 29 was required to detect this degree of correlation.

RESULTS

Twenty-eight patients with 46 manipulated fingers met the criteria. Table 1 summarizes the demographic and study characteristics of the cohort. Table 2 summarizes the injuries and initial treatment before the manipulation and any surgeries after the manipulation. Fifteen (33%) PIP joints received a 20-mg triamcinolone injection and 3 (7%) PIP joints received a 3-mg betamethasone injection at the time of manipulation. One patient with 2 (4%) manipulated fingers was prescribed an oral Medrol Dosepak

TABLE 1. Patient Demographics (n = 28)

Patient Characteristics	Median (Interquartile Range)	n (%)
Age	54 (39−65)	
Sex		
Male		13 (46%)
Female		15 (54%)
Comorbidities		
Body mass index >30 kg/m^2		6 (21%)
Diabetes		4 (14%)
Smoking		2 (7%)
Time from injury/surgery, d	179 (130−228)	
Manipulation setting		
Operating room		7 (25%)
Clinic		21 (75%)
Follow-up, d	58 (19−121)	

immediately following manipulation. Two patients had concomitant stellate ganglion blocks at the time of manipulation in the operating room.

Table 3 details the data available for each patient at each time point. Table 4 summarizes the changes in ROM at all time points following manipulation, all of which were significantly improved compared with premanipulation for the same patients. Figures 1 and 2 demonstrate 2 clinical cases of immediate and sustained improvements in the PIP joint ROM following manipulation.

The bivariate linear regression analysis revealed that age and female sex were positively correlated with a greater immediate change in PROM (0.58° per each year of increasing age, $P < .05$; and 16° greater change for women, $P < .05$). Concurrent triamcinolone injection was associated with 16° of greater improvement in PROM immediately following manipulation ($P < .05$), 19° within 6 weeks following manipulation ($P < .05$), and 18° between 6 and 12 weeks following manipulation ($P < .05$). (Table 5) We did not have adequate power to evaluate the association between injection and change in PROM at >12 weeks since 29 samples would have been needed to detect the moderate correlation we chose to seek *a priori*. We were underpowered to evaluate for associations with changes in PROM for any of our recorded comorbidities.

One patient developed a 45° active extension lag at the distal interphalangeal joint of the middle finger

TABLE 2. Distribution of Injuries and Interventions

Patient Injuries and Interventions	n (%)
Hand injured	
Left	15 (54%)
Right	13 (46%)
Finger injured	
Index	6 (13%)
Middle	14 (30%)
Ring	15 (33%)
Small	11 (24%)
Patients with multiple fingers injured	12 (43%)
Finger or patient injuries (some fingers or patients had >1 injury)	
Finger fracture	18 (39%)
Open finger injury (GSW, log splitter, or power saw)	9 (19%)
PIP joint dislocation	7 (15%)
PIP joint sprain	5 (11%)
Distal radius fracture	2 (4%)
Perilunate dislocation	1 (2%)
Finger tendon injury	8 (17%)
Digital artery injury	4 (9%)
Digital nerve injury	10 (22%)
Swan neck deformity	2 (4%)
Boutonniere deformity	1 (2%)
Infection	1 (2%)
Finger treatments before the manipulation	
Closed reduction	9 (20%)
Kirschner wire fixation	11 (24%)
Plate fixation*	5 (11%)
Screw fixation	1 (2%)
Flexor tendon repair	5 (11%)
Extensor tendon repair	3 (7%)
Digital artery repair	4 (9%)
Digital nerve repair	10 (22%)
Fingers with additional procedures after the manipulation	
Flexor tenolysis	6 (13%)
Extensor tenolysis†	1 (2%)
Flexor tendon reconstruction	2 (4%)
DIP joint fusion	1 (2%)

DIP, distal interphalangeal; GSW, gunshot wound.

*One patient underwent open reduction internal fixation of a distal radius fracture with a volar locking plate and later had 4 stiff fingers treated with passive manipulation; another patient had a bridging plate placed across the metacarpophalangeal joint for a small finger replant that was removed before the finger was manipulated.

†One finger underwent a later extensor tenolysis to help improve active extension after improvement in passive motion following manipulation.

