# Static Wrist Splint Use in the Performance of Daily Activities by Individuals with Rheumatoid Arthritis

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***ABSTRACT.*** ***Objective.*** In individuals with rheumatoid arthritis (RA), to identify the influence of wrist splint wear on pain, work performance, endurance, perceived task difficulty, and perceived splint benefit while performing various upper limb tasks.

***Methods.*** This crossover study included 30 individuals with wrist involvement. Pain, work performance, endurance, and perceived task difficulty were assessed with the splint on and off. Using a work simulator, participants performed 14 tasks, 10 assessing work performance and 4 assessing endurance. A visual analog scale (VAS) was used to rate pain, task difficulty, and perceived splint benefit.

***Results.*** With the splint on, pain was significantly lower in 5 tasks, as was perceived difficulty in task performance. Work performance did not differ significantly with the splint on versus off. While mean endurance scores were always better with the splint on, differences reached significance on only one task. The task with greatest overall perceived splint benefit was "chopping with a knife."

***Conclusion.*** Results revealed that for most tasks, there was generally a positive effect of splint use on hand function; however, perceived splint benefit was marginal. For most tasks splint use improved or did not change pain levels, did not interfere with work performance, increased or maintained endurance, and did not increase perceived task difficulty. The findings suggest that wrist splint prescription is not a simple process; clinicians and clients need to work together to determine the daily wear pattern that maximizes benefit and minimizes inconvenience according to the client's individual needs. (J Rheumatol 2005;32:2136–43)

*Key Indexing Terms:*
RHEUMATOID ARTHRITIS
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About 75% of individuals with rheumatoid arthritis (RA) have inflammatory involvement of the wrist joint[1]. Pain from active synovitis or joint damage contributes to a reduction in actual or perceived hand strength and a concomitant decrease in functional ability. Static wrist orthoses are provided by rehabilitation clinicians to reduce pain and inflammation at the wrist[1-6].

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Several studies have attempted to identify the influence of various working wrist orthoses on wrist mobility and hand strength and function[7-17]. In a study that looked specifically at grip strength[9], 92 women with RA were randomly assigned to receive either no splint or one of 4 types of splints (dorsal, palmar, gauntlet, or fabric). The results indicated that grip strength, when assessed in a laboratory setting, was not increased in any of the 4 splint groups. Backman and Deitz[10] studied the effect of a static, custom-made polyethylene gauntlet-type wrist splint in 3 women with RA using a single-subject, alternating-treatment design. Grip strength and applied strength were greater in all 3 participants with the splint on, and pinch strength was greater in 2 participants with the splint on. Applied dexterity was either unaffected or worsened by the splint. The small number of participants and the quantitative limitations of the outcome measures make the study results, while interesting, somewhat limited.

Considering the high frequency of hand involvement in RA, it is not unexpected that dexterous hand function would be reduced in those with this disease and that a wrist splint might further hinder dexterity. Two studies[12,14] using healthy participants noted a significant increase in the time taken to complete dexterous tasks in most splint wear situations. For example, Carlson and Trombly[14] reported that in individuals with normal hand function, there is a significant increase in time to do the Jebsen Hand Function Test while wearing a gauntlet-type, commercially available orthosis. These findings were substantiated in individuals with RA[18].

In those with RA, splint wear patterns appear to differ by task. Stern and colleagues[11,13] found that clients reported using a splint for activities that place large demands on the wrist such as lawn mowing, raking, vacuuming, and lifting moderately heavy objects, but that they removed the splint for tasks such as equipment repair because it seemed to "get in the way" or it reduced needed "flexibility" or "mobility." It is likely that this variability in splint use may be attributable in part to the requirements that each of these tasks places on the wrist. Indeed, our previous work using the Baltimore Therapeutic Equipment Company (BTE) work simulator and 2 simulated tasks to explore the effect of a wrist splint on work performance suggested task-specific variability in splint effectiveness[19]. One task simulated the use of a "screwdriver" requiring supination and pronation of the forearm; the second task simulated "cutting with shears," which placed the forearm in neutral position. Work performance with and without splint use differed according to the tool used: work performance was hindered with the splint on for a "screwdriver" task but not for a "cutting with shears" task. This information led us to speculate that, for each activity performed in daily life, there is a task-specific effect of a wrist splint on work performance.

