In clients with upper-extremity injuries or surgery, occupational therapy services focus on enabling the client to regain functional use of the traumatized arm and hand or both and return to their pre-injury occupations. Often hand rehabilitation consists of intensive outpatient services and a recommended home program of exercises (Chen, Neufeld, Feely, & Skinner, 1999; Cooper, 2002). Generally, hand rehabilitation involves comprehensive services for (1) physiological impairments, (2) activity difficulties, and (3) limitations in roles or occupations, as defined in the International Classification of Functioning, Disability, and Health (ICF) (World Health Organization, 2001; Cooper; MacDermid, 2002). Within an individual hand therapy session, the occupational therapist may address physiological issues (e.g., pain, stiffness, edema, tissue healing, scarring) using physical agent modalities, splinting, manual techniques, and individually designed activities focused on the client’s functional goals (Cooper; Taylor & Humphry, 1991).

One method to facilitate client-driven therapy is to use the Canadian Occupational Performance Measure (COPM) (Law et al., 1998). The COPM provides an assessment process for developing client-centered goals and for evaluating the success of those goals over time (Law & Mills, 1998; McColl, Paterson, Davies, Doubt, & Law, 2000). The COPM helps to set the course of intervention so that it remains true to the client’s goals and priorities (Law & Mills). An important feature of the current study was implementing the COPM as one of the outcome measures.
Outcomes studies in hand rehabilitation have examined role, activity, and impairment level outcomes, but have not included measures of clients’ goals, such as those derived from the COPM. MacDermid, Richards, and Roth (2001) examined outcomes of 275 patients who received hand rehabilitation following distal radius fractures. Positive activity and role-level outcomes were demonstrated using the Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire, Patient-Rated Wrist Evaluation (PRWE), and Short Form 36 Health Survey (SF-36). Clients made the greatest gains in specific wrist functions (as measured by the PRWE) and changed the least in roles and overall health related quality of life (as measured by the SF-36). Amadio, Silverstein, Ilstrup, Schleck, and Jensen (1996) measured outcomes of carpal tunnel surgery using a battery of instruments that measured impairment and function. These researchers found that activity-level outcome questionnaires, such as the DASH, were more sensitive to short-term change than impairment-level physical measures of strength, sensibility, and motion. MacDermid (2001, 2002) emphasized the importance of measuring disability and function in addition to impairment (e.g., strength), citing the DASH and SF-36 scales as important programmatic measures of hand rehabilitation. Her recommendations for tools to measure hand rehabilitation outcomes were used in the current study.

The purpose of this study was to evaluate the outcomes of clients receiving occupational therapy services for hand rehabilitation. Given a sample of clients who receive 6–8 weeks of client-centered occupational therapy services for hand rehabilitation, the research questions were:

1. Do clients perceive changes in performance and satisfaction on their individualized functional goals as measured by the Canadian Occupational Performance Measure?
2. Do clients make significant progress in functional performance as measured by the Disabilities of the Arm, Shoulder, and Hand questionnaire?
3. Do clients perceive changes in health-related quality of life when measured by the Short-Form 36?
4. Do outcome scores on the Canadian Occupational Performance Measure correlate with outcome scores on the Disabilities of the Arm, Shoulder, and Hand questionnaire?

**Methods**

In this descriptive study, outcomes at different ICF levels for patients who received occupational therapy for hand rehabilitation were evaluated. Portney and Watkins (2000) noted that “the concept of outcomes has been expanded to fit with the World Health Organization’s definition of health, which includes physical, social, and psychological well being” (p. 5). Post-test scores and change scores were correlated to understand the relationships among the performance levels.

**Sample**

The hand rehabilitation participants in this study were recruited from five sites in Ohio, including two hospital outpatient clinics, one rehabilitation center, and two hand outpatient centers. One occupational therapist from each of the sites served as the study coordinator to assist in recruiting the participants, collecting the data, and checking the data before submission to the principal investigators. The five coordinators, three of whom were Certified Hand Therapists (CHTs), and three additional occupational therapists implemented the intervention. The eight therapists had an average of 7 (2.2 SD) years of experience in hand rehabilitation. For each of the participants, occupational therapy was the only rehabilitation service provided. A client was selected for the study if he or she was ready to begin active therapy and the therapist anticipated that approximately 8 weeks of services would be needed. All participants signed informed consent. The selection criteria for the participants included:

1. Had been referred for direct occupational therapy services because he or she had experienced an upper-extremity injury or surgery within the previous 30 days and was not immobilized.
2. Did not have a significant secondary diagnosis involving the central nervous system (e.g., traumatic brain injury).
3. The hand injury did not involve burn injury or major nerve injury. These clients were excluded because their recovery generally required longer than 8 weeks (the intervention period selected for this study).
4. Received only occupational therapy services and standard medical care during the time of the study.

