

The ICF and postsurgery occupational therapy after traumatic hand injury

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Recent studies have examined the effectiveness of hand rehabilitation programmes and have linked the outcomes to the concept of ICF but not to specific ICF category codes. The objective of this study was to gain experience using ICF concepts to describe occupational therapy interventions during postsurgery hand rehabilitation, and to describe improvement in functioning using ICF categories. In addition, investigated was the agreement between the ICF categories for occupational therapy interventions and the outcome measures used. Fifteen patients with traumatic hand injuries agreed to participate. Outcome measures were used to assess the following variables: range of motion, grip strength, pain intensity, upper-extremity functioning and health-related quality of life. Analysis of variance for repeated measures was used between the measures at baseline and at 3-month and 12-month follow-ups. The results showed that a pattern of occupational therapy interventions concerning body functions and body structures, activities and environmental factors could be identified during the early postsurgery phase and for interventions at participation level during the later phase. Agreement between occupational therapy interventions and outcome measures was found for 11 pairs. Three of the pairs concerned body function and eight were at the activity and participation level. During the rehabilitation process, the majority of improvements took place between baseline and the 3-month follow-up. We concluded that ICF categories can be used to describe occupational therapy interventions in postsurgery hand rehabilitation after trauma; that the use of ICF as a reference framework provides a clear picture of which health domains are addressed; and that a consistent use of ICF categories facilitates linking between rehabilitation interventions and outcome assessments, thereby increasing the possibility of showing the effects of these interventions.

Neuere klinische Studien, die die Effektivität von Handrehabilitationsprogrammen untersucht haben, haben die Outcomes mit dem ICF-Konzept in Verbindung gebracht, jedoch nicht mit bestimmten ICF-Kategorien. Die vorliegende Studie verfolgte das Ziel, bei der Beschreibung von ergotherapeutischen Interventionen während der postoperativen Handrehabilitation mittels ICF-Konzepten sowie bei der Beschreibung der Verbesserung der Funktionsfähigkeit mit Hilfe von ICF-Kategorien Erfahrungen zu sammeln. Außerdem untersuchte sie, inwieweit die ICF-Kategorien für ergotherapeutische

Interventionen und die verwendeten ergebnisorientierten Messgrößen übereinstimmen. Insgesamt 15 Patienten mit traumatischen Handverletzungen erklärten sich zur Teilnahme bereit. Zur Beurteilung der folgenden Variablen wurden ergebnisorientierte Messgrößen eingesetzt: Bewegungsamplitude, Griffstärke, Schmerzintensität, Funktionsfähigkeit der oberen Extremitäten und gesundheitsbezogene Lebensqualität. Zwischen den Messungen bei Baseline und den Nachsorgeuntersuchungen nach 3 und 12 Monaten wurden Varianzanalysen für Messwiederholungen angewandt. Die Ergebnisse zeigten, dass bei den Körperfunktionen und Körperstrukturen, Aktivitäten und Umweltfaktoren in der frühen postoperativen Phase und bei Interventionen auf Teilnehmerebene während der späteren Phase ein Muster mit ergotherapeutischen Interventionen erkennbar war. Bei elf Paaren konnte eine Übereinstimmung zwischen ergotherapeutischen Interventionen und ergebnisorientierten Messgrößen festgestellt werden. Drei Paare bezogen sich auf die Körperfunktion und acht auf den Grad der Aktivität und Teilnahme. In der Rehabilitationsphase stellten sich die meisten Verbesserungen zwischen Baseline und der Nachsorgeuntersuchung nach 3 Monaten ein. Daraus schlossen wir Folgendes: Die ICF-Kategorien zur Beschreibung von ergotherapeutischen Interventionen können während der postoperativen Handrehabilitation nach Trauma herangezogen werden; die Verwendung der ICF als Bezugsrahmen verdeutlicht, welche Gesundheitsdomänen abgedeckt werden; und eine konsistente Verwendung der ICF-Kategorien erleichtert die Verknüpfung zwischen Rehabilitationsinterventionen und Outcome-Beurteilungen und erhöht somit die Möglichkeit, dass die Wirkungen dieser Interventionen aufgezeigt werden können.