If there is task specificity in relation to work performance, this may explain in part why clients show variable adherence to splint use[20-24]. Splint adherence is also dependent on the client's and the clinician's perceived benefit of splinting[23,24]. If a clinician recommends a splint without knowledge of which activities are seriously hampered, the client's frustration may lead to limited splint use. Therefore, to improve our understanding of the task-specific benefits of splint wear, we explored, in individuals with RA involving the wrist and hand, the influence of splint wear on pain, work performance, endurance, perceived task difficulty, and perceived splint benefit in tasks representative of common activities of daily living as simulated on a work simulator. A secondary objective was to determine whether the perceived splint benefit differed according to clinical characteristics including initial pain score, degree of wrist and hand disease activity, and degree of wrist and hand structural changes and type of manual activities the participant routinely engaged in during daily activities.

## MATERIALS AND METHODS

*Study design and participants*. This study used a crossover design. A consecutive sample of individuals admitted for inpatient or outpatient treatment in the Rheumatic Disease Unit of the Jewish Rehabilitation Hospital, a McGill University affiliated teaching hospital in Montreal, Canada, over a 24 month period were screened for eligibility. Subjects were eligible if they had a diagnosis of RA and had recently used a prefabricated and commercially available, circumferential fabric-type wrist working splint with a palmar metal insert. While providing support for the wrist, these types of splints (i.e., Futuro, Roylan D. Medical Specialties) function similarly and permit slight wrist movements. Clients with RA generally prefer these types of splints over wrist splints that fully immobilize the wrist. Clients were excluded if (1) they were unable to wear a prefabricated elasticized wrist splint because of advanced wrist and hand deformities, rash, allergies, altered sensation, or skin breakdown; (2) they had received an injection of corticosteroid medication in the wrist or any small joints of the hand or flexor tendon sheath of the hand within the preceding 2 months; (3) they were diagnosed as having carpal tunnel syndrome associated with persistent numbness; (4) they had severe finger deformities limiting grip of the tools; (5) they had clinical fusion of the radiocarpal joint; or (6) they had had wrist and/or hand surgery in the past 6 months.

*Measures*. The primary outcomes of interest were pain, work performance, endurance, and perceived difficulty of the task with and without the splint, as well as perceived benefit in task performance with the splint. In addition, information on potential explanatory variables was collected, including age, sex, handedness, duration of disease, initial pain, disease activity and structural changes, type of manual activities the participant routinely engaged in during daily activities, and functional status as defined by the American Rheumatism Association (ARA) functional class scale[25]. This scale defines 4 categories of functional capacity ranging from functional Class I, indicating complete functional capacity with ability to carry on all usual duties without handicaps, to functional Class IV, indicating someone who is largely or wholly incapacitated and who is bedridden or confined to a wheelchair, permitting little or no self-care.

*Pain*. Pain at the wrist was measured using an unnumbered 10 centimeter horizontal visual analog scale (VAS). The participant was asked to indicate on the line, using a straight vertical pencil marking, where he or she would situate their level of wrist pain, with 0 cm indicating "no pain" and 10 cm indicating "pain as bad as it can be." A VAS provides a simple way to record estimates of pain intensity and has been used widely in research[26]. Among clients with rheumatological conditions, this scale has been shown to be highly reliable, with test-retest reliability of 0.99[26]. Pain was measured before and after the performance of each task, both with the splint on and with the splint off.

*Work performance*. The Baltimore Therapeutic Equipment Company manufactures the work simulator used in this protocol[27,28]. The machine has an axial shaft to which an electric braking system delivers varying degrees of resistance. Numerous tools can be attached to the shaft to simulate specific hand and upper extremity function. Ten activities using BTE tools were identified for use in the assessment of participants' work performance that mimic such tasks as vacuuming and driving. Each of the tools simulates a daily task that an individual with arthritis is likely to perform (Table 1). The work done by the hand is measured by assessing the distance traveled (i.e., the degrees of arc turned on the axis of the apparatus) against the resistance applied by the instrument to the axial shaft. Work performance that represents power or the amount of work done over a period of time is calculated as inch-pound-degrees/second (engals) with time measured in milliseconds by the internal clock. For this study, the period of time was designated at 30 s. Computerized readouts were generated for each task. For certain activities, such as "pull electric cord," resistance for the task (torque) was applied only in the direction simulating pulling.

