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# Unilateral hand training on functional performance in patients with upper extremity trauma

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ABSTRACT

*Study Design:* Case series.
*Introduction:* Upper extremity (UE) trauma and subsequent immobilization affects functional performance.
*Purpose of the Study:* Determine the usefulness and feasibility of unilateral hand training (UHT) on improving functional performance in patients with UE trauma.
*Methods:* Nine participants received UHT within 10 days of immobilization. Functional performance, dexterity, grip, and pinch strength were measured at initial and 4-week visits. Qualitative interviews were coded to develop themes.
*Results:* All Jebsen-Taylor hand function test subtests improved from pretest to post-test. Disabilities of the Arm, Shoulder and Hand scores of all 9 participants improved. Functional performance was more impaired for participants with dominant UE injury. Four themes emerged: participants were forced to alter or avoid most daily activities, had an increased dependency on others, took longer to perform activities, and felt UHT decreased the impact of UE trauma on function.
*Discussion:* Functional performance was impaired for all participants. Participants believed that UHT was useful and contributed to improved function.
*Conclusion:* This case series tracked a comprehensive intervention based on a holistic activities of daily living framework that considered the nuances of individual complexities of immobilization following hand trauma. Knowledge from this study supports an early intervention like UHT to educate clients on effective strategies to improve immediate activities of daily living functioning and potentially prevent longer term impairments.

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## Introduction

In 2009, there were approximately 3.5 million upper extremity (UE) injuries treated in emergency departments in the United States.[1] Impaired function from UE trauma is influenced by a state of one-handedness that can range from partial to complete loss of hand use.[2] When the dominant hand is injured, a double-impact injury occurs because not only is the individual forced into a state of one-handedness but also he or she has a loss of the stronger, faster, and more dexterous limb resulting in greater difficulty with activities of daily living (ADL).[2] Even if the dominant UE is not affected, increased time will be required to perform many activities.[3]

In 1 qualitative study,[4] stress factors were evaluated after hand trauma in 20 participants, of which less than half of the participants injured the dominant UE, but all participants reported some level of impaired function. Participants reported immediate functional impairments during their inpatient stay, including difficulty with eating, showering, and managing medication bottles. Impairments were magnified on return to home. Daily tasks, such as dressing, toileting, cooking, and driving, were problematic. In a subsequent study, Gustaffson and Ahlstrom[5] followed 91 participants for a year after hand surgery and concluded that functional performance (eating, bathing, dressing, and working) was most impaired 1-2 weeks after UE trauma. Function improved during the first 3 months but tended to remain unchanged during the remainder of the year after injury. Two additional studies found that at a minimum of 2 years after traumatic hand injury, 90% of

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696 participants reported residual difficulties with occupational performance, especially work and leisure.[6,7] In a retrospective study exploring employment and hobby participation after hand surgery, 40 of 61 participants returned the questionnaire and 19% reported not yet returning to work by 2 years after surgery; an additional 20% of participants reported quitting their jobs or changing their hobbies.[8]

Regardless of nonoperative or operative treatment, many clients with UE trauma will likely require immobilization for a period. Immobilization creates a barrier to functional independence, and the prevalence of noncompliance may be underestimated. In a study by Coenen et al,[3] 45 participants with hand conditions (carpal tunnel syndrome, Dupuytren disease, hand amputations, fractures, or lacerations) reported limitations in self-care activities, such as washing or dressing, specifically as a result of wearing an orthosis. In 2 different studies ($N = 19$ and $N = 80$, respectively),[9,10] more than 50% of participants with tendon repairs reported not abiding by precautions to perform self-care, care of others, home management, work, leisure activities, communication tasks, and driving. This was despite understanding the rationale for the orthosis, wearing schedule, risk of re-rupture, and instruction to use a shower bag to cover the affected arm during bathing.

Impaired function as a result of UE trauma may lead to various psychosocial issues, the most common of which is stress created by dependence on others.[3-5,10-12] Other individuals perceive the inability to engage in desired occupations as a threat to personal identity.[11] Starck Schier and Chan[12] found that hand injuries led to a reduction in role participation and an increase in dependence on others, including a role reversal where children had to assist parents with dressing and bathing.

Hand therapists recognize that ADL performance is of high value and priority; however, formal ADL assessments are not commonly administered.[13-15] Lack of evaluation and interventions addressing functional performance and one-handed training may be for any one, or a combination, of the following: (1) treatment priority placed on the injured UE, (2) limited time to address a client's one-handedness, (3) client education time is focused on teaching a complicated postoperative protocol, (4) an expected recovery of the injured side (no need to address the temporary state of single-handedness), (5) assumptions that the client will independently adapt, (6) logistical issues, such as clinic space and lack of appropriate equipment, and (7) reimbursement issues.[2,13,16]

Clients may independently find ways to perform ADL, but the risk involved in resumption of certain activities may not be adequately measured without skilled clinical assessment or thorough understanding of healing.[10,13] If not addressed, impairments in functional performance may lead to decreased client satisfaction.[11,17] Currently, rehabilitation is delivered based on the diagnosis rather than on immobilization status. Often a client is immobilized, sent home, and does not receive therapy until immobilization is complete. This approach appears logical and economical; however, the client is left to navigate obvious hurdles inherent in immobilization. There is a need to explore the feasibility and usefulness of an early intervention focused on ADL and instrumental activities of daily living (IADL) in individuals with UE trauma who require immobilization.

## Purpose of the study

This study explored the impact of unilateral hand training (UHT) on observed and self-reported functional performance. Study aims were to assess compliance with immobilization and qualitatively examine participants' response to UHT as a component of their rehabilitation.

## Methods

### *Participants*

After approval from San Antonio Military Medical Center (SAMMC) institutional review board, 9 participants with UE trauma participated in this study. They were recruited from SAMMC orthopedic department from December 2014 to April 2015. Recruitment time was limited as research was conducted as part of the first author's doctoral program. Inclusion criteria comprise the following: (1) diagnosis of any UE injury requiring continual immobilization of the hand, wrist, elbow, or shoulder for a period of four or more weeks; (2) immobilization by either a cast or a custom-fabricated orthosis; (3) immobilization before study enrollment had to be less than or equal to 10 days; and (4) English speaking. Participants were excluded if younger than 18 years, diagnosed with a bilateral UE injury, and/or were hospitalized at the time of enrollment.

All participants provided informed consent. Confidentiality was ensured using nonidentifying participant numbers. Data were stored in a locked file located within a secured office.

### *Clinical measures*

Four quantitative measures and one qualitative measure were used. Pretest and post-test scores for each of the quantitative measures were obtained during the initial visit and at 4-week follow-up. Functional performance as well as dexterity, grip, and pinch strength of participants' unaffected UE were measured. Qualitative data were obtained during follow-up visit only. Data were collected by the first author. Quantitative assessments were performed in the same order for each participant and according to corresponding standardized procedures. Consistency in qualitative data collection was ensured using semistructured interview questions.