**Instrumentation**

The instruments chosen for the study emphasized function in everyday activities. A measure of client-centered intervention (COPM) was used to assure that the client’s goals were identified, addressed in intervention, and considered as one outcome. The DASH and SF-36 have been frequently used in hand rehabilitation studies and recommended in the literature (MacDermid, 2001, 2002; MacDermid et al., 2001). These measures were administered when the client first received occupational therapy services and at the time of discharge from services. The Community Integration Questionnaire (CIQ), which examined independence in community functioning, was administered 2 to 3 months after discharge.
The COPM (Law et al., 1998) is designed to develop individualized client centered goals, and to serve as an outcome measure in client-centered occupational therapy practice. Examples of its prior use in hand rehabilitation studies were not found in the literature. When using the COPM, the therapist and client together identify occupational performance problem areas and level of performance and satisfaction relative to those problem areas. The client identifies problems and goals in personal care, functional mobility, community management, work, household management, and leisure. The client rates his or her performance and satisfaction with performance using a 1- to 10-point scale with 1 representing “notable” or “not satisfied” and 10 representing “able to do well” and “extremely satisfied.” Each client’s mean scores across all goals were used in the analysis.

In a study by Sanford, Law, Swanson, and Guyant (1994) test–retest reliability within a 2-week intervention for 27 clients was ICC = 0.63 for performance and ICC = 0.84 for satisfaction. Validity was estimated by correlating COPM change scores with changes in overall function as rated by caregivers (r = 0.55, r = 0.56), therapists (r = 0.30, r = 0.33), and clients (r = 0.26, r = 0.53). COPM performance scores highly relate to life satisfaction (McColl et al., 2000) and quality of life as measured by the SF-36 (Law et al., 1994).

Disabilities of Arm, Shoulder, and Hand (DASH) Questionnaire. Functional performance in the participants was evaluated using the DASH questionnaire (Institute for Work and Health, 1997). This outcome measure is a standardized questionnaire that rates disability and symptoms related to upper-extremity musculoskeletal disorders. The 30-item questionnaire includes 21 physical function items and 9 symptom items that are self-rated on a 0 to 4 scale. The first part of this scale (21 items; range of scores: 0–84) is scored from “no difficulty in performance” (4) to “unable to perform” (0). The items for the first section are everyday tasks that require manipulation with both hands. The second part of the scale (9 items; range of scores: 0–36) rates symptoms (i.e., severity of pain and weakness experienced). These items are scored “not-at-all” (4) to “extreme” (0). Scores on the DASH were reported separately for each section. We reversed the scoring as reported by MacDermid et al. (1994) and Beaton et al. (2001).

In a study of reliability and validity (Beaton et al., 2001), the DASH questionnaire demonstrated excellent test-retest reliability (ICC = 0.96) in 86 patients. The DASH correlated with other measures of pain and functional limitations (r > 0.69). It has been shown to be sensitive to change in people being treated for rotator cuff impingement, cumulative trauma syndrome, osteoarthritis (shoulder) or tendonitis. The DASH questionnaire discriminated between patients who were not working and those who were (p < .001) and its responsiveness to patient progress was as good as or better than joint specific measures (Beaton et al., 2001).

Health-Related Quality of Life. Health-related quality of life was measured by the Short Form-36 (SF-36) (Ware, Snow, Kosinski, & Gandek, 2000). This scale measures eight aspects of health that relate to quality of life: (1) physical functioning, (2) role limitations due to physical health problems, (3) bodily pain, (4) general health, (5) vitality, (6) social functioning, (7) role limitations due to emotional problems, and (8) mental health (psychological distress and psychological well-being). For purposes of the study, only subscales for physical functioning (11 items), physical role (4 items), general health (5 items), bodily pain (2 items) and social functioning (2 items), were included in the analyses. For most items, the scores ranged from 1 to 5; however, the physical health items were scored 1 to 3 and needed to be fit to a five-point scale. In addition, a number of items required reverse scoring. The manual details how summary scores are calculated. Mean scores for each factor were used in the analysis.

Reliability estimates for SF-36 have been reported in numerous studies (e.g., Brazier et al., 1992) and range from r = 0.43 to r = 0.96. The average reliability coefficient is greater than .80 and is therefore acceptable (Ware et al., 2000). The scale demonstrates concurrent validity with other quality of life measures. The SF-36 correlated with the Arthritis Impact and Measurement Scales (r = 0.82) and with psychological dimension of the Sickness Impact Profile (r = -0.70) (Ware et al., 2000). In addition, the differences in SF-36 scores for healthy individuals and those with serious medical or psychiatric conditions are statistically significant. The SF-36 has been well used in outcome studies because the items define general functions, daily living activities, pain, and discomfort (Atroshi, Johnsson, & Sprinchorn, 1998; MacDermid, 2001, 2002).