In a pilot study[19] we determined that the resistance (torque) against which a participant works on the BTE must be individualized, as it is not possible for all participants to work against the same resistance. The goal was to have the movement required for each task be the same for each participant, while at the same time providing a resistance that represented a proportion of the individual's maximal resistance capacity. The following procedure worked successfully in our previous study and was used here. Setting the machine to a static mode, participants were instructed to give a "strong quick push (or pull or tug or lift)" according to the action required for the task. The mean of 3 trials on each tool was calculated and the

*Table 1.* Description of simulated tasks (BTE work simulator).

| Simulated Tasks: Work Performance (WP) and Endurance (E) | Explanation |
|---|---|
| Vacuuming (WP) | 30 s of repetitive back and forth; whole arm movement on the side; oblique grip |
| Vacuuming (E) | ≤ 7 min of above task depending on participant's endurance in performing the task |
| Lift pot or pitcher (WP) | 30 s of repetitive lifting from waist to shoulder level; vertical handle; cylindrical (coal hammer) grip |
| Chop with a knife (WP) | 30 s of chopping with a knife tip fixed on cutting board; oblique grip |
| Chop with a knife (E) | ≤ 7 min of above task according to participant's tolerance |
| Lift briefcase (WP) | 30 s of repetitive lifting of a weight by its handle such as a bag or briefcase from the floor to waist level; hook grip |
| Turn faucet or jar (WP) | 30 s of repetitive tight gripping with the whole hand while twisting toward the thumb, such as turning a faucet or twisting off a jar cover; spherical grip |
| Pull electric cord (WP) | Repetitive pulling with fingertips such as pulling an electric cord out of the socket, pulling on a small appliance knob, oven rack, or pulling on fitted sheets; tip grip |
| Pull electric cord (E) | ≤ 7 min of above task depending on participant's endurance in performing the task |
| Placing (WP) | Repetitive placing of an object held by the fingertips such as storing a box on a shelf or stacking items; movement is from waist to shoulder level; palmar grip |
| Placing (E) | ≤ 7 min of above task depending on participant's endurance in performing the task |
| Turn key or knob (WP) | Repetitive twisting side to side with fingertips; lateral grip |
| Driving (WP) | Repetitive side to side motion of the forearm with light grip such as in driving or wiping: cylindrical grip |
| Push shopping cart (WP) | Horizontal pushing with the whole arm such as pushing shopping cart, lawn mower, or a stroller; cylindrical grip |

applied resistance for the task was set at 50% of that mean for both the work performance and endurance tasks using the dynamic mode of the BTE.

*Endurance*. The BTE was also used to measure endurance. Four tasks were chosen from the work performance tasks to represent daily activities that commonly require sustained repetition over a period of time, including: simulated "chopping with a knife," "vacuuming," "placing" of an object from waist to shoulder level, and "pulling an electrical cord." In contrast to the 30 s used to measure work performance, endurance was measured in engals for up to a maximum of 7 min according to the participant's tolerance.

*Perceived difficulty*. Participants were asked to rate their perceived level of difficulty in doing each task (with splint on and off) using a VAS similar to that used for pain assessment. Participants responded using a straight vertical pencil mark indicating the level of task difficulty, 0 cm indicating "no difficulty" and 10 cm indicating "extreme difficulty."

*Perceived splint benefit*. Participants rated their perception of the splint's benefit during performance of each task with the splint on, again using a VAS, with 0 cm indicating "no benefit" and 10 cm indicating "great benefit." Three rehabilitation specialists created clinically relevant categories of perceived splint benefit based on their clinical judgment and client perceptions. VAS responses > 7 were classified as indicative of strong perceived benefit of the splint, scores 3 to 7 were classified as moderate benefit, and ratings < 3 were classified as little or no perceived benefit.