#### *Disabilities of the Arm, Shoulder and Hand outcome measure*

The Disabilities of the Arm, Shoulder and Hand (DASH), a well-established self-report tool, was used to measure participants' perceived level of physical function and symptoms, with lower scores on a 0-100 scale indicating less functional impairment. The DASH has demonstrated test-retest reliability (intraclass correlation coefficient [ICC], 0.96) and construct validity by correlation with other measures ($r > 0.69$; $P < .0001$).[18] A minimal clinically important difference (MCID) of 10.83 was used to represent the smallest improvement in score that reflects meaningful change to an individual.[19]

#### *Jebsen-Taylor hand function test*

Observed functional performance was measured using the Jebsen-Taylor hand function test (JTT). Each of 7 subtests on the JTT was performed using the unaffected UE and timed in seconds. Performance was compared with normative data for each subtest based on gender, hand dominance, and age group.[20] With adults, the JTT has demonstrated test-retest reliability ($r = 0.60$-$0.99$), discriminate validity, and construct validity ($r = 0.625$; $P < .01$).[20,21]

#### *Grooved pegboard*

Dexterity of the unaffected UE was measured using the grooved pegboard (GPB). The GPB has demonstrated good test-retest reliability coefficients of 0.91 and 0.85 for right and left hands, respectively (all $P < .001$). Construct validity of the GPB has been demonstrated through correlation with the Bruininks-Oseretsky test of motor proficiency ($-0.50$ to $-0.63$) and with the Purdue pegboard (Pearson $r$, $-0.73$ to $-0.78$).[22] Total scores (the sum of total time, number of pegs completed, and number of pegs

dropped) were compared with normative data based on gender, hand dominance, and age.

*Grip and pinch strength*

A dynamometer and pinch gauge (North Coast Medical, Gilroy, CA) were used to measure grip and 3-jaw pinch strength of each participant's unaffected UE. These measures have strong face validity and good inter-rater reliability (ICC 1,1 for dynamometer: 0.996-0.998, $P < .05$ and ICC of the pinch gauge: 0.949-0.990, $P < .05$).[23] Three trials for both grip and pinch strength were performed following standardized procedures and were averaged to obtain a final score in pounds. Participants' scores were compared with normative data for grip and pinch strength based on gender, hand dominance, and age group.[24,25]

*Semistructured interviews*

At 4-week follow-up, qualitative data were collected via audiotaped semistructured interviews guided by a study-specific questionnaire done by the first author (Appendix A). Following a phenomenological approach to qualitative study, data provided a description of the experience of living while one-handed and the impact on ADL/IADL as well as exploring the perceived usefulness of the intervention.

*Intervention*

The intervention, UHT, was delivered at initial visit by the first author in a 30-minute encounter. The length of time between immobilization and initial visit was limited to 10 days based on the study by Gustaffson et al,[4] who found that participants with hand trauma reported the highest impairments in functional performance at an average of 10 days after injury. In addition, immobilization of an UE rapidly produces positive and negative changes in the somatosensory[26] and sensorimotor[27] cortices. To encourage the most adaptive and efficient neuroplasticity,[28,29] UHT was delivered within 10 days of initial immobilization.

UHT was standardized and included 3 components: (1) participant education, (2) provision of a one-handed backpack with adaptive equipment, and (3) a home exercise program (HEP). Participants were given a written handout describing each component (Appendix B). Participant education focused on activity modifications and compensatory strategies to perform daily activities one handed. Topics covered included dressing, writing, computer and cell phone use, driving, grooming/hygiene, and home management.

The second component of UHT was the provision of a one-handed backpack containing adaptive equipment and commercially available items. The items (Fig. 1) were chosen based on standard issue equipment given to clients with UE amputation at Walter Reed Army Medical Center.[30] In addition, items were chosen in an attempt to mitigate the challenges of using everyday products such as bottle/can closures and cutlery, which were cited as barriers to performance of ADL by focus groups comprised of participants with hand injury.[3] Each item was explained, and participants were instructed to use the items as needed. Participants were also educated regarding other equipment options not provided in the backpack.

The HEP for the unaffected UE was the last component of UHT. Participants were given medium resistance Theraputty (Southpaw Enterprise, Dayton, OH) and instructed on exercises focusing on grip and pinch strength of unaffected UE. Specific repetitions were not prescribed, and participants were cautioned to discontinue exercises if sore or fatigued. Inclusion of a HEP was designed to increase strength of an unaffected UE to potentially improve function and assist future return of strength of the immobilized UE.[31] Several studies on the cross-transfer phenomenon have shown that unilateral strength and motor training in 1 UE can improve strength and motor skills in the untrained UE.[32,33] A study by Stromberg[34] showed that participants who received a HEP after UE surgery and immobilization had an augmented return of strength in the operated UE by up to 150% as compared with a control group.

*Data analysis*

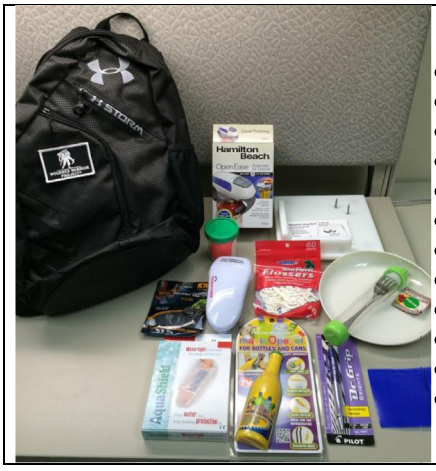
Quantitative data were analyzed using descriptive statistics. Means and standard deviations (SDs) were calculated for each outcome measure overall and were then stratified for gender, age group, and hand affected. Mean DASH scores were additionally stratified based on home environment, initial pain level, and method of immobilization.

Structured methods of qualitative data analysis, as suggested by Creswell,[35] were used to help create the essence of living with UE trauma. All interviews were transcribed and coded into categories that were then organized into broader themes representing how participants experienced UE trauma.