Community Integration Questionnaire (CIQ). The project manager conducted a telephone interview with the participants 2-3 months after discharge from the project using the CIQ. The CIQ (Willer, Rosenthal, Kretz, Gordon, & Rempel, 1993) measures home integration—competency, social integration, and productive activity in persons with significant disability. This 15-item questionnaire rates the client’s independence in instrumental activities of daily living (IADL) (e.g., shopping, meal preparation, housework, and finance management). The interview uses a 3-point scale (0–2) with higher scores indicating greater independence. Mean scores for the 15 items were used in the analysis.
Using principal components analysis with 327 patients, Sander et al. (1999) found that the CIQ confirmed that it measures the three factors it was designed to measure: home competency, social integration, and productive activity. The scale demonstrates moderate correlations with the Functional Independence Measure (FIM) (Uniform Data System for Medical Rehabilitation, 1999) and the Functional Assessment Measure (Sander et al., 1999). The scales with the lowest correlations were FIM social function and CIQ social integration, as the FIM measures the appropriateness of social interactions and the CIQ the frequency. Willer, Ottenbacher, and Coad (1994) found that CIQ scores were significantly different for patients with traumatic brain injury compared to persons without brain injuries or other disabilities.

Procedures
At the beginning of the project, the principal investigators trained the five site coordinators. The training sessions consisted of orientation to the project, informed consent procedures and criteria for inclusion of participants, documentation requirements, measures, reliability in administering the measures, and recording of data. The site coordinators were given manuals detailing all of the procedures, with copies of all of the assessments. Three of the coordinators trained one other occupational therapist to assist in data collection; therefore, eight therapists participated in the project. The site coordinators organized data collection, selecting clients who met the criteria and compiling the data. They submitted evaluation reports, notes, and billing records for each participant.

Except for the COPM, the clients completed the assessments on their own; therefore, the occupational therapists were not involved in the evaluation except to give the forms to the clients and collect them when completed. Because the COPM is essentially a contract between the therapist and the client, it is most appropriate for the treating therapist to interview the client using the COPM. The DASH, COPM, and SF-36 were completed in the first therapy session and in the last two sessions prior to discharge. The CIQ was administered by telephone by the project manager 2–3 months after discharge. Participants were recruited for 7 months and data were collected over 11 months.

Analysis
Demographic data and test results were entered into an SPSS file. To determine pre- and post-test differences, repeated measures t tests and effect sizes were calculated (Portney & Watkins, 2000). Change scores were calculated by subtracting pre-test scores from post-test scores for each of the scales. Pearson correlations coefficients using post-test and change scores were computed to determine the relationships among the outcome variables.

Results
A total of 37 clients entered the study, and 33 completed the post tests. Of the 4 clients who did not complete, 2 were discharged before 6 weeks, one was lost when a therapist transferred positions, and one developed significant medical problems. Of the 33 participants with complete data, the predominant diagnoses were contusions, lacerations, infections, and soft tissue trauma (n = 15), followed by fractures and crush injuries (n = 9), and then surgeries for various conditions (e.g., ligament repair, arthritis, carpal tunnel syndrome, or arthroplasty) (n = 9). See Table 1 for a list of participant characteristics.

The mean age for the sample was 44 years, and the majority were women (61%). At the time of hand injury or surgery, 22 of the hand clients were employed, 3 were full-time students, and 8 were retired or unemployed.

For each of the participants, occupational therapy was the only rehabilitation service provided. The number of hours of intervention and the types of intervention for each participant were recorded. These are listed in Table 2. The mean number of treatment hours per participant was 13 hours. Twenty of the clients (61%) received therapeutic activities, and the mean amount of therapeutic activities per client (25.2 units; one unit equals 15 minutes) was greater than any other treatment approach or modality. Therapeutic exercise was also prevalent (45% of clients received an average of 15.5 units). Almost half (n = 15; 45%) of the clients received services involving physical agent modalities, with 30% receiving ultrasound treatments and 15% hot–cold packs. Eleven (33%) of the participants

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<th>Table 1. Characteristics of the Participants</th>
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<td>Demographic Categories</td>
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Note. n = 33.
Effect sizes were large (2.45, performance; 2.52, satisfaction). Significant improvement in the participants, whereas general health, as measured by the SF-36, did not improve. All of the hand rehabilitation participants completed the COPM with their occupational therapists, identifying and rating performance and satisfaction in three to five activities that they wished to work on in therapy sessions. Examples of goals selected by the participants are driving, typing, writing, cooking, child care, doing laundry, using tools, gardening, activities that involved lifting heavy objects, specific work tasks (e.g., in hair dressing, teaching), and a wide variety of leisure activities (e.g., crocheting, hunting, sailing, biking, tennis). The goal mentioned most frequently was driving (18/33). Because the clients self-identified the goals, it seems remarkable that 18 spontaneously identified driving, suggesting its importance to achieving other life roles.