*Explanatory variables*. The main clinical indicators of interest included initial pain, disease activity, structural changes, and types of manual activity the participant engaged in during routine daily activities. Initial pain at the wrist was measured using the same unnumbered 10 cm horizontal VAS used for the measure of pain outcome. Initial pain was recorded before the start of the testing procedure and the scores were dichotomized into 2 categories: < 5 indicating "low pain" and ≥ 5 indicating "high pain." Disease activity was measured using a standard procedure for the assessment of tenderness and swelling as described in the *Dictionary of the Rheumatic Diseases*[29]. Tenderness was evaluated on a 4 point scale ranging from 0 indicating "no tenderness" to 3 indicating "wincing and attempt to withdraw." Swelling was also graded on a 4 point scale from 0 indicating "no swelling" to 3 indicating "swelling outside normal joint contours." Crepitus was coded as "present" or "absent." Range of motion and structural changes of the joints were assessed using the Treuhaft hand assessment[30], which scores structural changes numerically. For some analyses, these scores were summed to create a total score. For disease activity and structural change, a dichotomy was created to classify participants into 2 groups: a score < 14 classified "low" hand involvement and ≥ 14 "high" hand involvement. The cutoff value was based on consultation with a group of clinical experts: consensus was that an individual with hand disease activity and structural changes of 14 or greater represents a different clinical picture (i.e., more hand involvement) than an individual who scores less than 14.

Information on the type of manual activities the participant engaged in during routine daily activities was elicited and coded as "light," "moderately heavy," or "heavy." For example, manual activities such as self-care and tidying tasks were categorized as "light"; activities such as meal preparation, laundry, and shopping tasks were categorized as "moderately heavy"; and activities such as outdoor maintenance work and strenuous, repetitive manual activities such as infant or toddler care were classified as "heavy."

*Procedure*. This project was approved by the Research Ethics Review Committee of the Jewish Rehabilitation Hospital. Potential participants were screened for eligibility by the patient's occupational therapist (OT) and those who met eligibility criteria, if willing, had their names forwarded to the primary investigator; all provided written consent to participate.

Participants were assessed for their baseline pain level and scheduled for two 1.5-hour sessions that were held 3 to 7 days apart. The participant's splint was checked for appearance and conformity to approximately 10° to 15° of wrist extension, the recommended splint angle for individuals with chronic wrist synovitis[2]. One trained OT with 25 years of experience in rheumatology assessed baseline hand function using a standardized procedure[29,30]. Participants were then given a questionnaire: the first part indicated a list of common reasons why an individual would or would not wear the splint. Each participant was asked to indicate his or her reasons for wearing the splint and to rank the 2 most important reasons.

During each session participants completed 5 work performance tasks under 2 conditions, with their personal splint and without the splint, and 2 endurance tasks, again with and without the splint. Activities were presented in random order, according to a randomization scheme determined before the study. The order of splint wear (whether the participant performed the activity first with or without the splint) was also randomly determined, such that half the participants first performed all tasks with the splint, while the other half first performed all tasks without the splint.

Participants had an opportunity for a brief practice of each task prior to the testing situation. A research assistant or the OT collected the information on pain, work performance, endurance, and the participant's perceived difficulty with the task and perceived benefit of the splint using a standardized sequence and procedure.

Rest periods were provided between tasks, and readiness to resume participation was ascertained by the evaluator before each trial. If a participant's pain level rose close to the level of "extreme pain" on the VAS (≥ 8) the participant rested for a period of 10 min to allow the pain to subside. If the pain persisted after the rest period, the trial was discontinued and ice and the client's usual pain medications were offered.

*Sample size*. Sample size calculations were based on the primary outcome of interest, work performance. Information on means and standard deviations used in the calculations was available from the pilot study in which 10 individuals underwent BTE testing[19]. The average work performance generated in the 10 individuals when performing the simulated screwdriver activity without the orthosis was 223 engals (± 164). Sample size calculations for dependent samples, using the computer program PC-Size[31], indicated that a sample size of 32 participants would provide 95% power to detect differences of 10 engals between the splint on/splint off situation with p = 0.05. As a difference of 10 engals between the splint on and splint off situations is likely to be clinically important, this difference was considered suitable for determining sample size.

*Data analysis*. It was difficult to standardize the amount of stress the participants placed on their joints while performing the tasks. In consequence, large variations between participants were observed and the data were not normally distributed. Therefore, nonparametric paired t tests (Wilcoxon signed-rank) were used to examine the main objective of comparing pain, work performance, endurance, and perceived task difficulty with and without splint wear. Descriptive statistics were used to identify tasks with a strong perceived benefit of the splint. Additionally, a trichotomized variable was created to identify the number of participants who scored "better," "worse," or "the same" with the splint on for each of the outcomes (pain, work performance, endurance, perceived difficulty, and perceived benefit). With the splint on, differences of 20% improvement or greater were classified as "better," those 20% worse or more were classified as "worse," and those with less than a 20% difference in either direction were classified as the same. The cutoff was based on 2 criteria. Clinically, 3 rehabilitation specialists in the area of rheumatology judged that a 20% change or more represented a clinically important difference. In addition, while not without controversy, there is literature that supports the notion of using approximately 20% on a standard VAS or 0.5 of a standard deviation from the baseline score as representing an important clinical difference in patient responses[32].