## Results

*Characteristics of participants*

Nine participants (6 males and 3 females) with an average age of 40.3 (range, 20-54) were enrolled in this study. Eight participants were right handed, and the dominant hand was affected in 7 participants (Table 1). Participants' diagnoses and types of




- Under Armour® Compel sling backpack
- Hamilton Beach Open Ease™ automatic jar opener
- Handy Can Opener™ automatic can opener
- The Extreme magicOpener™ 5-in-1 bottle opener
- LockLaces™ elastic shoe laces
- Knork™ adapted fork
- North Coast Medical™ one handed cutting board
- AquaShield USA™ cast and bandage shower cover
- Dycem® non-slip material
- GripWare™ scoop dish
- Pilot® Dr. Grip® retractable ballpoint pen
- Iodent® flossers

**Fig. 1.** One-handed backpack.

**Table 1**
Participant demographics ($n = 9$)

| Participant information | Number | % |
|---|---|---|
| Status | | |
| AD military | 3 | 33.3 |
| RET military | 4 | 44.4 |
| Civilian | 1 | 11.1 |
| Dependent | 1 | 11.1 |
| Current home environment | | |
| Alone | 1 | 11.1 |
| Spouse/significant other | 5 | 55.6 |
| Other family | 2 | 22.2 |
| Roommate/other | 1 | 11.1 |
| Caring for children younger than 18 y | | |
| Yes | 4 | 44.4 |
| No | 5 | 55.6 |
| Multiple joints immobilized | | |
| Yes | 8 | 88.9 |
| No | 1 | 11.1 |

AD = active duty; RET = retired.

immobilization varied. Of the diagnostic groups, there was 1 traumatic digital amputation, 1 flexor tendon injury, 2 soft tissue injuries, and 5 fractures. Most participants were immobilized via a short arm cast. Three participants required surgical intervention. Two participants, initially managed nonoperatively, later underwent open reduction and internal fixation between their initial and follow-up visits (Table 2).

### *Functional performance*

All participants improved from pretest to post-test on 3 of the 7 subtests of the JTT. Between 5 and 8 participants improved on the remaining 4 subtests. Time to complete all subtests decreased from mean pretest to post-test (Fig. 2), and approximately 57% (72 of 126) of all scores were within the normative range (Table 3). Females and participants between 40 and 50 years demonstrated larger mean improvements on 4 of the 7 subtests. Participants whose nondominant UE was affected performed better on all subtests except for one (picking up small objects), as indicated by lower mean scores.

All 9 participants improved from pretest to post-test on the DASH. The overall mean pretest score was 53.76 (range, 22.5-75.83; SD, 19.32), and the mean post-test score was 35.89 (range, 11.7-54.2; SD, 15.48). Five participants improved by the MCID of 10.83. Less functional impairment was seen in participants who were males, between 20 and 30 years, reporting pain as less than 4 of 10 on the verbal analog scale, immobilized via an orthosis, and living with a spouse or significant.

The largest difference between mean scores was seen when comparing the injured hand; specifically, nondominant affected participants' mean scores were at least twice as low as those with dominant hand injuries (Table 4).

### *Dexterity, grip, and pinch strength of the unaffected UE*

The overall mean pretest score of the GPB was 108.04 (range, 86.90-160.70), and the overall mean post-test score was 107.77 (range, 82.63-190.30). Six of the 9 participants improved dexterity from pretest to post-test as demonstrated by a lower score, with a mean change of 0.27. All scores except one were within the normative range. Females and participants between 20 and 30 years performed better, on average.

All scores for grip and pinch strength were within 2 SDs of the norm. Six participants improved grip strength, and 4 participants improved pinch strength. The overall mean pretest scores for grip and pinch strength were 84.5 and 16.4, and the overall mean post-test scores were 91.4 and 17.6, respectively. Males demonstrated higher mean grip and pinch strength. Mean strength scores based on age group did not favor either. With participants whose nondominant UE was affected, the mean pretest to post-test improvement (16.4) was almost 4 times as high compared with participants whose dominant UE was affected (4.2).

### *Qualitative themes*

Four main themes regarding the impact of UE trauma on daily life emerged from analysis of qualitative data. Participants reported that they were forced to alter or avoid most daily activities, they had an increased dependency on others for help with daily activities, most daily activities took more time to perform, and UHT decreased the negative impact of UE trauma on functional performance.

#### *Alter or avoid activities*

Performance of most, if not all, ADL and IADL was altered in some manner by all participants. In addition, some daily activities had to be completely avoided as a result of UE trauma. Participant 2 (P2), whose nondominant hand was affected, reported difficulty with all bimanual tasks. He specifically discussed the change in his ability to drive,

> Well, you have to change a lot of things. I used to drive with my left hand at the 12:00 position. I had to totally switch around and it changes your entire seating arrangement when driving. Using your [injured] hand is out of the question for opening

**Table 2**
Participant diagnoses and immobilization

| Diagnosis categories | No. of participants | Diagnoses by participant (P) | Immobilization method | Immobilization type | Surgical intervention |
|---|---|---|---|---|---|
| Digital amputation | 1 | P1: traumatic R SF amputation with R RF MCP fracture | Orthosis | HB ulnar gutter | No |
| Flexor tendon injury | 1 | P2: L thumb flexor tendon laceration | Orthosis | SA dorsal blocking | Yes |
| Soft tissue injury | 2 | P3: R thumb CMC joint tear | Cast | SA thumb spica | Yes |
| | | P9: R SF central slip injury | Cast | SA ulnar gutter | Yes |
| Fracture | 5 | P4: R IF MCP fracture | Cast | SA radial gutter | No |
| | | P5: R SF MCP fracture | Cast | SA ulnar gutter | No |
| | | P6: R SF MCP fracture | Cast | SA ulnar gutter | No |
| | | P7: R intra-articular distal radius fracture with ulnar styloid fracture | Cast | LA wrist cock-up then Munster | Yes[a] |
| | | P8: R distal radius fracture | Cast | SA wrist cock-up | Yes[a] |

R = right; SF = small finger; RF = ring finger; MCP = metacarpal; HB = hand based; L = left; SA = short arm; CMC = carpometacarpal; IF = index finger; LA = long arm.
[a] Participants initially managed via closed reduction; underwent open reduction and internal fixation after initial visit but before follow-up visit secondary to failed reduction.

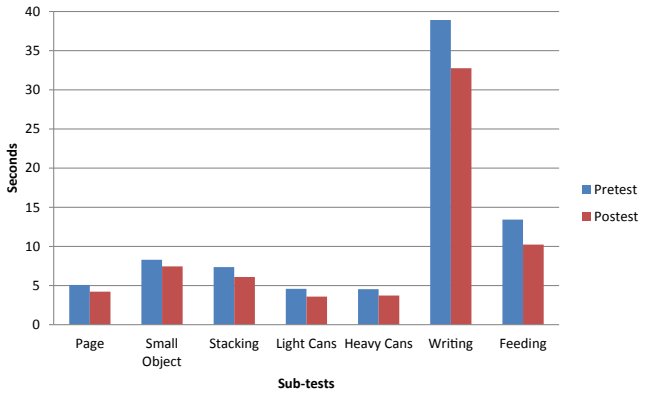



**Fig. 2.** Jebsen-Taylor hand function test subtest means.

things. So, at first I tried pinching it in my elbow or in my armpit area, you know, to open stuff, bottles, cans, jars, and that got old fast.