TABLE 3. Patient Follow-Up Data Availability at Different Time Points After Passive Manipulation*

Patient No.	No. of Fingers Injured	<6 Weeks	6−12 Weeks	>12 Weeks
1	1	Yes	Yes	Yes
2	2	Yes	Yes	Yes
3	4	Yes	No	Yes
4	2	Yes	No	Yes
5	3	Yes	Yes	Yes
6	3	Yes	Yes	Yes
7	1	Yes	Yes	Yes
8	1	Yes	No	Yes
9	1	Yes	Yes	Yes
10	2	Yes	Yes	No
11	1	Yes	No	No
12	1	No	No	No
13	1	Yes	No	No
14	1	No	No	No
15	1	Yes	No	No
16	2	No	Yes	No
17	4	Yes	Yes	No
18	2	No	No	No
19	1	Yes	No	No
20	1	Yes	No	No
21	1	Yes	No	No
22	2	Yes	Yes	No
23	1	Yes	No	No
24	2	Yes	Yes	No
25	1	Yes	No	No
26	2	Yes	No	Yes
27	1	No	No	No
28	1	No	No	No

*All time points indicated as “Yes” had data available; if PROM was not recorded but AROM was, we included the AROM values in the PROM analyses, given that PROM values would have been equal to or better than AROM.

after the manipulation of all 4 fingers (Fig. 2). This patient was started on a nighttime orthosis and continued to work on flexion while awake to not lose the gains achieved. The patient was later discharged with no further treatment indicated or requested. No patients underwent subsequent surgery for inadequate passive PIP joint flexion while under our care, though we were unable to determine if they had surgery elsewhere. Eight fingers, all with prior open injuries, had adequate gains in PROM after the manipulation and inadequate improvement in active flexion and later underwent flexor tenolysis or tendon reconstruction to address this. One of these was a small finger that subsequently developed necrosis at the distal phalanx level and underwent distal interphalangeal joint disarticulation. This was not thought to be associated with the prior passive manipulation.

DISCUSSION

Our cohort had a median immediate improvement in the PIP joint PROM of 40°—from a median arc of 50° before the manipulation to 90° after the manipulation (interquartile range, 85° to 105°). This result supports our primary hypothesis that PIP joint manipulation can lead to clinically relevant improvements in PROM for certain extension contractures. These results are comparable to the immediate PROM values following surgical release reported in

TABLE 4. Change in PIP Joint ROM Postmanipulation

	Premanipulation Median Arc (°) (IQR)	Postmanipulation Median Arc (°) (IQR)	△ ROM (°)	*P* Value
Premanipulation to immediate postmanipulation				
PROM (n = 46)	50 (40−70)	90 (85−105)	40	<.05
AROM (n = 17)	40 (50−65)	90 (70−90)	50	<.05
Premanipulation to within 6 weeks postmanipulation				
PROM (n = 36)	55 (40−70)	80 (70−90)	25	<.05
AROM (n = 34)	44 (30−60)	70 (50−81)	26	<.05
Premanipulation to between 6 and 12 weeks postmanipulation				
PROM (n = 19)	55 (40−70)	85 (70−90)	30	<.05
AROM (n = 19)	40 (15−55)	50 (25−90)	10	<.05
Premanipulation to >12 weeks postmanipulation				
PROM (n = 15)	55 (40−70)	85 (70−95)	30	<.05
AROM (n = 17)	42 (5−65)	60 (0−75)	18	<.05
Skillings-Mack repeated measures analysis for changes in ROM across all time points				
PROM				<.05
AROM				<.05

△ ROM, change in ROM; IQR, interquartile range; n, number of fingers available at each time point.

the literature, although we can make no comparisons to current surgical outcomes. Lutsky et al[14] reported that patients with flexion and extension contractures have an average starting PROM arc of 60°. The patients achieved full passive flexion and extension at the time of surgical release, demonstrating a net gain of approximately 40°.[14]

Beyond the immediate postmanipulation results, some of our patients had limited follow-up recorded because of being discharged with a satisfactory outcome, differences between surgeons' follow-up routines, failing to return for scheduled visits, or for other unknown reasons that could include dissatisfaction or seeking care elsewhere. Many of the patients who continued the visits did so to ensure that they maintained their PROM gains as they awaited further interventions. Based on our mid-term data, manipulation led to reasonably well-sustained improvements in PROM, comparable with those historically reported for surgical release.

As is often the case with surgical releases for PIP joint extension contractures, the main goal for our manipulations was to regain and maintain PROM, with the understanding that later flexor tenolysis or reconstruction may be required to regain active flexion, depending on the underlying pathology. Nevertheless, our patients who had immediate AROM recorded achieved a median gain of 50° following manipulation. Sprague[7] reported an average 52° increase in AROM immediately following capsulectomy and collateral ligament excision for PIP joint flexion and extension contractures.[7] Additionally, our patients who underwent later flexor tenolysis/reconstruction to improve active flexion were at least able to avoid surgical intervention for PIP joint extension contracture beforehand.