To examine the correlations between individual clinical factors (initial pain, degree of disease activity, and structural changes in the wrist and hand) and perceived splint benefit, Pearson's product moment correlation coefficients were calculated employing an alpha level of 0.01. Independent t tests were used to analyze the mean perceived benefit of the splint for the group of participants who classified their daily manual activities as light versus those who classified them as moderately heavy: no participant was categorized as performing heavy activities.

## RESULTS

All individuals referred to the study agreed to participate. However, because of logistical limitations, 4 could not be assessed during the study period and were excluded. All those approached to participate owned a personal splint and thus none were excluded for non-wear reasons. Results are presented on the 30 individuals (26 women, 4 men) who participated. The average age was 56.7 years (SD 14.2, range 28–76). The average time from disease onset was 9.2 years (SD 8.73; range, recent onset to 31 yrs). Twenty-eight participants were right-hand dominant and 2 were left-hand dominant. On the ARA functional class scale no participant was in Class I, 18 participants (60%) were in Class II, 11 (37%) were in Class III, and one (3%) was in Class IV. The mean initial pain score was 4.09 (SD 2.18, range 0.8–8.3).

From the baseline questions regarding reasons for splint wear, the primary reason noted by those who "sometimes" or "often" wore a splint was for pain management. The majority of participants did not use their splints regularly. Participants indicated that the splint often "got in the way" or made movement "cumbersome." While all 30 participants attempted the work performance tasks, some could not complete the task due to fatigue or pain, and thus 5 work performance tasks and 2 endurance tasks had less than a full sample of participants (Table 2). Twelve participants reported engaging in light manual activities in their routine daily activities, 18 in moderately heavy activities; none reported engaging in heavy activities.

*Effect of splint wear on outcome (continuous measures)*. Table 2 describes the mean direction and magnitude of changes in pain, work performance, endurance, and perceived difficulty in performing each task, with and without use of the splint, for the study group as a whole. Pain was significantly less when using the splint on 3 work performance tasks ("placing," "turning key or knob," and "driving") and 2 endurance tasks ("chopping with a knife" and "placing"). Work performance did not differ significantly on any of the 10 tasks with and without splint wear (Table 2). Scores for endurance were better with the splint on in all 4 tasks, but the differences reached significance only for "pull electric cord." Perceived difficulty in performing a task was less when wearing the splint for 13 of the 14 tasks: on 5 tasks these findings reached significance.

The mean perceived splint benefit on the endurance and work performance tasks on the 10 point VAS (Table 3) ranged from 3.01 to 5.39 across tasks. "Chop with a knife," in terms of both work performance and endurance, had the highest mean perceived splint benefit (Table 3).

*Effect of splint wear on outcomes (proportions)*. Tables 4 and 5 present the data using the 20% cutoff points to classify participants as having responded "better," "worse," or "the same" with the splint on, across all tasks for all 5 outcomes of interest. No more than 2 participants (4%) ever reported that pain was worse with splint use. The greatest reported splint benefit for pain (40%) was when performing the endurance task "chopping with a knife." When the mean percentage of participants classified across all tasks in the category "splint better" was calculated, 17% reported less pain when using the splint, while 79% reported no difference. When exploring the effects of the splint on work performance, 24% of participants had better work performance

*Table 2.* Magnitude (Δ) and direction (+/–) of change in pain, work performance, endurance, and perceived task difficulty with splint on and splint off according to task (n = 30 unless noted).