Participant 6 (P6) felt that her grades dropped in school as a result of her one-handed state.

I haven't been able to do the things that I do to study; like I can't make flash cards because I can't write them out or I can't take notes and highlight through them.

Many participants stated that they were unable to cook. Others, such as participant 5 (P5) and participant 9 (P9), were unable to engage in their preferred hobbies such as mountain biking and Crossfit®, respectively.

*Dependency on others for help*

All participants reported asking others for help to varying degrees throughout their immobilization periods. P6 stated,

I couldn't do anything for myself. I felt like I was two years old again. I had to have my battle buddy help me get dressed because, especially with like jackets and stuff, I couldn't get the cast through it.

Some participants were frustrated by the need for assistance, including participant 8 (P8), who noted,

They [my niece and her boyfriend] weren't willing to offer, so I had to ask them all time. 'Can you do this? Can you help me with this? Can you do this for me?'

Participants whose nondominant UE was affected depended on others for help with daily tasks, but to less of an extent. Participant 4 (P4), stated,

Not often [did I rely on someone for help], but more than normal.

*Increased time to perform activities*

Regardless of which hand was affected, participants reported that most daily activities took increased time to perform. Participant 5 (P5) stated because of his injury,

[It] took me a little longer [getting dressed]. I think, it probably added in like 15 minutes to my morning 'cause I remember going in to work a little later.

Even with his dominant hand unaffected, P4 stated,

Things took longer … I couldn't do everything in the amount of time we had.

*UHT decreased impact of UE trauma on functional performance*

Participants reported that the education and equipment in the one-handed backpack enabled engagement in activities for which they otherwise would have had to avoid or seek assistance for. Without UHT, participants postulated that they would have been able to perform most daily activities, but it would have taken increased time to problem solve a solution and to execute the task.

I [P6] tried living for a week without the stuff you gave me. When I had to take a shower, I literally had my hand outside of the shower the whole time and I noticed it's a lot different in how you effectively clean yourself when you have your hand outside of the shower as opposed to [having] like a glove [cast cover] on it.

When I [P7] came back from having the surgery, my mom didn't know about the fork and she gave me a few meals without it and when I was struggling a bit and then I told her, 'I have a fork in that bag, can we try that?' It made mealtimes so much easier.

## Discussion

This case series tracked a comprehensive intervention based on a holistic ADL framework that considered the nuances of individual complexities of immobilization after hand trauma. All participants improved on at least 5 of 7 JTT subtests; and all subtests demonstrated improvement from mean pretest to post-test. There were 3 subtests in which all participants improved: (1) page turning, (2) lifting light cans, and (3) lifting heavy cans. This may have been because these are gross motor subtests as compared with other fine motor (dexterity) subtests such as writing and picking up small objects. There were 2 participants whose nondominant UE was injured (P2 and P4). They improved from pretest to post-test on all but 1 subtest (P4, feeding subtest) suggesting that improvements to the dominant hand can also be achieved.

Most (5 of 7) of the JTT subtests had more than half of all pretest and post-test scores within normative range. This could indicate a potential ceiling effect. A study by Walsh et al[36] on the effect of hand trauma on hand dominance found that "simple, short activities that do not require sustained fine motor coordination are more easily performed with a different hand after injury than complex, continuous activities that require sustained fine motor coordination."[36] Most subtests, except writing, do not require sustained fine motor coordination. Indeed, as expected, a large gap was visually noted between the nondominant and dominant affected participants on the writing subtest (Fig. 2).

Developed nearly 5 decades ago, the JTT does not capture daily tasks that incorporate modern technology. However, all subtests incorporate functional movements (ie, picking up heavy and light objects) or basic ADL (ie, eating) and was the most appropriate as compared with other standardized assessments of simulated ADL performance. Measures such as the Chedoke Arm and Hand Activity Inventory include outdated tasks, such as using a landline telephone. The Kohlman Evaluation of Living Skills and Barthel Index measure observed functional performance but focus more on one's cognitive ability to execute ADL rather than UE musculoskeletal ability. Tests originally developed for amputees, like the Southampton Hand Assessment Procedure, simulate ADL performance using the UE but focus heavily on prehensile patterns to measure prosthetic function. With an orthopedic population, the JTT may not have been sensitive enough to pick up difficulties with functional performance, even if the nondominant hand was being used. Despite a potential ceiling effect, there was still an overall trend of better scores from pretest to post-test indicating improved functional performance. Future research may be needed to develop

**Table 3**
Individual scores for each outcome measure

| JTT | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Writing | | | Page | | | Small objects | | | Feeding | | | Stacking | | | Light cans | | | Heavy cans | | |
| | Pre | Post | Δ | Pre | Post | Δ | Pre | Post | Δ | Pre | Post | Δ | Pre | Post | Δ | Pre | Post | Δ | Pre | Post | Δ |
| P1 | 35.08 | 43.96 | −8.88 | 7.13[a] | 5.71 | 1.42 | 9.96[a] | 8.41 | 1.55 | 22.06[a] | 10.60[a] | 11.46 | 7.38[a] | 8.96[a] | −1.58 | 6.33[a] | 4.38 | 1.95 | 6.46[a] | 4.33[a] | 2.13 |
| P2 | 10.18 | 7.58 | 2.60 | 3.98 | 3.66 | 0.32 | 10.90[a] | 6.18 | 4.72 | 14.75[a] | 10.48[a] | 4.27 | 6.40[a] | 5.40[a] | 1.00 | 4.40[a] | 3.35 | 1.05 | 3.98 | 3.20 | 0.78 |
| P3 | 62.47[a] | 38.07 | 24.40 | 5.58 | 4.20 | 1.38 | 9.25[a] | 6.27 | 2.98 | 13.65[a] | 9.75 | 3.90 | 7.75[a] | 5.50[a] | 2.25 | 5.10[a] | 3.83 | 1.27 | 5.45[a] | 4.11 | 1.34 |
| P4 | 11.55 | 11.10 | 0.45 | 5.30 | 3.83 | 1.47 | 8.15[a] | 6.66 | 1.49 | 6.46 | 8.50[a] | −2.04 | 5.85[a] | 5.01[a] | 0.84 | 4.03[a] | 3.10 | 0.93 | 4.11[a] | 3.58 | 0.53 |
| P5 | 54.57 | 46.38 | 8.19 | 5.81 | 5.03 | 0.78 | 6.91 | 7.10 | −0.19 | 8.71 | 9.05 | −0.34 | 7.61[a] | 5.23[a] | 2.38 | 4.95[a] | 3.88 | 1.07 | 5.26[a] | 4.13[a] | 1.13 |
| P6 | 34.38 | 23.21 | 11.17 | 5.10 | 4.25 | 0.85 | 7.21 | 8.46[a] | −1.25 | 20.59[a] | 12.88[a] | 7.71 | 7.61[a] | 6.45[a] | 1.16 | 4.74[a] | 3.90 | 0.84 | 4.46[a] | 4.08 | 0.38 |
| P7 | 36.81 | 28.63 | 8.18 | 4.35 | 3.96 | 0.39 | 7.86 | 6.91 | 0.95 | 8.88 | 7.91 | 0.97 | 8.35[a] | 5.55[a] | 2.80 | 4.13 | 3.46 | 0.67 | 3.91 | 3.35 | 0.56 |
| P8 | 75.05[a] | 69.17[a] | 5.88 | 5.26 | 4.73 | 0.53 | 9.15[a] | 9.45[a] | −0.30 | 15.10[a] | 12.43[a] | 2.67 | 10.48[a] | 8.51[a] | 1.97 | 5.16[a] | 4.18[a] | 0.98 | 4.46[a] | 4.30[a] | 0.16 |
| P9 | 30.17 | 26.78 | 3.39 | 3.20 | 2.60 | 0.60 | 5.30 | 7.58 | −2.28 | 10.66[a] | 10.51[a] | 0.15 | 4.80 | 4.28 | 0.52 | 2.51 | 2.20 | 0.31 | 2.75 | 2.50 | 0.25 |
| Mean | 38.92 | 32.76 | 6.15 | 5.08 | 4.22 | 0.86 | 8.3 | 7.45 | 0.85 | 13.43 | 10.23 | 3.19 | 7.36 | 6.1 | 1.26 | 4.59 | 3.59 | 1.01 | 4.54 | 3.73 | 0.81 |

