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The relationship between hand therapy and long-term outcomes after distal radius fracture in older adults: evidence from the WRIST randomized trial

Kevin C. Chung, MD, MS[1], **Sunitha Malay, MPH**[2], **Melissa J. Shauver, MPH**[2], **For the WRIST Group**[3]

[1]Professor of Surgery, Section of Plastic Surgery, Assistant Dean for Faculty Affairs, University of Michigan Medical School

[2]Clinical Research Coordinator, Section of Plastic Surgery, Department of Surgery, University of Michigan Medical School

[3]**The WRIST Group** - **Michigan Medicine (Coordinating Center):** Kevin C. Chung, MD, MS (Principal Investigator); H. Myra Kim, ScD (Study Biostatistician); Steven C. Haase, MD; Jeffrey N. Lawton, MD; John R. Lien, MD; Adeyiza O. Momoh, MD; Kagan Ozer, MD; Erika D. Sears, MD, MS; Jennifer F. Waljee, MD, MPH; Matthew S. Brown, MD; Hoyune E. Cho, MD; Brett F. Michelotti, MD; Sunitha Malay, MPH (Study Coordinator); Melissa J. Shauver, MPH (Study Coordinator). **Beth Israel Deaconess Medical Center:** Tamara D. Rozental, MD (Co-Investigator); Paul T. Appleton, MD; Edward K. Rodriguez, MD, PhD; Laura N. Deschamps, DO; Lindsay Mattfolk, BA; Katiri Wagner. **Brigham and Women's Hospital**: Philip Blazar, MD (Co-Investigator); Brandon E. Earp, MD; W. Emerson Floyd; Dexter L. Louie, BS. **Duke Health:** Fraser J. Leversedge, MD (Co-Investigator); Marc J. Richard, MD; David, S. Ruch, MD; Suzanne Finley, CRC; Cameron Howe, CRC; Maria Manson; Janna Whitfield, BS. **Fraser Health Authority:** Bertrand H. Perey, MD (Co-Investigator); Kelly Apostle, MD, FRCSC; Dory Boyer, MD, FRCSC; Farhad Moola, MD, FRCSC; Trevor Stone, MD, FRCSC; Darius Viskontas, MD, FRCSC; Mauri Zomar, CCRP; Karyn Moon; Raely Moon. **HealthPartners Institute for Education and Research:** Loree K. Kalliainen, MD, MA (Co-Investigator, now at University of North Carolina Health Care); Christina M. Ward, MD (Co-Investigator); James W. Fletcher, MD; Cherrie A. Heinrich, MD; Katharine S. Pico, MD; Ashish Y. Mahajan, MD; Brian W. Hill, MD; Sandy Vang, BA. **Johns Hopkins Medicine:** Dawn M. Laporte, MD (Co-Investigator); Erik A. Hasenboehler, MD; Scott D. Lifchez, MD; Greg M. Osgood, MD; Babar Shafiq, MD, MS; Jaimie T. Shores, MD; Vaishali Laljani. **Kettering Health Network:** H. Brent Bamberger, DO (Co-Investigator); Timothy W. Harman, DO; David W. Martineau, MD; Carla Robinson, PA-C, MPAS; Brandi Palmer, MS, PC, CCRP. **London Health Sciences Centre:** Ruby Grewal, MD, MS (Co-Investigator); Ken A. Faber, MD; Joy C. MacDermid, PhD (Study Epidemiologist); Kate Kelly, MSc, MPH; Katrina Munro; Joshua I. Vincent, PT, PhD. **Massachusetts General Hospital:** David Ring, MD, PhD (Co-Investigator, now at University of Texas Health Austin); Jesse B. Jupiter, MD, MA; Abigail Finger, BA; Jillian S. Gruber, MD; Rajesh K. Reddy; Taylor M. Pong; Emily R. Thornton, BSc. **Mayo**

Corresponding author: Kevin C. Chung, MD, MS, Comprehensive Hand Center, Michigan Medicine, 1500 E. Medical Center Drive , 2130 Taubman Center, SPC 5340, Ann Arbor, MI 48109-5340, Phone: 734-936-5885, Fax: 734-763-5354, kecchung@med.umich.edu.