| Tasks: Work Performance (WP) and Endurance (E) | Pain, 1–10 | | Work Performance, engals | | Endurance engals | | Perceived Difficulty, 1–10 | |
|---|---|---|---|---|---|---|---|---|
| | Δ | Splint Better | Δ | Splint Better | Δ | Splint Better | Δ | Splint Better |
| Vacuuming WP | –0.23 | Yes | –168.8 | | | | –0.1 | Yes |
| Vacuuming E | –0.52 | Yes | | | 4.1 | Yes | –0.3 | Yes |
| Lift pot or pitcher WP | –0.80 | Yes | 126.9 | Yes | | | –0.9 | Yes* |
| Chop with a knife WP | –0.72 | Yes | 15.3 | Yes | | | –0.9 | Yes* |
| Chop with a knife E | –1.39 | Yes* | | | 11.6 | Yes | –1 | Yes* |
| Lift briefcase WP | –0.53 | Yes | 37.2 | Yes | | | –1 | Yes* |
| Turn faucet or jar WP | 0.01 | | 44.2 | Yes | | | 0.2 | |
| Pull electric cord WP (n = 28) | –0.43 | Yes | 61.8 | Yes | | | –0.2 | Yes |
| Pull electric cord E (n = 26) | –0.75 | Yes | | | 21 | Yes* | –0.8 | Yes |
| Placing WP (n = 28) | –1.01 | Yes* | 105.2 | Yes | | | –0.2 | Yes |
| Placing E (n = 28) | –0.62 | Yes* | | | 7.8 | Yes | –0.2 | Yes |
| Turn key or knob WP (n = 28) | –0.82 | Yes* | 21.5 | Yes | | | –0.7 | Yes |
| Driving WP (n = 28) | –0.67 | Yes* | 195.8 | Yes | | | –0.7 | Yes* |
| Push shopping cart WP (n = 27) | –0.01 | Yes | 94.8 | Yes | | | –0.4 | Yes |

Δ Pain = difference in change scores [pain Splint on (Post-Pre) – pain Splint off (Post-Pre)].
Δ WP, E, and Perceived Difficulty = change in scores (Splint on – Splint off).
* Significantly better with splint on ($p < 0.05$).

*Table 3.* Perceived splint benefit* during task performance (N = 30 unless noted).

| Tasks: Work Performance (WP) and Endurance (E) | Perceived Benefit, mean (± SD) |
|---|---|
| 1. Chop with a knife WP | 5.39 (3.81) |
| 2. Chop with a knife E | 5.21 (3.78) |
| 3. Vacuuming E | 4.45 (3.56) |
| 4. Pull electric cord E (n = 26) | 4.41 (3.53) |
| 5. Lift briefcase WP | 4.41 (3.46) |
| 6. Push shopping cart WP (n = 27) | 4.08 (3.57) |
| 7. Driving WP (n = 28) | 4.00 (3.02) |
| 8. Turn faucet or jar WP | 3.98 (3.77) |
| 9. Vacuuming WP | 3.95 (3.70) |
| 10. Lift pot or pitcher WP | 3.91 (3.64) |
| 11. Placing E (n = 28) | 3.84 (3.52) |
| 12. Placing WP (n = 28) | 3.75 (3.59) |
| 13. Turn key or knob WP (n = 28) | 3.56 (3.36) |
| 14. Pull electric cord WP (n = 28) | 3.01 (3.28) |

* Using a visual analog scale of 0 to 10 to indicate perceived benefit of splint wear.

with the splint on, 62% had no difference in work performance, and 14% were worse. Forty-eight percent had improved endurance with the splint on and 20% had poorer endurance.

Table 5 shows that, overall, when participants were asked to indicate the perceived difficulty in performing a task with the splint on, 90% perceived the task as being either the same or less difficult to perform while wearing the splint. "Chop with a knife" (both work performance and endurance tasks) was the activity with the most frequently reported perceived benefit of splint use, with 47% of participants indicating a strong perceived benefit. Across all tasks, 45% of participants found little or no perceived benefit of the splint.

*Clinical indicators.* There were no significant associations between any of the individual explanatory factors (initial pain, disease activity, structural changes and types of manual activity the participant engaged in during routine daily activities) and perceived splint benefit ($p < 0.01$).

## DISCUSSION

Our findings indicate that for most tasks, the splint improved or did not change pain, did not interfere with work performance, increased or maintained endurance, and did not increase perceived task difficulty. The effect of splint wear on pain, work performance, or endurance was similar regardless of initial wrist pain level, wrist and disease activity, and structural damage, as well as the type of manual activity routinely done by the participant.