| | DASH | | | Grooved pegboard | | | Grip strength | | | Pinch strength | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Δ | Pre | Post | Δ | Pre | Post | Δ | Pre | Post | Δ |
| P1 | 65.52 | 37.07 | 28.45 | 108.72 | 102.79 | 5.93 | 105 | 95 | −10 | 16 | 16 | 0 |
| P2 | 22.50 | 11.70 | 10.80 | 104.00 | 102.00 | 2.00 | 75 | 116.70 | 41.70 | 14[a] | 18 | 4 |
| P3 | 57.50 | 53.30 | 4.20 | 108.85 | 95.40 | 13.45 | 80 | 80 | 0 | 19 | 18 | −1 |
| P4 | 32.50 | 17.50 | 15.00 | 92.14 | 82.63 | 9.51 | 82 | 73 | −9 | 18 | 20 | 2 |
| P5 | 69.17 | 40.00 | 29.17 | 113.99 | 112.14 | 1.85 | 132 | 142 | 10 | 24 | 22 | −2 |
| P6 | 66.67 | 50.00 | 16.67 | 103.74 | 100.40 | 3.34 | 45 | 60 | 15 | 11 | 10[a] | −1 |
| P7 | 75.83 | 35.00 | 40.83 | 93.32 | 93.49 | −0.17 | 76 | 80 | 4 | 13 | 18 | 5 |
| P8 | 61.67 | 54.20 | 7.47 | 160.70 | 109.30[a] | −29.60 | 50[a] | 54.30[a] | 4.30 | 9[a] | 12[a] | 3 |
| P9 | 32.50 | 24.20 | 8.30 | 86.90 | 90.82 | −3.92 | 115.70 | 121.70 | 6 | 24 | 24 | 0 |
| Mean | 53.76 | 35.89 | 17.88 | 108.04 | 107.7 | 0.27 | 84.52 | 91.41 | 6.89 | 16.44 | 17.56 | 1.11 |

JTT = Jebsen-Taylor hand function test; Δ = change; DASH = Disabilities of the Arm, Shoulder and Hand.
[a] Score above/below 2 standard deviations of norm.

**Table 4**
DASH means based on demographic conditions

| Demographic condition | *N* | Better mean scores | Pretest mean | Post-test mean |
|---|---|---|---|---|
| Gender | | | | |
| Male | 6 | X | 47.31 | 30.78 |
| Female | 3 | | 66.67 | 46.10 |
| Age group (y) | | | | |
| 20-30 | 4 | X | 49.38 | 37.73 |
| 40-50 | 5 | | 57.27 | 40.41 |
| Hand affected | | | | |
| Nondominant | 2 | X | 27.5 | 14.6 |
| Dominant | 7 | | 61.27 | 41.97 |
| Initial pain level | | | | |
| <4 | 5 | X | 42.10 | 28.75 |
| 4+ | 4 | | 68.34 | 44.80 |
| Immobilization type | | | | |
| Orthosis | 2 | X | 44.01 | 24.39 |
| Cast | 7 | | 56.55 | 39.17 |
| Home environment | | | | |
| Spouse/significant other | 5 | X | 51.5 | 31.5 |
| Other family/roommate | 3 | | 64.62 | 47.09 |
| Alone | 1 | | 31.5 | 24.2 |

DASH = Disabilities of the Arm, Shoulder and Hand.

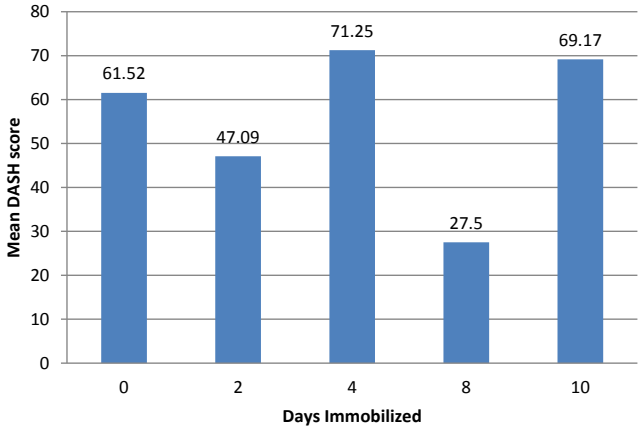



**Fig. 3.** Mean Disabilities of the Arm, Shoulder and Hand scores based on time immobilized at initial visit.

an assessment of UE function more specific to an orthopedic population and more reflective of modern technology.

Participants' subjective functional performance as measured by the DASH improved during 4 weeks. All participants improved from pretest to post-test on the DASH, and 5 achieved the MCID. A sixth participant (P4) fell short off the MCID by a score of only 0.03. There may have been a few possible explanations for the remaining 3 participants who did not achieve the DASH MCID. Participant 3 (P3) was the only participant to have her thumb included in immobilization, which may have created more limitations on function. This is consistent with findings that clients with UE amputations, followed by those with thumb injuries, are more functionally impaired than those with other UE trauma diagnoses.[5] Participant 8 (P8) enrolled into this study for an injury to his right UE, but later reported that 3 weeks prior, he had undergone an arthroscopic tennis elbow procedure on his left UE. He reported residual deficits from that procedure.