Clinic: David G. Dennison, MD (Co-Investigator); Sanjeev Kakar, MD; Marco Rizzo, MD; Alexander Y. Shin, MD; Tyson L. Scrabeck, CCRP. **The MetroHealth System:** Kyle Chepla, MD (Co-Investigator); Kevin Malone, MD; Harry A. Hoyen, MD; Blaine Todd Bafus, MD; Roderick B. Jordan, MD; Bram Kaufman, MD; Ali Totonchil, MD; Dana R. Hromyak, BS, RRT; Lisa Humbert, RN. **National University of Singapore**: Sandeep Sebastin, MCh (Co-Investigator), Sally Tay. **Northwell Health**: Kate W. Nellans, MD, MPH (Co-Investigator); Sara L. Merwin, MPH. **Norton Healthcare:** Ethan W. Blackburn, MD (Co-Investigator); Sandra J. Hanlin, APRN, NP-C; Barbara Patterson, BSN, CCRC. **OrthoCarolina Research Institute:** R. Glenn Gaston, MD (Co-Investigator); R. Christopher Cadderdon, MD; Erika Gordon Gantt, MD; John S. Gaul, MD; Daniel R. Lewis, MD; Bryan J. Loeffler, MD; Lois K. Osier, MD; Paul C. Perlik, MD; W. Alan Ward, MD; Benjamin Connell, BA, CCRC; Pricilla Haug, BA, CCRC; Caleb Michalek, BS, CCRC. **Pan Am Clinic/University of Manitoba:** Tod A. Clark, MD, MSc, FRCSC(Co-Investigator); Sheila McRae, MSc, PhD. **University of Connecticut Health:** Jennifer Moriatis Wolf, MD (Co-Investigator, now at University of Chicago Medicine); Craig M. Rodner, MD; Katy Coyle, RN. **University of Oklahoma Medicine:** Thomas P. Lehman, MD, PT (Co-Investigator); Yuri C. Lansinger, MD; Gavin D. O'Mahony, MD; Kathy Carl, BA, CCRP; Janet Wells. **University of Pennsylvania Health System:** David J. Bozentka, MD (Co-Investigator); L. Scott Levin, MD; David P. Steinberg, MD; Annamarie D. Horan, PhD; Denise Knox, BS; Kara Napolitano, BS. **University of Pittsburgh Medical Center**: John Fowler, MD (Co-Investigator); Robert Goitz, MD; Cathy A. Naccarelli; Joelle Tighe. **University of Rochester:** Warren C. Hammert, MD, DDS (Co-Investigator); Allison W. McIntyre, MPH; Krista L. Noble; Kaili Waldrick. **University of Washington Medicine:** Jeffery B. Friedrich, MD (Co-Investigator); David Bowman; Angela Wilson. **Wake Forest Baptist Health:** Zhongyu Li, MD, PhD (Co-Investigator); L. Andrew Koman, MD; Benjamin R. Graves, MD; Beth P. Smith, PhD; Debra Bullard.

Abstract

Background: Older patients are frequently referred to hand therapy after distal radius fracture (DRF). Supervised therapy sessions place a transportation burden on patients and are costly on both the individual and systematic level. Furthermore, there is little evidence that supervised therapy or home exercises improve long-term outcomes.

Methods: Data were collected for the Wrist and Radius Injury Surgical Trial (WRIST), a multicenter, international, pragmatic, randomized trial of DRF treatment in patients age 60 years and older. Referral to therapy and therapy protocol was at the discretion of the treating surgeon and therapist. We examined outcomes between participants who underwent therapy and those who did not and assessed the duration of therapy. We also analyzed the effect of therapy on subgroups at risk for poor outcomes: older participants and those who had more comorbidities or lower baseline activity.