Although there was generally a positive effect of splint use on hand function, its effect on the outcomes varied greatly according to the task. The perceived benefit of the splint in performing the tasks was, at best, mediocre, with the exception of one task, "chop with a knife," where the benefit of the splint was consistently rated favorably. There are, however, several task characteristics that appear to be connected to better-perceived splint benefit. The splint seemed to be most beneficial for tasks that incorporated the splint's palmar metal slab into the task action, such as when chopping with a knife. Splint wear was perceived as offering little to no benefit in tasks where a tight, secure grip of an object in the hand was essential, such as in "lift pot or pitcher," "turn faucet or jar," and "placing." In tasks such as

*Table 4*. Effect* of splint wear on pain, work performance, and endurance according to task.

| Tasks: Work Performance (WP) and Endurnace (E) | Post-Pain*, n (%) | | | Work Performance*, n (%) | | | Endurance*, n (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Splint Better | Splint Worse | Splint Same | Splint Better | Splint Worse | Splint Same | Splint Better | Splint Worse | Splint Same |
| Vacuuming WP | 3 (10) | 2 (7) | 25 (83) | 9 (30) | 6 (20) | 15 (50) | | | |
| Vacuuming E | 6 (20) | 0 (0) | 24 (80) | | | | 12 (40) | 5 (17) | 13 (43) |
| Lift pot or pitcher WP | 7 (23) | 1 (3) | 22 (74) | 7 (23) | 3 (10) | 20 (67) | | | |
| Chop with a knife WP | 7 (23) | 2 (7) | 21 (70) | 5 (17) | 0 (0) | 25 (83) | | | |
| Chop with a knife E | 12 (40) | 0 (0) | 18 (60) | | | | 14 (47) | 9 (30) | 7 (23) |
| Lift briefcase WP | 5 (17) | 1 (3) | 24 (80) | 8 (27) | 4 (13) | 18 (60) | | | |
| Turn faucet or jar WP | 7 (23) | 2 (7) | 21 (70) | 6 (20) | 9 (30) | 15 (50) | | | |
| Pull electric cord WP, n = 28 | 3 (11) | 2 (7) | 23 (82) | 8 (29) | 4 (14) | 16 (57) | | | |
| Pull electric cord E, n = 26 | 4 (15) | 1 (4) | 21 (81) | | | | 14 (54) | 5 (19) | 7 (27) |
| Placing WP, n = 28 | 6 (21) | 1 (4) | 21 (75) | 10 (36) | 7 (25) | 11 (39) | | | |
| Placing E, n = 28 | 4 (14) | 1 (4) | 23 (82) | | | | 14 (50) | 4 (14) | 10 (36) |
| Turn key or knob WP, n = 28 | 3 (11) | 0 (0) | 25 (89) | 6 (21) | 6 (21) | 16 (57) | | | |
| Driving WP, n = 28 | 3 (11) | 0 (0) | 25 89) | 6 (21) | 1 (4) | 21 (75) | | | |
| Push shopping cart, n = 27 | 1 (4) | 1 (4) | 25 (92) | 3 (11) | 1 (4) | 24 (86) | | | |
| Mean percentage | 17 | 4 | 79 | 24 | 14 | 62 | 48 | 20 | 32 |

* Coded as splint better if difference between splint on/off improvement was 20% or greater; as worse if difference was 20% worse or greater; and as the same when the difference was less than a 20% difference in either direction.

*Table 5*. Effect* of splint wear on perceived difficulty and perceived benefit according to task (N = 30 unless noted).