The highest pretest DASH score was reported by P7, but he demonstrated the largest improvement. This is promising as it may suggest that individuals who are highly impaired initially can still make meaningful improvements in function. Conversely, improvements in functional performance can be made even if mild impairments are reported initially. The nondominant affected participants had the lowest DASH scores but still achieved, or came close to achieving, the MCID.

The timing of when the pretest DASH was administered was also considered. Participants completed the DASH at various time points ranging from the same day as immobilization to up to 10 days from immobilization (Fig. 3). The 2 participants who had been immobilized for 8 days also had their nondominant UEs affected; therefore, their mean score was expectedly lower. At all other time points, the average DASH score was 47.09 or higher, indicating moderate functional impairment. This is consistent with the study by Gustaffson et al[4] in which participants reported the highest functional limitations 1-2 weeks after injury.

Comparisons of mean DASH scores based on demographic factors in Table 4 were not significant. In addition, with only 2 participants in certain conditions such as hand affected and immobilization type, means had the potential to be skewed by outlying scores. However, it is of value to note how various internal and external factors influenced participants' perceived functional performance. Those who lived with a spouse or a significant other had better DASH scores than those living with other family members. It may be that spouses were able to offer more support, or participants were more comfortable relying on assistance from a spouse. For example, P8 reported that he did not feel comfortable asking his niece for assistance with self-care tasks such as dressing and toileting. The better DASH scores for the 20-30 year group may reflect that the impact of UE trauma on function is related to age. Participants immobilized via orthosis rather than a cast reported lower levels of functional impairment. It could be that this method of immobilization is less restrictive as the material used is less bulky. All participants reported 100% compliance with wearing orthoses at all times; however, with no way to verify other than self-report, it is possible that a participant could have removed an orthosis for ADL. The most notable difference between mean DASH scores was seen when comparing hand affected with nondominant affected participants' mean scores at least twice as low compared with the other participants, suggesting less functional impairment. This supports the concept of injury to the dominant UE as a double-impact injury due to loss of more dexterous main executor.[2] In addition, this confirms findings by Hodges and Adams[37] that hand dominance has a considerable effect on function. Interestingly, they found that left-handed individuals are significantly more dexterous with their nondominant hand compared with the right-handed group. In other words, left-hand dominant individuals may be able to adapt better to one-handedness.

Six participants improved dexterity as measured by the GPB. There was 1 participant (P8) who demonstrated large decline from pretest to post-test, which may have reflected residual impairments from his prior elbow procedure. Females and participants between 20 and 30 years performed better, on average, in terms of dexterity. This is consistent with normative data for this test.[38] Six participants improved grip strength, and 4 participants improved pinch strength. As expected, based on norms, males had higher grip and pinch strength mean scores. Mean strength scores based on age group did not favor either.

Although overall improvements were anticipated in dexterity, grip, and pinch strength due to forced increased use, it was also expected that the unaffected side would have normal values. For this reason, the HEP component of the intervention was offered to maintain these basic strength and motion capabilities and may explain the small improvements in pretest to post-test means (Table 3). Similar to the JTT, a ceiling effect could have occurred. Almost all scores in all 3 measures were within the 2 SDs of normal values for each participant.

*Limitations*

Lack of a control or a comparison group limits the generalizability of the study and makes it difficult to assess the degree to which time and practice may have contributed to improvements. A trend toward improvement in function was expected; however, improvements tend to plateau by 3 months after injury.[5] A control group was purposefully avoided based on (a) a seminal study by Appleby et al,[39] in which 90% of participants who underwent hand surgery found education beneficial, (b) the previous success of the one-handed backpacks used at Walter Reed Army Medical Center, and (c) the authors' collective clinical experience with clients with UE impairment benefiting from ADL training. This study was also limited by the lack of a more prescriptive and customized exercise program based on each participant's baseline hand function performance. This study could have been improved by adding an additional study aim to assess a cross-transfer gain.

Although there are inherent limitations to a case series design, there were several benefits. This case series marks the beginning of tracking a comprehensive intervention based on a holistic ADL framework or viewpoint. It included the nuances of individual complexities to provide a deeper understanding and fosters inductive reasoning to develop the clinical knowledge base. In addition, researcher bias was minimized by prospectively studying a group following a specific protocol. Future research could include larger group analysis to allow for inferential statistical analysis and to further examine hand dominance and adaptation. A multisite study to compare UE trauma standard of care to UHT or a similar ADL intervention could improve generalizability. Finally, dexterity, grip, and pinch strength did not seem to have major impact on functional performance in this study. Future research could explore the impact of a more specific and strictly enforced HEP protocol or the effects, if any, of unilateral strength training on the cross-transfer phenomenon.

*Clinical implications*

Improvements in objective measures such as range of motion may not always translate into successful participation in daily activities.[39] Study results found benefit to the UHT in assisting with performance of daily activities; these results may encourage therapists to incorporate an ADL/IADL intervention into the plan of care for individuals who sustain UE trauma. In addition, UHT and its components demonstrate good feasibility for practice. Client education is easily incorporated into treatment and positively influences recovery.[39] The education and equipment reportedly enabled participation in occupations that participants otherwise may have stopped doing due to immobilization. Participants were made aware of practical ideas such as making alternate choices when buying everyday products (eg, flossers instead of dental floss spool) or exploring already available options (eg, accessibility settings on cell phone).

The total value of each backpack was approximately $162. Backpacks were obtained with grant funding and provided to participants at no cost. At present, it is unlikely that private insurance would cover similar equipment; however, it is arguable that the cost may be marginal when compared with the potential expense to treat a reinjured UE. In addition, total cost of the one-handed backpacks can be lessened as contents can be customized to individuals. For example, the adapted cutting board could be excluded for individuals who did not cook often before injury. If costs or other logistical issues, such as storage space, prevent providing clients with equipment, the items used in this study can help clinicians prioritize recommendations. Several participants reported using all items in the one-handed backpack. All participants believed that the cast shower cover, an item available at most drug stores, saved time and helped with performance of self-care. Participants reported that the most often used adaptive equipment included the cutting board, Knork™, bottle opener, can opener, scoop dish plate, and one-handed flossers.

Finally, there were various benefits reported by participants regarding the HEP. P7 stated, "I like[d] doing something [with the exercises]. I felt like I was … participating in my healing process." Most hand therapy clinics already have Theraputty, and it is relatively inexpensive. In addition, alternate methods for improving strength in the unaffected UE could be used such as isometric exercises or functional activities.

## Conclusion

Improving function is a core principle driving all occupational therapy treatments. The usefulness and feasibility of UHT encourages a change in culture in hand therapy to address ADL/IADL in evaluations and treatments. Therapists may take knowledge gained from the participants' experiences shared through this case series to develop an early intervention like UHT to educate clients on effective strategies to improve immediate ADL functioning and potentially prevent long-term impairments.