Although still significantly improved from the baseline, the median change in AROM decreased from 50° immediately postmanipulation to approximately 26° within 6 weeks, 10° between 6 and 12 weeks, and 18° at >12 weeks. This could reflect selection/attrition bias as patients who required later procedures to regain active flexion continued to follow-up more than those who did not. Nonetheless, these AROM results are comparable with those in the literature for surgical release, as summarized in Table 6.[7,9−14,28]

As previously mentioned, although clinical outcomes overall are favorable enough for surgeons to continue offering surgery for PIP joint extension contractures, many investigators have reported either no improvement or even worsening of ROM.[6,7,10−12,14,15] Mansat and Delprat[10] noted that 33% of their patients either had no improvement or worsening ROM, whereas Ghidella et al[12] reported that 29% of their patients lost motion after surgical

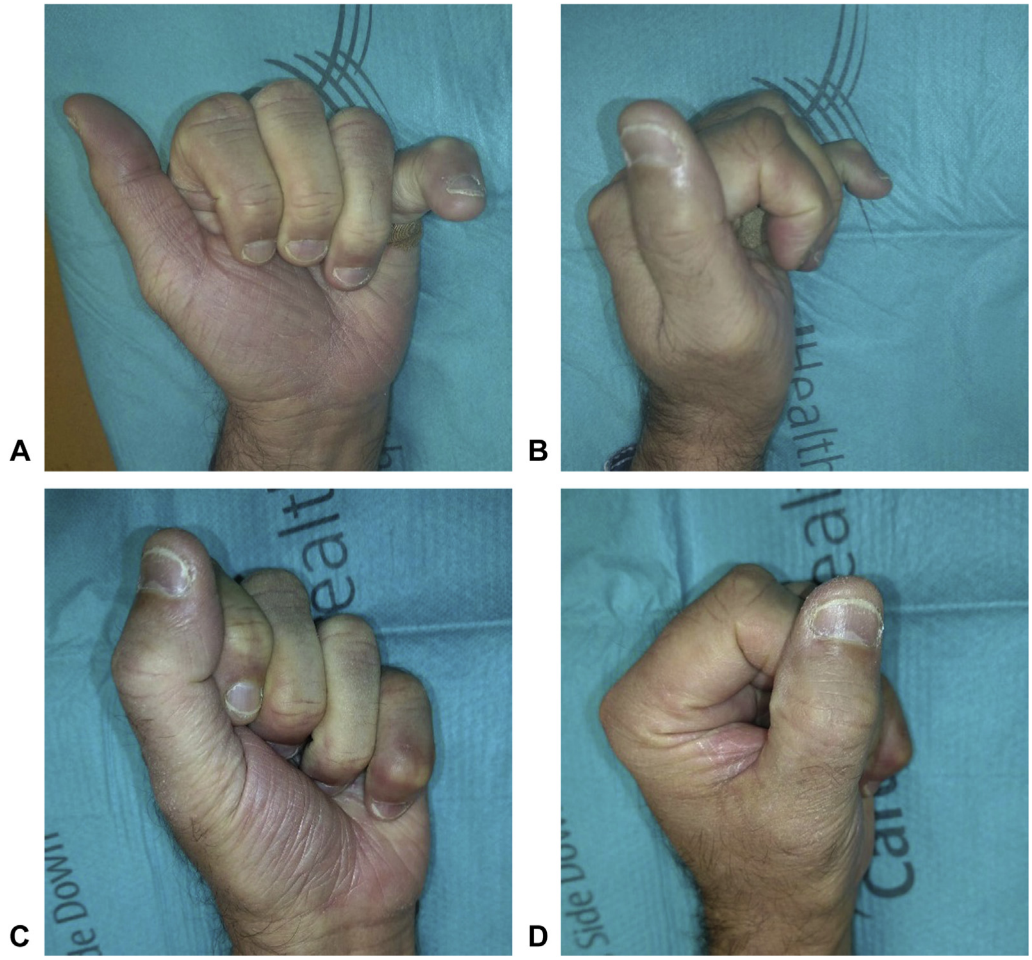

FIGURE 1: Passive manipulation of the left small finger PIP joint in a clinic. **A, B** PIP joint hyperextension contracture/swan neck deformity of the small finger from a prior (151 days) open PIP dislocation and 0° of PROM and AROM before the manipulation. **C, D** The 70° of PROM and AROM of the small finger PIP joint <6 weeks following manipulation, with the patient able to achieve palmar touchdown. The patient was pleased with their result and believed they did not need to follow-up again.

intervention. However, the latter report had more patients with flexion contractures, multiple procedures, and longer-term follow-up.[10,12] No patient in our cohort had worse motion recorded compared with that before the manipulation.