Results: 80% of participants underwent therapy; 70% did both supervised therapy and home exercises. Participants had a mean 9.2 supervised sessions over 14.2 weeks. There were no differences in patient-reported outcomes between participants who underwent therapy and those who did not. Participants who did not have therapy recovered more grip strength. Participants who engaged in therapy for a shorter time reported greater function, ability to work, and satisfaction. There were no relationships revealed in subgroup analyses.

Conclusions: Hand therapy after DRF may not be necessary for older patients. Encouraging participants to resume activities of daily living as soon as possible may be as effective as formal therapy.

Keywords

distal radius fracture; older adults; hand therapy

Introduction

Treatment of distal radius fractures (DRFs) in older adults often includes referral to hand therapy. There are no published clinical guidelines,(1) but a traditional therapy protocol is for 2–3 supervised sessions a week with an occupational therapist for up to 6 weeks of treatment.(2, 3) Several studies have demonstrated that therapy may provide benefits in the short-term, but there is little evidence that supervised therapy, sessions that occur in the presence of a hand therapist, improves long-term outcomes.(4–6) This uncertainty is supported by the inconsistent use of therapy.

Using Medicare data, a previous analysis by our group found geographical variations in therapy use ranging from 2% of DRF patients age 65 years and older receiving therapy in parts of the South and Southwest to over 55% receiving therapy in California and the East coast.(7) Furthermore, we found that younger patients, female patients, and patients treated by members of American Society for Surgery of the Hand were more likely to receive supervised therapy.(7) Supervised therapy protocols place tremendous burden on patients. Hickey et al. examined barriers to compliance with the standard therapy protocol prescribed at the University of Pittsburgh Medical Center: 2–3 60 minute sessions per week for up to 7 weeks.(8) Factors that were significantly related to attending less than 50% of prescribed therapy sessions were all related to transportation (not owning a vehicle, living far from the therapy clinic, and relying upon someone else to provide transportation). Telemedicine and remote monitoring may ease the transportation-related burdens for patients. Older patients, however, may not be confident users of the necessary technology and telemedicine interfaces are often not optimized for vision and hearing declines common in older populations.(9) Finally, the cost burden of supervised therapy is felt by both patients and health systems. Medicare places caps on covered therapy services and requires a 20% copay, which adds an additional barrier to older adults on fixed incomes.(10) Therapy costs make up 11% to 21% of Medicare reimbursements for DRF treatment depending on treatment method.(11, 12) Total Medicare expenditures on post-DRF hand therapy exceed $12M annually.(7)

Home exercises can be prescribed in addition to, or in lieu of, supervised therapy. Such practices ease the transportation-related burden on patients and reduce costs. Outcomes are similar to formal hand therapy. Patients who have fewer or no supervised session have similar quality of life to those who completed a full course of post-DRF therapy. (13, 14) A meta-analysis found insufficient evidence to pronounce supervised therapy superior to home exercise programs. (15) The American Academy of Orthopaedic Surgeons recommendations also found no evidence for or against home exercise after DRFs.(1) Some investigators have gone further, suggesting that even home exercises are unnecessary for satisfactory outcomes

following DRF. A systematic review of therapy programs for any upper extremity fracture found that for DRF, functional deficits and impairment in everyday activities were related more to length of immobilization than to the type or presence or absence of therapy.(16)

A pilar of the Affordable Care Act was to fund research to eliminate treatments that consume scarce resources but provide little benefit to patients. Standard referral to therapy after DRF may be one of these treatments. However, few studies of post-DRF therapy have focused on an older adult population. Furthermore, previous studies frequently eliminated from their analyses patients who experienced complications or who were non-adherent to therapy.(1, 15) This limits the generalizability of these studies. The aim of this project is to use data collected as part of the multicenter, international Wrist and Radius Injury Surgical Trial (WRIST) to assess the relationship between therapy participation and therapy duration on patient-reported and functional outcomes.