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## References

1. Ootes D, Lambers KT, Ring DC. The epidemiology of upper extremity injuries presenting to the emergency department in the United States. *Hand (N Y)*. 2012;7:18–22.
2. Yancosek K. Management of dominant upper extremity injuries: a survey of practice patterns. *J Hand Ther*. 2012;25(1):79–87.
3. Coenen M, Kus S, Klaus-Dieter R, et al. Do patient-reported outcome measures capture functioning aspects and environmental factors important to individuals with injuries or disorders of the hand? *J Hand Ther*. 2013;26:332–342.
4. Gustaffson M, Persson L, Amilon A. A qualitative study of stress factors in the early stage of acute traumatic hand injury. *J Adv Nurs*. 2000;32(6):1333–1340.
5. Gustaffson M, Ahlstrom G. Problems experienced during the first year of acute traumatic hand injury—a prospective study. *J Clin Nurs*. 2004;13:986–995.
6. Bell J, Gray M, Kingston G. The longer term functional impact of a traumatic hand injury on people living in a regional metropolitan Australian location. *Int J Ther Rehabil*. 2011;18(7):370–382.
7. Kingston G, Tanner B, Gray M. The functional impact of a traumatic hand injury on people who live in rural and remote locations. *Disabil Rehabil*. 2010;32(4):326–335.
8. Meiners PM, Coert JH, Robinson PH, Meek MF. Impairment and employment issues after nerve repair in the hand and forearm. *Disabil Rehabil*. 2005;27(11):617–623.
9. Sandford F, Barlow N, Lewis J. A study to examine patient adherence to wearing 24-hour forearm thermoplastic splints after tendon repairs. *J Hand Ther*. 2008;21(1):44–53.
10. Kaskutas V, Powell R. The impact of flexor tendon rehabilitation restrictions on individuals' independence with daily activities: implications for hand therapists. *J Hand Ther*. 2013;26(1):22–29.
11. Chan J, Spencer J. Adaptation to hand injury: an evolving experience. *Am J Occup Ther*. 2004;58(2):128–139.
12. Starck Schier J, Chan J. Changes in life roles after hand injury. *J Hand Ther*. 2007;20:57–69.
13. Powell RK, von der Hyde RL. The inclusion of activities of daily living in flexor tendon rehabilitation: a survey. *J Hand Ther*. 2014;27:23–29.
14. Grice KO. The use of occupation-based assessments and intervention in the hand therapy setting—a survey. *J Hand Ther*. 2015;28(3):300–306.
15. Weinstock-Zlotnick G, Bear-Lehman J. How therapists specializing in hand therapy evaluate the ability of patients to participate in their daily lives: an exploratory study. *J Hand Ther*. 2015;28(3):261–268.

16. Colaianni D, Provident I. The benefits of and challenges to the use of occupation in hand therapy. *Occup Ther Health Care*. 2010;24(2):130–146.
17. Marks M, Herrnen DB, Vliet Vlieland TPM, Simmen BR, Angst F, Goldhahn J. Determinants of patient satisfaction after orthopedic intervention to the hand: a review of the literature. *J Hand Ther*. 2011;24:303–312.
18. Beaton DE, Katz JN, Fossel AH, Wright JG, Tarasuk V, Bombardier C. Measuring the whole or the parts? Validity, reliability, and responsiveness of the Disabilities of the Arm, Shoulder and Hand outcome measure in different regions of the upper extremity. *J Hand Ther*. 2001;14(2):128–146.
19. Franchignoni F, Vercelli S, Giordano A, Sartorio F, Bravini E, Ferriero G. Minimal clinically important difference of the Disabilities of the Arm, Shoulder, and Hand Outcome Measure (DASH) and its shortened version (QuickDASH). *J Orthop Sports Phys Ther*. 2014;44(1):30–39.
20. Jebsen RH, Taylor N, Trieschmann RB, Trotter MJ, Howard LA. An objective and standardized test of hand function. *Arch Phys Med Rehabil*. 1969;50:311–319.
21. Lynch KB, Bridle MJ. Validity of the Jebsen-Taylor Hand Function Test in predicting activities of daily living. *Occup Ther J Res*. 1989;9:316–317.
22. Wang Y, Magasi S, Bohannon R, et al. Assessing dexterity function: a comparison of two alternatives for the NIH toolbox. *J Hand Ther*. 2011;24(4):313–321.
23. Lindstrom-Hazel D, Kratt A, Bix L. Interrater reliability of students using hand and pinch dynamometers. *Am J Occup Ther*. 2009;63(2):193–197.
24. Hanten WP. Maximum grip strength in normal subjects from 20 to 64 years of age. *J Hand Ther*. 1999;12:193–200.
25. Mathiowetz V, Kashman N, Volland G, Weber K, Dowe M, Rogers S. Grip and pinch strength: normative data for adults. *Arch Phys Med Rehabil*. 1985;66:69–72.
26. Lissek S, Wilimzig C, Stude P, et al. Immobilization impairs tactile perception and shrinks somatosensory cortical maps. *Curr Biol*. 2009;19(10):837–842.
27. Langer N, Hanggi J, Muller NA, Simmen HP, Jäncke L. Effects of limb immobilization on brain plasticity. *Neurology*. 2012;78(3):182–188.
28. Westlake KP, Byl NN. Neural plasticity and implications for hand rehabilitation after neurological insult. *J Hand Ther*. 2013;26(2):87–93.
29. Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. *J Speech Lang Hear Res*. 2008;51:S225–S239.
30. Yancosek K. One-handed backpacks. *InMotion*. 2007;17(7):33–34.
31. Cox J, Spaulding S, Kramer J. Is there a relationship between hand strength and hand function? *J Hand Ther*. 2006;19(4):444–445.
32. Munn J, Herbert RD, Gandevia SC. Contralateral effects of unilateral resistance training: a meta-analysis. *J Appl Physiol*. 2004;96:1861–1866.
33. Nagel M, Rice M. Cross-transfer effects in the upper extremity during an occupationally embedded exercise. *Am J Occup Ther*. 2001;55(3):317–323.
34. Stromberg BV. Influence of cross-education training in postoperative hand therapy. *South Med J*. 1988;81(8):989–991.
35. Creswell JW. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. 3rd ed. Thousand Oaks, CA: SAGE Publications, Inc; 2013.
36. Walsh WW, Belding NN, Taylor E, Nunley JA. The effect of upper extremity trauma on handedness. *Am J Occup Ther*. 1993;47(9):787–795.
37. Hodges L, Adams J. Grip strength and dexterity: a study of variance between right- and left-handed healthy individuals. *Br J Hand Ther*. 2007;12(1):15–21.
38. Strenge H, Niederberger U. Unidirectional interference in use of nondominant hand during concurrent Grooved Pegboard and random number generation tasks. *Percept Mot Skills*. 2008;106:763–774.
39. Appleby M, Schkade J, Gilkeson G. Timing of ADL education with hand surgery patients. *J Hand Ther*. 1992;4:218–225.