En estudios recientes se ha explorado la eficacia de los programas de rehabilitación de la mano y se ha establecido la relación entre los resultados y el concepto de la CIF, pero no entre aquellos y determinados códigos de categorías de la CIF. El objetivo de este estudio fue obtener experiencia en el uso de los conceptos de la CIF para describir las intervenciones de terapia ocupacional en la rehabilitación después de la cirugía la mano, y describir la mejora en el funcionamiento, utilizando para ello las categorías de la CIF. Además, se investigó el acuerdo entre las categorías de la CIF para las intervenciones de terapia ocupacional y las medidas de los resultados utilizadas.

Quince pacientes con lesiones traumáticas de la mano estuvieron de acuerdo en participar en el estudio. Las medidas de los resultados fueron utilizadas para evaluar las siguientes variables: el arco de movimiento, la fuerza de prensión, la intensidad del dolor, el funcionamiento de las extremidades superiores y la calidad de vida relacionada con el estado de salud. Se realizaron análisis de varianza de las diversas medidas, usando las medidas obtenidas al inicio del estudio y a los 3 y 12 meses del seguimiento. Los resultados mostraron que era posible establecer un patrón en las intervenciones de terapia ocupacional, basado en las funciones corporales, las estructuras corporales, las actividades, y los factores ambientales durante la fase postoperatoria inicial y las intervenciones de participación durante la fase posterior. Se halló correspondencia entre las intervenciones de terapia ocupacional y las medidas de los resultados en 11 pares de categorías. Tres de dichos pares tienen que ver con el funcionamiento del cuerpo, y ocho corresponden al grado de actividad física y de participación. Durante el proceso de rehabilitación, la mayoría de las mejoras se obtuvieron en el período comprendido entre el inicio del estudio y los 3 meses de seguimiento. Llegamos a la conclusión de que las categorías de la CIF pueden utilizarse para describir las intervenciones de terapia ocupacional en la rehabilitación después de la cirugía de la mano debido a traumatismos, que el uso de la CIF como marco de referencia proporciona una idea clara de cuáles de los dominios de salud se exploran, y que un uso coherente de las categorías de la CIF facilita la vinculación entre las intervenciones de rehabilitación y la evaluación de los resultados, lo que aumenta la posibilidad de mostrar los efectos de estas intervenciones.

Des études récentes ont examiné l'efficacité des programmes de rééducation de la main et ont relié les résultats au concept de l'ICF, mais pas à des codes de catégorie ICF spécifiques. Cette étude avait pour objet d'acquiescer de l'expérience en utilisant les concepts ICF pour décrire les interventions en ergothérapie de rééducation de la main après chirurgie, et de décrire l'amélioration du fonctionnement en utilisant les catégories ICF. En outre, l'accord entre les catégories CIF pour les interventions d'ergothérapie et les mesures des résultats utilisées ont été examinés. Quinze patients atteints de

Introduction

The effects of occupational therapy interventions in hand rehabilitation after trauma have been published earlier (Case-Smith, 2003; Chan and Spencer, 2004; Harth *et al.*, 2008). In some of these studies (Chan and Spencer, 2004; Harth *et al.*, 2008; Wirtz and Voight-Radloff, 2008) the effects have been related to the concepts of the International Classification of Functioning, Disability and Health (ICF) (World Health Organization, 2001).

lésions traumatiques de la main ont accepté de participer. Les mesures des résultats ont été utilisées pour évaluer les variables suivantes: amplitude du mouvement, force de préhension, intensité de la douleur, fonctionnement des extrémités supérieures et qualité de la vie liée à la santé. Une analyse de variance pour les mesures répétées a été utilisée entre les mesures au départ et à 3 mois et 12 mois de suivi. Les résultats ont montré qu'un modèle des interventions en ergothérapie concernant les fonctions du corps et les structures de l'organisme, les activités et les facteurs environnementaux a pu être identifié durant la phase postopératoire précoce et pour les interventions au niveau de la participation au cours de la phase ultérieure. L'accord entre les interventions d'ergothérapie et les mesures des résultats a été constaté pour 11 paires. Trois des paires concernaient les fonctions de l'organisme et huit portaient sur les activités et la participation. Pendant le processus de rééducation, la majorité des améliorations ont été constatées entre le début et le suivi à 3 mois. Nous en concluons que les catégories CIF peuvent être utilisées pour décrire les interventions postopératoires en ergothérapie de rééducation de la main après un traumatisme, que l'utilisation de la CIF comme cadre de référence fournit une image claire des domaines de la santé qui sont concernés et qu'une utilisation cohérente des catégories CIF permet d'établir des corrélations entre les interventions de rééducation et les évaluations des résultats, augmentant ainsi la possibilité de démontrer les effets de ces interventions. *International Journal of Rehabilitation Research* 34:79-88 © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins.