Methods

WRIST is a pragmatic trial randomizing participants to one of 3 surgical treatment options for DRF: internal fixation with volar locking plates (VLPS), closed reduction and external fixation with a bridging fixator, with or without supplemental k-wire fixation, or closed reduction and percutaneous pinning. Participants who did not want to undergo surgery were treated with casting and followed as an observation group. Participants were enrolled at 24 sites in the US, Canada, and Singapore. Inclusion criteria for both randomized and nonrandomized participants included age of 60 years or older and unstable fracture for which surgery was recommended (meeting one of the following criteria after initial reduction attempt: dorsal angulation >10°, radial inclination <15°, or radial shortening >3mm). Exclusion criteria included residing in a nursing home or other institutional setting, dementia, open or bilateral fractures, previous DRF to same wrist, and comorbid conditions prohibiting surgery. Assessments took place at 2 weeks, 6 weeks, 3 months, 6 months, and 12 months following final fracture reduction or surgery.

In keeping with the pragmatic nature of this study, a referral to therapy was at the discretion of the treating surgeon and the specific therapy course was at the discretion of the surgeon and therapist. A Therapy Data Form was created for this study and was completed by study personnel at each follow-up assessment. Therapy was monitored whether it took place at the treating institution or at an outside facility. The type of therapy was noted (supervised/in clinic or a home exercise program) and the number of supervised sessions attended was counted. We did not count the initial therapy consultation as a supervised visit. Therapy duration, both for supervised sessions and home exercises, was also recorded.

The primary outcome of WRIST is the MHQ Summary score at 12-month assessment. Secondary outcomes are MHQ domain scores, SF-36 score, and strength and motion outcomes at 12-month assessment. Analyses were performed as-treated. Baseline factors were compared to determine if any variables were associated with participation in any form of therapy using Wilcoxon-Mann Whitney for continuous variables and chi-square or Fisher exact test for categorical variables. Unadjusted 12 month outcomes for participants who underwent therapy and those who did not were compared using Wilcoxon-Mann Whitney

test. To determine if there were relationships between duration of therapy or number of therapy sessions we performed non-parametric correlation using number of supervised therapy sessions or duration of therapy as the independent variable. Finally, we performed subgroup analysis using analysis of covariance (for continuous variables) and factorial ANOVA (for categorical variables) for patient groups identified in the literature as being at risk of poor outcomes: older participants, patients with more comorbidities, and patients with lower baseline functional status.(17–19) Significance was set at $p<0.05$. Because we expected therapy to commence after the 6-week follow-up appointment at the latest, we eliminated any participant who did not have at least 3 months of follow-up data available.

Results

A total of 304 participants were enrolled in WRIST. We excluded from the analysis cohort 36 participants who did not have at least 3 months of follow-up, leaving us with 268 participants (Table 1). The majority of participants (80%) engaged in some sort of hand therapy. Participants who received surgical treatment were more likely to have therapy than those treated with casting (68% vs 49%, $p=0.009$). There was no significant difference in AO class by participation in therapy, nor was there any significant difference in treatment modality by AO class (60% of AO class A and 63% of AO class C fractures were treated with surgery, $p=0.65$). Based on this we can be confident that fracture severity did not vary by treatment or therapy groups.

Smoking status was the only measured baseline variable that was significantly associated with having therapy. Only 6% of participants who had therapy were current smokers compared to 21% of participants who did not have therapy ($p=0.003$). Therapy started a mean 3.8 weeks after fracture, but the range was <1 week through 24 weeks. (Table 2) Participants who received VLPS started therapy earliest (mean 2.9 weeks) followed by participants who received external fixation or pinning (3.2 and 3.1 weeks respectively); casting participants started therapy the latest (5.6 weeks, $p<0.0001$). Both supervised therapy and home exercises were performed by the majority of participants (70%). Most participants (81%) ended therapy by 12-month follow-up. Participants completed a mean of 9.2 supervised therapy sessions over 14.2 weeks. Home exercise routines were performed for a mean 16.9 weeks.