# JHT Read for Credit
## Quiz: # 586

**Record your answers on the Return Answer Form found on the tear-out coupon at the back of this issue or to complete online and use a credit card, go to *JHTReadforCredit.com*. There is only one best answer for each question.**

# 1. The following were measured
   a. grip strength
   b. dexterity
   c. pinch strength
   d. all of the above
# 2. The impact of UHT on patients was explored through
   a. chart reviews
   b. video analysis
   c. qualitative interviews
   d. interviews of treating physicians and therapists
# 3. Functional performance was more impaired in patients
   a. sustaining injury of the dominant upper extremity
   b. sustaining injury of the non-dominant upper extremity
   c. equally of either upper extremity
   d. injured in a recreational activity
# 4. The therapeutic program was
   a. referred to but not described in detail
   b. described in detail
   c. implied but not specifically referenced
   d. complex and required TIW visits to the hand therapy clinic
# 5. Patients reported that they felt the exercise regime was beneficial
   a. false
   b. true

When submitting to the HTCC for re-certification, please batch your JHT RFC certificates in groups of 3 or more to get full credit.

## Appendix A.

### Semistructured interview

1. Did you ever go through something similar to this injury before? (ie, had to negotiate with cast/orthosis) YES/NO
2. How did your injury impact your daily life? What types of activities were affected if any? Did you have to change the way you did things? Did you have to rely on help from someone else?
   a. Dressing, bathing, grooming, eating, cooking, opening containers, lifting, shopping, driving, cleaning, childcare, work, hobbies
3. How did the education and equipment you received help you perform your daily activities?
   a. What equipment did you NOT use, why
      i. Flossers, LockLaces®, can opener, Magic Opener®, jar opener, cutting board, Knork™, scoop dish, shower shield, Dr Grip® pen, Dycem®
   b. What *ONE* item did you use the MOST, why
      i. Flossers, LockLaces®, can opener, Magic Opener®, jar opener, cutting board, Knork™, scoop dish, shower shield, Dr Grip® pen, Dycem®
4. What help did you still need from friends or family?
   a. Dressing, bathing, grooming, eating, cooking, opening containers, lifting, shopping, driving, cleaning, childcare, work, hobbies
5. If you did not get the education and equipment, what would you have done?
   a. Looked on the Internet
   b. Asked friend/family member for help
   c. Avoid certain things (ie, opening jars)
   d Call Dr back and ask
   e. Other ….
6. Did you take off your orthosis/cast in the last 4 weeks? YES/NO
   a. Why/for what
      i. Pain
      ii. Dressing
      iii. Bathing
      iv. Work
      v. Driving
      vi. Other ….
7. How often did you do your exercises?

## Appendix B.

### Intervention handout

The following information and equipment was designed to assist you in performing your daily tasks more efficiently and safely while your arm/hand is casted or splinted to recover from injury. There are numerous ways to perform daily tasks beyond the suggestions provided. There is no right or wrong way to perform different activities; however, we want to ensure that you can do so while safely maintaining the precautions outlined by your physician (keeping your injured hand/arm from moving). The purpose of this information is to give some examples of methods that will allow you to do so.

*One-handed techniques/activity modifications*

- Dressing
  - Shirts: choose pullover instead of button up if possible; thread injured arm into sleeve first
  - Pants: choose pants with easier fasteners if possible (drawstring/elastic waist instead of buttons, zippers); button extenders can sometimes make buttoning easier (eg, easy fit jeans buttons)
  - Shoes: slip-on shoes, Velcro fasteners instead of laces, elastic laces, one-handed lace tying
  - Males: clip on ties/bows, Ziptie
  - Females: front clasp or Velcro fastener bra

- Writing
  - Clipboard, paperweight, nonskid surface (eg, Dycem), or tape paper to surface for stabilization
  - Pencil grips or choose fatter pen/pencils

- Technology options
  - Typing/computer work:
    - Microsoft accessibility options
      - Start → Control panel → ease of access/accessibility options
      - StickyKeys: designed for people who have difficulty holding down 2 or more keys at a time. When a shortcut requires a key combination such as Ctrl + P, StickyKeys allows you to press 1 key at a time instead of pressing them simultaneously
      - Mouse settings: hover instead of having to click, control with keyboard, and others
      - Built-in speech recognition
    - Word prediction software (eg, Dragon NaturallySpeaking)
  - Cells phones
    - One touch dialing using preprogrammed numbers (favorites)
    - Voice commands for calling, texting, and others
    - Headset or Bluetooth to answer/make calls without touching phone
    - iPhone (settings → general → accessibility settings)
      - Assistive touch: allows you to use if you have difficulty touching screen or home button
      - Custom gestures: allow you to record gestures
      - Click speed: adjust speed required to activate double and triple click home

- Driving: Safety is paramount. Follow the instructions of the medications that the doctor prescribed, if any, and never operate a vehicle if you feel you cannot safely do so
  - Grooming/hygiene
    - Cast shield in shower/bath
    - Use electric razor (more stable and safe)
    - Wall-mounted hair dryer
    - Suction brush attached to sink or counter can be used for nail care (or fasten emery board to table top); mounted nail clipper
    - Instead of screw-top cap, use a pump bottle for shampoo, condition, and others; toothpaste container instead of tube

- Home management
  - Nonskid mats to keep pots, bowls, and dishes from sliding during meal preparation
  - Easier meals (microwave meals, slow cooker, etc.)

*Adaptive equipment*

There are a number of commercially available devices and specialized adaptive equipment designed to assist in the performance of one-handed tasks. You will be provided with the following equipment to trial/use as appropriate:

- Sling backpack
- One-handed dental flossers

- Dycem
- Dr Grip retractable pen
- LockLace
- Electric letter opener
- Hands-free can opener
- Hands-free bottle opener
- Hands-free jar opener
- One-handed cutting board
- Knork™
- Cast/splint shower shield
- Scoop dish

Examples of additional devices available:

- Clip on neck ties/bows
- Rocker knife
- Plate guards
- Pan stabilizer
- Wash mitts
- One-handed nail clippers
- Electric toothbrush

*Home exercise program*

During your immobilization period, your noninjured hand will be mainly responsible for execution of daily tasks. These exercises are designed to improve the strength and dexterity of your noninjured hand so that performance of these tasks becomes easier.

- Putty press: use dowel to slowly press into putty
- Putty roll and pinch: roll putty into long thin cylinder and then pinch with index finger, middle finger, and thumb
- Items in putty: bury 10-20 coins, paper clips, small items (eg, beads) into putty and then pull out using fingertips