The results of their COPM scores pre- and post-intervention are reported in Table 3. The participants reported 4 to 5 levels of improvement in their self-identified performance problems. Their scores in performance satisfaction more than doubled. These improvements were statistically significant when using a 10-point scale (> .001) and effect sizes were large (2.45, performance; 2.52, satisfaction).

**Disabilities of Arm, Shoulder, and Hand Questionnaire**

Mean summary scores for the two DASH scales were 52.6 initially and 89.2 at discharge (mean change of 36.6 points total). The clinical interpretation of this level of change suggests that the hand rehabilitation clients initially performed ADL tasks with great difficulty and at the end of 8 weeks performed ADL tasks with mild difficulty. At the beginning of treatment, they experienced moderate to severe pain, weakness, and limitations. At the end of 8 weeks, they experienced mild pain and weakness. Pre- and post-test scores, change scores, t-test results, and effect sizes are listed in Table 4.

**Health-Related Quality of Life (SF-36)**

Pre- and post-test SF-36 scores are listed in Table 5. These results indicate that scores for physical health, physical roles, pain, and social participation demonstrated statistically significant improvement in the participants, whereas general health, as measured by the SF-36, did not improve.

Average quality of life in physical health and physical roles was poor at the beginning of treatment and improved to moderate at the time of discharge from therapy services. In social participation and leisure activities, the improvements were highly significant, suggesting that the participants regained their lifestyle despite some remaining health issues (i.e., discomfort or pain and disability). Their perceived pain decreased significantly. The participants indicated that their general health did not change during the course of the study.

**Community Integration Questionnaire**

Of the 33 total participants, 28 were reached by telephone 2–3 months after discharge to complete the CIQ. On a three-point scale (0–2) the mean CIQ score was 1.28 (SD = .23) indicating that the participants performed activities such as shopping, banking, or housekeeping with “someone else.” It is not clear from the assessment results if they needed to have a companion to provide assistance and support or they chose to perform IADL with another for the companionship (e.g., with a spouse). Based on the conversations...
during the follow up phone call, many participants indicated that they had returned to driving \((n = 18)\) and to their important activities of daily living \((n = 26)\).

**Disposition at Discharge**

At the time of injury or surgery, 22 participants were employed, 3 were students in high school or college, and 8 were retired. At discharge from occupational therapy services, 17 of the 22 had returned to work and 2 had plans to return within a few weeks. The three students had returned to school. Of those who returned to work, 2 were working with restrictions, 2 were wearing splints, and 1 was on light duty. Three remained on medical leave at discharge.

**Correlations Among the Functional Measures**

To determine if performance on the clients’ individualized occupational goals correlated with a standardized scale of functional performance, outcome scores for COPM were correlated with the DASH outcome scores. Correlations between the sections of the COPM and DASH outcome and change scores are presented in Table 6. The moderate correlations suggest that clients’ selected functional goals on the COPM vary with the functional task competencies measured on the DASH. The positive correlations between the change scores on the COPM and the change scores on the DASH confirm the validity of the COPM in measuring clients’ progress. Examination of the participants’ COPM goals confirmed that they selected functional outcomes similar to DASH items.

**Discussion**

Each hand rehabilitation participant received approximately 13 hours (54 units) of outpatient occupational therapy services. Other than medical care by physicians and nurses, the occupational therapists were the participants’ sole providers of rehabilitation services. Following their rehabilitation, these clients gained 36.6 points in the total DASH scores and doubled their initial COPM scores. These findings suggest that clients with impaired hand function, who do not have secondary complications (i.e., central nervous system disorders, burns, or severe peripheral nerve injuries) make substantial progress in a 6- to 8-week occupational therapy program for hand rehabilitation. The change in DASH scores surpassed those reported by MacDermid et al. (2001) following 8 weeks of intervention (23 points).