Proximal interphalangeal joint injection with triamcinolone after the manipulation was positively correlated with immediate changes in PROM, within 6 weeks, and between 6 and 12 weeks of manipulation. Given that the steroid would not have an immediate effect, at least the association with an immediate change in PROM is likely related to provider, patient, or other unknown reasons. The steroid injection cohort with >12-week follow-up and the stellate ganglion block cohort at all time points were underpowered, and there may be an association in the change in ROM that we were unable to detect. Regardless, we cannot make any firm conclusions currently about the ultimate relation between intra-articular or stellate ganglion steroid administration and ROM outcomes. The positive association between increasing age and PROM immediately following manipulation is also potentially biased because of our sample sizes. The positive association between female sex and PROM improvement immediately following manipulation may be attributable to a worse starting arc (40° compared with 58°). All the above associations should be considered exploratory, given that our sample sizes for each finding are too small to allow multivariable analyses. This negated our ability to control for confounding variables and determine independent associations.

Our study has several further limitations. First, we had no control or comparison group. Also, the gaps in recorded ROM resulted in patient exclusion. In particular, 40 of 97 (41%) potential patients were excluded for missing premanipulation and/or immediate postmanipulation PROM data. Inclusion of their

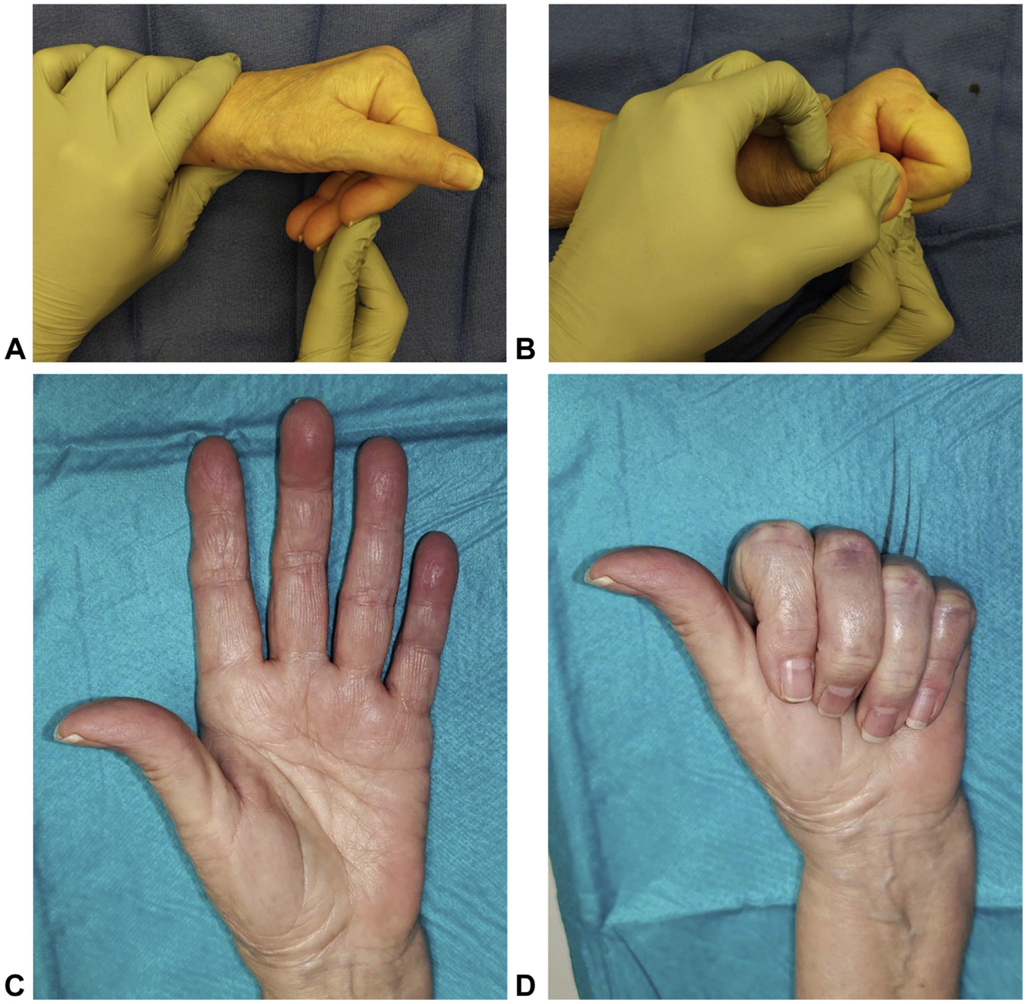

FIGURE 2: Passive manipulation of the left index, middle, ring, and small fingers under general anesthesia. The patient had finger stiffness 228 days after a distal radius fracture was treated with closed reduction/casting. **A** Premanipulation PROM increased to **B** 110° in all 4 PIP joints immediately after the manipulation. **C** AROM of 90° for all 4 PIP joints with **D** palmar touchdown 6 weeks following passive manipulation. The patient had a 45° middle finger distal interphalangeal active extension lag at this time point.