There were no differences in 12-month patient-reported outcomes based on participation in therapy (Table 3). Participants who did not have therapy recovered a mean 87% of grip strength (compared to the contralateral uninjured hand); significantly more than participants who did have therapy (78%, $p=0.03$). Participants who did not have therapy also recovered more grip strength by the 6 month assessment (70% vs 60%, $p=0.003$). There were no differences in grip strength by group at the 6 week or 3 month assessments, however. There were no other differences in 12-month functional outcomes based on participation in therapy. There were moderate negative correlations between duration of all therapy (both supervised and home exercises) and patient-reported outcomes such that participants who performed therapy for longer periods of time reported lower MHQ Summary score as well as lower scores on the Function, Activities of Daily Living, and Satisfaction domains. (Table

4) This may be confounded, however. Participants who engage in therapy longer may do so *because* they are unable to perform everyday tasks or are dissatisfied with their outcomes.

Finally, we performed subgroup analysis to assess if performing hand therapy impacted outcomes for patients who are at risk for poor outcomes. After adjusting for age, there were still no differences in MHQ summary score based on participation in therapy (F=0.01, p=0.91). There were also no differences after adjusting for number of comorbidities reported at enrollment (F=0.01, p=0.91) or baseline functional status (F=0.20, p=0.66).

Because there was no difference in the primary outcome, 12-month MHQ Summary score between therapy and no therapy, we performed post hoc power analysis to detect for possible β-error. We found 71% power to detect an 8 point difference in MHQ Summary score, indicating a β of 29.

Discussion

Our study found no differences in patient-reported outcomes between participants who underwent therapy and those who did not. There were also no differences in functional outcomes, except for grip strength. Participants who did not undergo therapy recovered more grip strength than participants who had any type of therapy. Because there were no differences in grip strength between groups early in the study, we do not have any reason to believe that this is attributed to selection bias. As suggested by Bruder et al., performing everyday activities results in as good or better outcomes than formal rehabilitation.(16)

The Bruder et al. systematic review identified 3 studies that compared either supervised or home therapy to no therapy after DRF treatment, but they were not limited to older participants.(16) Two found no difference in functional or patient-reported outcomes. The third study found modest benefits in patient-reported outcomes of a formal therapy program, but no differences in functional outcomes. However, this study only included participants treated with casting and pins and ended follow-up at 6 weeks.(20) Short follow-up duration also hampers comparison to studies of therapy timing. There may be some benefits of early therapy but they often performed the last assessment by 6 or 12 weeks, which may not be sufficient.(21) For example, Brehmer et al. also found benefits of early therapy until the 12 weeks assessment. But a 6 month assessment found no differences in functional or patient-reported outcomes.(4)

We also found that MHQ Summary score, as well as several domain scores, were negatively correlated with duration of therapy. This, however, may be due to selection bias, indicating that participants stop therapy once they achieve good outcomes. We could find no other studies that examined outcomes as a function of therapy duration. Lyngcoln et al. studied adherence to post-DRF therapy and reported that adherence significantly predicted change in Jebsen-Taylor test time and wrist extension. Their study included only 15 participants, however, and only 2 participants attended less 100% of therapy sessions.(22) Finally, we were unable to show that patient age, number of comorbidities, or baseline functional status modified the relationship between MHQ Summary score and participation in therapy. We

could identify no published studies that examined varying effectiveness of therapy based on patient factors.

This project is limited by the pragmatic nature of our study. We did not standardize a therapy protocol for the study and thus, the type and duration of therapy varied. We collected information on general therapy modality (supervised vs home), number of sessions, and duration of therapy, but we are not able to compare details of different therapy regimens. We also do not know why participants did not have therapy. Participants who were not referred to therapy because of good recovery would likely have different outcomes at 12 months than participants who were referred to therapy but did not attend for other reasons. Our project benefits, however, from a long follow-up period relative to other studies of post-DRF hand therapy and the use of therapy duration and patient factors as mediators for therapy effectiveness.