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However, no study has been found in which ICF categories, that is, the units of classification, have been used to describe occupational therapy interventions.

It has been found that many occupational hand-therapy interventions focus primarily on those associated with the ICF domains body functions and body structures, and consist primarily of active and passive mobilization exercises (Muenzen *et al.*, 2002; Bücher, 2004; Ellis, 2004;

Pratt *et al.*, 2004). The occupational therapist guides and instructs patients in exercise programmes to increase their mobility or to reduce pain. However, some studies also describe interventions aiming at increased activity and participation (Brown, 1996; Gustafsson *et al.*, 2002), providing the patient with specific technical aids for use in daily activities and work-related training (Spencer, 1998).

Occupational therapy assessment

Surgical intervention with subsequent immobilization of the hand or fingers is frequently the consequence of traumatic hand injury (Rosberg *et al.*, 2005). This may result in decreased muscle strength, reduced gross and fine mobility, disturbed sensitivity, pain—accompanied by fear of using the hand—and a reduced ability to perform activities of daily living (Bear-Lehman, 1983; Chan and Spencer, 2002, 2004).

The use of valid and reliable outcome measures to guide clinical decision-making at the onset of the treatment is an essential component of occupational therapy practice (Muenzen *et al.*, 2002; Bücher, 2004; Ellis, 2004; Pratt *et al.*, 2004). A recent analysis showed that this activity accounts for up to 20% of the hand therapists' time and is ranked as the most critical domain of practice (Muenzen *et al.*, 2002). A study of patients with upper-extremity disorders, including 92 randomized controlled studies, showed that most of the outcome measures used were at body function and structure level (Gummeson *et al.*, 2004). However, in accordance with the ICF, a complete outcome assessment necessitates evaluation of each health domain (Cieza and Stucki, 2008).

With regard to the compatibility (content comparison) between ICF and outcome measures currently in use in occupational therapy, the disabilities of arm, shoulder and hand questionnaire (DASH) (Hudak *et al.*, 1996; Drummond *et al.*, 2007; Dixon *et al.*, 2008) and the short form-36 (SF-36) health-related quality-of-life measure, (Cieza and Stucki, 2005; Harris *et al.*, 2005) have been used to assess activity and participation. Recent studies linking DASH to the ICF showed that 15 categories belonged to body function components and 48 to the activity and participation components (Drummond *et al.*, 2007). Further, linking the SF-36 to ICF addressed body function categories 14 times and activity and participation categories 24 times (Cieza *et al.*, 2005). Thus, the SF-36 and DASH are associated with the ICF by linking specific items to the ICF category representing this concept, and not to the eight subscales of the SF-36 or to the DASH score. The focus of outcome measurements using different ICF components should reflect the occupational therapists' interventions (MacDermid, 2004).

The aims of this exploratory study were to gain experience of using ICF concepts to describe the process

of occupational therapy interventions during the postsurgery phase after traumatic hand injury; to describe improvement in functioning in ICF categories of the hand rehabilitation programme and to analyse the agreement between categories of occupational therapy interventions and the outcome measurements/assessments used, and to reflect critically on these.

Methods

Participants

Participants attending the Hand Surgery Clinic in Stockholm between January 2002 and January 2003 were recruited consecutively into this exploratory longitudinal study. All patients had suffered a traumatic hand injury. Thirty-one patients were invited to participate, of these, 15 accepted and 16 declined. The reasons given for nonparticipation were that the project would last too long, it would take place too far from home/work, and it would be too time-consuming. Of the 15 patients, who agreed to participate in the study (Table 1), one patient sustained a further hand injury before the 3-month follow-up and was excluded from the study, so that 14 complete data sets were available for analyses.

The inclusion criteria were hand surgery after traumatic hand injury; age between 18 and 65 years; an ability to communicate in the Swedish language. Excluded from the study were those patients who had undergone surgery for nontraumatic conditions, for example, rheumatoid arthritis.