outcomes, if they had been available, could have had a substantial impact on our results and conclusions. Patients who achieved satisfactory gains in ROM immediately or early in their course following manipulation were either discharged or did not return for further follow-up, whereas those awaiting later procedures continued to follow-up. The overall length of follow-up for our study was also relatively short.[7–15] Nevertheless, the timeline of data available was consistent with our typical clinical practice, with patients discharged if they did not warrant, or wish to pursue, any further interventions or were able to continue with self-care. It is possible that more patients than were documented in our records had subsequent worsening of ROM and never returned to our care, which would have influenced our results and conclusions. Ultimately, the reasons for each case of limited data cannot be definitively determined and may have biased our findings. Collecting broader data prospectively with longer follow-up and patient incentives to maintain engagement could improve on our efforts. Also, our analyses were by fingers, which are not independent for patients with multifinger inclusion. We accounted for this as best as possible with our repeated measures and bivariate analyses.

We likely had variation between providers for their definition of when a patient had reached a plateau in improvement following their contracture-inciting event. While accounting for what some may consider an early inclusion of those >12 weeks from injury, our cohort had a median of 6 months between contracture-inciting event and manipulation. We were also unable to collect consistent data on therapy adherence or patient-reported outcomes before and

TABLE 5. Bivariate Regression Analyses*

Significant Patient or Treatment Characteristics	Coefficient	*P* Value
Outcome: PROM change from premanipulation to immediate postmanipulation (n = 46)		
Age	0.58 (0.20, 0.97)	<.05
Sex		<.05
Male	Ref	
Female	16.32 (2.31, 30.33)	<.05
Steroid usage		
None	Ref	
Triamcinolone injection	16.06 (1.54, 30.59)	<.05
Outcome: PROM change from premanipulation to <6 weeks postmanipulation (n = 36)		
Steroid usage		
None	Ref	
Triamcinolone injection	18.79 (4.71, 32.87)	<.05
Multiple digits		
No	Ref	
Yes	−16.33 (−30.09, −2.58)	<.05
Outcome: PROM change from premanipulation to 6−12 weeks postmanipulation (n = 19)		
Steroid usage		
None	Ref	
Triamcinolone injection	18.45 (5.17, 31.74)	<.05

n, number of fingers available at each time point; Ref, reference.
*Underpowered non−statistically significant results are not listed.

TABLE 6. Gains in AROM Following Surgical Release Reported in the Literature

Study	△ AROM (°)	PIP Joint Contracture	Follow-Up, Average Months (range)
Sprague[7]	23−34	Extension	NR (3 to >12)
Gould and Nicholson[28]	14	Extension	NR (3−24)
Inoue et al[9]	48	Extension	11 (6−36)
Mansat and Delprat[10]	28	Extension	NR (>6)
Diao and Eaton[11]	40	Extension + Flexion	66 (12−134)
Ghidella et al[12]	8	Extension + Flexion	35 (3−80)
Chinchalkar et al[13]	38	Extension	21 (3−96)
Lutsky et al[14]	14	Extension + Flexion	5 (2−8)

NR, not recorded.

after the manipulation. We did not assess inter- or intrarater reliability for determining joint ROM and did not always have treating surgeon−independent measurements available.

Potentially important complications for our patients may not have been recorded at the time of clinical care, and those with undocumented complications or unsatisfactory results may have sought care elsewhere. Retrospective studies predispose to underestimating complications; thus, our report should be regarded as including the minimum estimate of a true complication rate. Similar to other joint manipulations, patients considering PIP joint manipulation should be counseled about possible soft tissue, bone, or joint injuries during the procedure.[16]

Our patients had several etiologies for their stiffness, making for a heterogeneous, although clinically relevant, sample. We did not include fingers that had manipulation at <12 weeks after the event that led to their contracture or had not yet plateaued with therapy. Including only those patients' fingers that would otherwise have been surgical candidates provided a more distinct cohort and allowed better comparison with historical surgical results.

Despite these limitations, our study demonstrates that passive manipulation of PIP joint extension contractures can be a viable alternative to surgical release for select patients.

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