Use of the COPM with hand therapy clients has not been documented in the literature. The occupational therapists in this study had not previously used the COPM, and reported that it helped to focus intervention and supported the development of measurable, achievable goals that were meaningful to the clients. Improvements in scores for performance and satisfaction on individualized goals in self-care, work, and avocation were both clinically and statistically significant (clients gained more than four points on a 10-point scale). Outcome and change scores on the COPM correlated with outcome and change scores on the DASH, suggesting that clients prioritize daily activities for intervention goals, using the COPM, that are similar to the daily activities rated on the DASH. The correlations may mean that functional performance as measured by the DASH and by self-identified goals on the COPM were influenced by common underlying abilities. When used together, these instruments provide a comprehensive understanding of the client’s limitations in daily activities based on a standardized tool that allows comparison with other clients and a unique list of the client’s priority concerns.

Although the change scores offer positive support for the occupational therapy intervention program, other vari-

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<th>Table 5. Health-Related Quality of Life (SF-36) Mean Scores</th>
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Note. \(n = 33\). Scale: 1–5 (Higher scores indicate better quality of life.)

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<tr>
<th>Table 6. Correlations Between the Outcome and Change Scores of the Canadian Occupational Performance Measure (COPM) and the Disability of Arm, Shoulder, and Hand (DASH) questionnaire</th>
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<td><strong>COPM Performance Outcome</strong></td>
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<td>DASH Function Change</td>
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<td>DASH Symptoms Change</td>
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ables may have contributed to the client’s progress and were not controlled by the study’s design. For example, the clients’ own healing, attitude, motivation, spontaneous recovery, and the supportive environment were probably factors that also influenced the positive change (MacDermid, 2002).

Of the 25 participants who were employed or full-time students at the time of injury, 20 returned to work or school at the end of the 8 weeks. Successfully returning to work following a severe upper-extremity injury or surgery represents a highly valued outcome for clients and their families, employers, and the community. In addition, the participants made significant improvements in physical health, physical roles, pain, and social participation on the SF-36, suggesting important positive changes in quality of life. These SF-36 improvements in physical components, but not general health, were similar to those reported by MacDermid et al. (2001).

The CIQ was less sensitive than the other measures to the changes made by the clients in hand rehabilitation. It was originally developed for clients with head trauma and seemed to be an inadequate measure of the issues that hand patients had following rehabilitation. For example, driving, a major concern among a majority of the clients, is not measured on the CIQ. The participants’ mean score of 1.28 is higher than the mean scores for a sample of individuals with traumatic brain injury rated 1 year after injury (.86–1.07) (Willer et al., 1993). The CIQ scores indicate that the clients were relatively independent in the community with some assistance or companionship in community activities.

Although the participants had a variety of hand injuries or surgeries, the intent and form of intervention held certain commonalities across clients. Each hand rehabilitation client received only occupational therapy services and each practitioner first identified the clients’ goals and priorities using the COPM. Substantial gains on the COPM provide evidence that the clients perceived that their goals had been met and their priorities addressed.

Limitations

In this study, outcomes of 33 hand rehabilitation clients in five sites were evaluated. The questionnaires were completed by the clients, which can introduce error in how the items are interpreted. A combination of diagnoses was included in the sample, which is typical of hand rehabilitation practices; however, the variety of diagnoses, combined with the relatively small sample size, creates some difficulty in interpreting and generalizing the results.

The measures appeared to be sensitive to the clients’ progress and consistent findings across instruments confirmed the validity of the results. The COPM was administered to each participant by the therapist who provided the intervention, and although the therapists simply recorded the client’s verbal responses, lack of blind evaluation may have biased the final results. The remaining instruments were self-administered and the CIQ was administered by telephone by the project manager. The CIQ did not seem as useful or appropriate with hand rehabilitation clients as other measures, whose function is relatively high. As a descriptive outcome study, these findings are a first step in examining the effectiveness of occupational therapy with hand rehabilitation clients, and true experimental designs using randomization and comparison groups are needed to rigorously examine the effectiveness of occupational therapy interventions.

Conclusion

Following 6 to 8 weeks of client-centered hand rehabilitation by occupational therapists, clients made clinically and statistically significant improvements in functional performance. The clients received an average of 13 hours of occupational therapy services and typical sessions included physical agent modalities, manual techniques, and therapeutic activities. In general, clients experienced severe difficulties in activities of daily living when admitted to occupational therapy services and mild difficulties at the time of discharge. Despite these mild difficulties, 20 of 25 hand rehabilitation clients returned to their former occupations. The priority problems that clients identified on the COPM showed clinically and statistically significant improvements as noted by scores on the COPM that doubled. A recommended next step is to validate these results using a more rigorous trial of occupational therapy intervention with hand rehabilitation clients that would include a comparison group and randomized sampling procedures.

Acknowledgments

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