| Tasks: Work Performance (WP) and Endurnace (E) | Perceived Difficulty*, n (%) | | | Perceived Benefit with Splint, n (%) | | |
|---|---|---|---|---|---|---|
| | Splint Better | Splint Worse | Splint Same | Strong Benefit, VAS > 7 | Moderate Benefit, VAS 3–7 | Little/No Benefit, VAS < 3 |
| Vacuuming WP | 6 (20) | 5 (17) | 19 (63) | 7 (30) | 9 (23) | 14 (47) |
| Vacuuming E | 5 (17) | 5 (17) | 20 (66) | 8 (27) | 10 (33) | 12 (40) |
| Lift pot or pitcher WP | 9 (30) | 1 (3) | 20 (67) | 8 (27) | 7 (23) | 15 (50) |
| Chop with a knife WP | 9 (30) | 2 (7) | 19 (63) | 14 (47) | 6 (20) | 10 (33) |
| Chop with a knife E | 8 (27) | 3 (10) | 19 (63) | 14 (47) | 6 (20) | 10 (33) |
| Lift briefcase WP | 8 (27) | 1 (3) | 21 (70) | 10 (33) | 7 (24) | 13 (43) |
| Turn faucet or jar WP | 6 (20) | 6 (20) | 18 (60) | 10 (33) | 5 (17) | 15 (50) |
| Pull electric cord WP, n = 28 | 4 (14) | 5 (18) | 19 (68) | 5 (18) | 7 (25) | 16 (57) |
| Pull electric cord E, n = 26 | 6 (23) | 2 (8) | 18 (69) | 7 (27) | 9 (35) | 10 (38) |
| Placing WP, n = 28 | 5 (18) | 4 (14) | 19 (68) | 6 (21) | 7 (25) | 15 (54) |
| Placing E, n = 28 | 3 (11) | 1 (4) | 24 (85) | 7 (25) | 7 (25) | 14 (50) |
| Turn key or knob, n = 28 | 8 (29) | 2 (7) | 18 (64) | 6 (21) | 9 (33) | 13 (46) |
| Driving WP, n = 28 | 6 (21) | 2 (7) | 20 (72) | 5 (18) | 13 (46) | 10 (36) |
| Push shopping cart, WP, n = 27 | 4 (15) | 2 (7) | 21 (78) | 9 (32) | 5 (22) | 13 (46) |
| Mean percentage | 22 | 10 | 68 | 29 | 26 | 45 |

* Coded as splint better if difference between splint on/off improvement was 20% or greater; as worse if difference was 20% worse or greater; and as the same when the difference was less than a 20% difference in either direction. VAS: visual analog scale.

"cutting with shears," "vacuuming," "lift briefcase," "push a shopping cart," and "driving" that do not necessitate as secure a grip, the splint appeared to offer wrist comfort and perceived benefit.

Subjectively, participants reported that in daily use, the splint often "got in the way" or made movement "cumbersome." The majority reported not wearing the splint regularly during daily activities. The literature suggests that the client's perceived need for wrist support has to be weighed against the irritation of having restricted wrist movement.[11,12,13.] In addition, the splint may contribute to increased discomfort in other joints. For example, wrist splints are known to place additional stress on the proximal joints[33,34], and this has important implications especially for clients who have multiple compromised joints.

Poor compliance to splint wear is a common complaint of clinicians[20-24], a complaint that may stem, in part, from a flaw in prescription practices. Our study supplied evidence suggesting that the improvements gained from splint wear were often small and variable across tasks. Possibly with current prescription practices, potential benefits of splint wear for specific tasks are overshadowed by use of the splint in tasks where there is no benefit. Without careful consideration of the client's wrist pain, the displaced stress the splint places on other joints, and the client's daily activities, splints are likely to be perceived as generally cumbersome rather than beneficial. Instructional sessions that simulate the client's daily activities, analyze the individualized benefits and deterrents to wear, and make the client aware of the effect of the braced wrist on various functional activities are likely to increase the value of the splint, and concomitantly affect adherence to splint wear.

We recognize that our small sample size and the participant variability may have limited the power of the study to detect significant effects of splint use. However, the trends in the findings are noteworthy in that they are consistent and convey clinically important information. In addition, it is recognized that because of the inclusion criterion of enrolling only individuals who were wearing commercially available, circumferential fabric-type wrist splints with a palmar metal insert, we can infer our findings only to such individuals.

The creation of categorical variables from the continuous scores, as in classifying perceived benefit of splint wear, also poses potential concerns regarding the validity of the categories. For example, while classifying a VAS score $\geq$ 7 as "strong perceived benefit" may have clinical relevance, the classification scheme has not been validated. Nevertheless, we deemed the categorization of variables to be valuable to the reader as it allowed exploration and interpretation of information across the spectrum of scores, contributing over and above the often-equalizing analyses created by using means and standard deviations.

Prefabricated circumferential fabric-type wrist splints have traditionally been prescribed in the management of clients with wrist involvement for symptom control, function, and joint protection. The findings suggest that wrist splint prescription is not a simple process; clinicians and clients need to work together to determine the daily wear protocol. The use of a wrist splint is likely to be effective for certain tasks and not effective for others and clients should be made aware of this information. It is recommended that the spectrum of daily activities performed by the client be considered, and that a variety of the clients' routine tasks be practiced with and without the splint to allow an individualized prescribed wrist splint protocol. This should help promote realistic expectations regarding the value of using a wrist splint, which maximizes its benefits and minimizes its inconveniences according to the client's individual needs.


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