Procedures

An initial assessment was carried out by a qualified occupational therapist at baseline, with follow-up assessments at 3 and 12 months. At baseline, all physical variables were measured and all participants completed the SF-36 and DASH questionnaires. At the 3-month and 12-month follow-ups the questionnaires were posted to the participants in advance. Additional interviews were carried out at 6 and 9 months to optimize the identification of changes in occupational therapy interventions during the rehabilitation process. Participants were asked 'What kind of occupational therapy treatment did you receive during the past month?' To make this information as reliable as possible, medical records were investigated retrospectively to verify the identification of interventions used.

During the first phase postsurgery, participants were treated in the occupational therapy department as inpatients. Depending on the severity and type of their injury, approximately 4 to 8 weeks after the start of treatment participants were registered as outpatients but visited the occupational therapy department regularly. By the 3-month data collection time, most participants had been discharged or were being treated in their primary care centres, and only visited the occupational therapy department for assessments and interviews.

Table 1 Demographic data, type of accident and type of injury

No	Age	Sex	Profession	Type of accident	Type of injury
1	35	M	Electrician	Grinding	Arthrodesis in pip IV, temporarily arthrodesis in pip III, and local flaps, left hand
2	67	M	Retired	Mower	Multiple fractures; dig II, III and IV amputated distally to pip-joints, amputated dig V from mcp-joint, dig I fractured, right hand
3	36	M	Musician	Fall	Radius fracture of right wrist;
4	40	F	Bank clerk	Sport	Intra-articular fracture, left hand
5	67	M	Retired engineer	Saw	Amputation dig V, pip joint in right hand
6	57	M	Building worker	Saw	Amputation in pip, dig III and V and tendon rupture in dig IV, arthrodesis in dip, dig II
7	35	M	Technician	Crush	Fractures in dig II, III, IV and V mcp, digital nerve injury and CTS-operation; Operation nr 2; amputated dig II, right hand
8	26	M	Carpenter	Saw	Flexor tendon injury dig I and II, digital nerve injury dig I and II, fracture dig I. Second operation: tenolyses of dig II
9	58	F	Secretary	Fall from horse-back	Fracture of distal radius left wrist
10	51	M	IT-consultant manager	Saw	Extensor tendon injury dig II, III, IV and V
11	61	M	Construction worker	Cut	All flexor tendons cut off, right hand
12	56	F	Supervisor	Complication	Complex regional pain syndrome after fracture mcp IV
13	39	M	Transport-business	Cut	Tendons of flexor digitorum profundus and superficialis dig II cut off, right hand
14	37	M	Marketing director	Fall through glass window, cut	All tendons in left wrist, all flexor tendons and medianus and ulnaris nerves were cut off and ruptured
15	26	F	Florist	Cut, glass vase	Tendons of flexor profundus and superficialis and ulnar digital nerve to dig IV cut and wound as well on dig II and IV

CTS, carpal tunnel syndrome; Dig II, index finger; Dig V, little finger; Dip, distal inter-phalangeal joint of finger; mcp, metacarpophalangeal joint; pip, proximal interphalangeal joint of finger.

Outcome variables and measures

Range of motion of wrist and fingers was measured using a goniometer and standardized protocol (Pratt *et al.*, 2004), with a 5° error (Trombly and Podolski, 2002). Total activity motion is a value obtained by summing the joint flexion angles minus the sum of the joint extension deficit angles (Ross *et al.*, 2003). Normal total activity motion is 270° for the finger joints (Fess, 1991).

A Jamar dynamometer was used for assessing grip strength (Jamar Owner's Manual, 1991; Mathiowetz, 2002; Massy-Westropp *et al.*, 2004). Mean values of grip strength were calculated and expressed in kilograms for each hand (Hanten *et al.*, 1999; Clerke and Cleke, 2001). These were then compared with normative data. Norm values used in this study were 47.8 kg for healthy men with a mean age of 46.5 years, and 26.8 kg for women with a mean age of 45 years (Jamar Owner's Manual, 1991). One patient used the Baltimore therapeutic equipment for both assessment and individual work-related training (Shechtman *et al.*, 2003).

Pain

Pain intensity in the upper limb was assessed using a visual analogue scale (Huskisson, 1974). The participants were asked to mark the level of their pain intensity on a 100 mm, nongraded scale marked at one end 'no pain' and at the other 'worst pain imaginable'.