As Medicare moves toward using bundled payment schemes for more conditions, therapy costs may consume a substantial portion of DRF treatment reimbursement, without a benefit to patients.(23) Existing evidence, both from WRIST and from the literature suggest that most patients will achieve satisfactory results whether or not they attend supervised therapy or follow a home exercise program. For many patients, simply performing activities of daily living as normal may be all the rehabilitation required.(16, 20)

Disclosure:

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Table 1.

Baseline characteristics of analysis cohort by participation in occupation/hand therapy

	Therapy	No Therapy	p-value
n (%)	215 (80%)	53 (20%)	
Female, n (%)	189 (85%)	43 (81%)	0.20
Age			
mean (SD)	71 (8.9)	72 (9.1)	0.44
median (range)[a]	69 (58–95)	69 (60–97)	
Race, n (%)			
Asian	19 (9%)	2 (4%)	0.29
Black	9 (4%)	6 (11%)	
White	180 (84%)	45 (85%)	
other	4 (2%)	0	
missing	3 (1%)	0	
Education, n (%)			
High school diploma/GED or less	75 (35%)	27 (51%)	0.07
Vocational school/ associate's degree/ some college	68 (32%)	10 (19%)	
Bachelor's degree+	72 (33%)	16 (30%)	
Employment – baseline, n (%)			
Full-time	36 (17%)	8 (15%)	0.26
Part-time	29 (13%)	5 (9%)	
Retired	137 (64%)	32 (60%)	
Receiving disability	2 (1%)	3 (6%)	
Unemployed	9 (4%)	2 (4%)	
missing	2 (1%)	3 (6%)	
RAPA Functional Status – pre-injury, n (%)			
Sedentary	24 (11%)	5 (9%)	0.65
Under-active	102 (47%)	29 (55%)	
Active	88 (41%)	19 (36%)	
missing	1 (0%)	0	
Number of comorbidities			
mean (SD)	3.9 (2.6)	3.4 (2.3)	0.15
median (range)	4 (0–12)	3 (0–12)	
Smoking status, n (%)			
No	122 (57%)	24 (45%)	**0.003**
Former	79 (37%)	18 (34%)	
Current	13 (6%)	11 (21%)	
missing	1 (0%)	0	
AO classification, n (%)			

	Therapy	No Therapy	p-value
A1	2 (1%)	0	0.83
A2	93 (43%)	22 (42%)	
A3	22 (10%)	9 (17%)	
C1	15 (7%)	3 (6%)	
C2	62 (29%)	15 (28%)	
C3	2 (1%)	0	
missing	19 (9%)	4 (8%)	
n	215	53	
Injury to dominant hand, n (%)	89 (41%)	25 (47%)	0.35
Treatment received, n (%)			
Surgery	147 (68%)	26 (49%)	0.009
Casting	68 (32%)	27 (51%)	

Table 2.

Therapy details

Had occupational/hand therapy, n (%)	
Yes	215 (80%)
No	53 (20%)
Therapy started, weeks after fracture or surgery[a]	
mean (SD)	3.8 (3.2)
median (range)	2 (0–24)
Therapy ongoing at 12-month assessment, n (%)[a]	
Yes	18 (8%)
No	175 (81%)
missing	22 (10%)
Type of therapy, n (%)[a]	
Supervised only	33 (15%)
Home/unsupervised only	32 (15%)
Both	149 (70%)
missing	1 (0%)
Number of supervised sessions attended, through 12-month assessment[a]	
mean (SD)	9.2 (10.2)
median (range)	6 (0–72)
Duration of supervised therapy, through 12-month assessment, weeks[a]	
mean (SD)	14.2 (10.8)
median (range)	11 (1–56)
Duration of all therapy, through 12-month assessment, weeks[a]	
mean (SD)	16.9 (13.1)
median (range)	12 (1–56)

[a]: among participants who had therapy

Table 3.

Unadjusted 12-month primary and secondary outcomes by therapy participation

	Any therapy	No therapy	p-value
MHQ[a]			
Summary	84 (79, 85)	82 (77, 87)	0.46
Pain	19 (16, 22)	20 (13, 26)	0.61
Function	77 (74, 81)	77 (71, 84)	0.73
ADL	85 (82, 88)	85 (78, 91)	0.60
Work	82 (78, 85)	81 (73, 90)	0.83
Aesthetics	84 (81,87)	86 (79, 92)	0.91
Satisfaction	77 (73, 81)	84 (77, 91)	
SF-36[b]			
Physical Component	47 (45, 49)	45 (40, 49)	0.32
Mental Component	55 (53, 56)	53 (49, 57)	0.69
Functional outcomes			
Grip strength, %	78 (75, 81)	87 (82, 92)	**0.03**
Key pinch strength, %	89 (85, 92)	87 (79, 94)	0.79
Flexion, %	85 (82, 88)	84 (76, 92)	0.88
Extension, %	92 (89, 94)	96 (87, 105)	0.85
Ulnar deviation, %	90 (84, 97)	82 (73, 92)	0.45
Radial deviation, %	98 (91, 105)	106 (92, 122)	0.13
Pronation, %	98 (96, 99)	97 (94, 100)	0.57
Supination, %	96 (93, 99)	97 (92, 102)	0.18
Complications			
Experienced any complications, n (%)	149 (69%)	32 (60%)	0.21
Experienced severe complications, n (%)	29 (13%)	8 (15%)	0.76
Experienced mild complications, n (%)	117 (54%)	27 (51%)	0.64

All cell values are mean (95% CI), and all hand outcomes are specific to injured side (hand or wrist), except the MHQ Work domain, which has one score for both hands. Functional measures are % of the injured hand/wrist compared to the uninjured wrist.

Abbreviation: MHQ=Michigan Hand Outcomes; ADL=activities of daily living.

[a]: MHQ Summary and domain scores, except pain, range 0–100, with 100 indicating no hand disability. Pain scores also range 0–100 but 0 indicates no pain;

[b]: SF-36 scores range 0–100, with 100 indicating the best quality of life

Table 4.

Non-parametric correlation between 12-month outcomes and number of supervised therapy session completed and duration of therapy[a]

	number of sessions		Duration of supervised therapy		Duration of all therapy	
	ρ	p-value	ρ	p-value	ρ	p-value
MHQ						
Summary	−0.07	0.35	−0.05	0.59	**−0.24**	**0.01**
Pain	0.05	0.53	−0.01	0.93	0.16	0.08
Function	−0.08	0.28	−0.08	0.38	**−0.29**	**0.002**
ADL	−0.09	0.26	−0.05	0.58	**−0.20**	**0.03**
Work	−0.05	0.56	0.01	0.90	−0.17	0.06
Aesthetics	−0.01	0.93	0.02	0.84	−0.19	0.04
Satisfaction	−0.07	0.34	−0.07	0.46	**−0.30**	**0.001**
SF-36						
Physical Component	0.01	0.87	−0.07	0.48	−0.14	0.12
Mental Component	−0.09	0.25	0.002	0.98	−0.07	0.48
Functional outcomes						
Grip strength, %	−0.19	0.01	−0.14	0.13	−0.18	0.07
Key pinch strength, %	−0.18	0.03	0.02	0.81	0.02	0.87
Flexion, %	−0.09	0.26	−0.09	0.32	−0.11	0.27
Extension, %	−0.16	0.05	−0.18	0.06	−0.16	0.10
Ulnar deviation, %	−0.09	0.25	−0.06	0.55	−0.18	0.06
Radial deviation, %	−0.11	0.16	−0.06	0.53	−0.03	0.79
Pronation, %	−0.27	0.0005	−0.14	0.13	−0.06	0.53
Supination, %	−0.13	0.10	−0.08	0.37	0.03	0.74

[a]: among participants who had therapy

Abbreviation: MHQ=Michigan Hand Outcomes; ADL=activities of daily living.