Self-report outcome instruments

The disabilities of arm, shoulder and hand questionnaire

The DASH questionnaire (Hudak *et al.*, 1996; Atroshi *et al.*, 2000; Davidsson, 2004; Drummond *et al.*, 2007;

Harth *et al.*, 2008) is an outcome instrument used to measure the limitations in upper-extremity functioning among patients with musculoskeletal disorders or injuries. Exploratory testing showed that the DASH modules differentiated between different diagnostic groups (Jester *et al.*, 2005). The scores of all DASH items can be used to calculate a total score ranging from 0 (no disability) to 100 (severest disability).

The short-form 36

The SF-36 is a widely used questionnaire for evaluating health-related quality of life. It includes eight subscales physical functioning, role physical (RP), role emotional, social functioning (SF), bodily pain and vitality, general health and mental health. Using scoring algorithms, the raw scores are transformed into a 0–100 scale, whereby 100 is the most positive and 0 is the most negative health state (Ware *et al.*, 1993).

Linking occupational therapy interventions to International Classification of Functioning, Disability and Health categories

On the basis of the results of the assessments, problem areas were identified and the individual patient and occupational therapy agreed on the aims of treatment. The interventions subsequently used to achieve the individual aims were linked to the corresponding ICF category and coding, for example, muscle strength training could be connected to the code 'b730 muscle power functions' and training in eating was connected to 'd550 eating.'

Statistical methods

All analyses were performed using SPSS for Windows (version 17.0, SPSS Inc., Chicago, USA). Earlier studies

(Gummeson *et al.*, 2003) and the SF-36 and the DASH manuals (Atroshi *et al.*, 2000; Sullivan *et al.*, 1995, 2002; Davidsson, 2004) recommend the use of parametric methods. Analysis of variance for repeated measures was used to evaluate the data collected at baseline, and at the 3-month and 12-month follow-ups.

As all items in a questionnaire were answered by all patients, item questions were entered into the model as a within-factor variable. Interaction between time and items was included in the model to test for heterogeneity in the recovery process of the items. If the test for interaction displayed a reasonably low *P* value ($P < 0.10$), simple main effects were performed to evaluate the existence of a time effect within each item. Pairwise comparisons between consecutive time points were performed on items, which displayed a significant simple main effect. *P* values less than 0.05 were considered as significant results for the simple main effects and the

pairwise comparisons. Normal probability plots were used to verify the assumptions of normality-distributed residuals. Mauchly's test was used to evaluate the assumption of sphericity and if *P* value is less than 0.1 then Greenhouse–Geisser-adjusted *P* values were used to test main effects and interaction. The different questionnaires were analyzed separately. The Bonferoni corrections were used for adjusting to multiple comparisons.

Results

Link between outcome measures applied, problems identified, aim of the treatment and interventions used to achieve these aims classified according to International Classification of Functioning, Disability and Health

Table 2 shows an overview of how interventions used to achieve the individual aims were linked to the – corresponding ICF category. An example is the variable 'household tasks' assessed in the DASH with the purpose

Table 2 Describes the link among the outcome measures applied, the problems identified, the aim of the treatment and the interventions used to achieve these aims (classified according to ICF)

Variable	Instrument	Problem	Aim	Interventions/ICF classification
Work ability	DASH, SF-36	Decrease ability to work because of hand injury	Remunerative employment	Work training at work place d(p)850
Hand use in work	BTE	Problems in using tools at work	Enabling work resumption	Training with BTE work simulator d(p)840
Drinking		Problems with managing the glass	Being able to independently drink	Training in managing the glass d560
Fine hand use		Problems with picking up, grasping, manipulating, releasing	To improve fine hand use	Oral instructions in fine hand use d440
Fine hand use		Problems with picking up, grasping, manipulating, releasing	To improve fine hand use	Training in fine hand use d440
Fine hand use	DASH	Difficulties in eating	Being able to independent eating	Trying out adapted knife, fork and spoon, e 115
Fine hand use	DASH	Difficulties in eating	Being able to independent eating	Training in using adapted knife, fork and spoon, e115
Eating	DASH	Difficulties in eating	Being able to independent eating	Oral instructions in eating d550
Eating	DASH	Difficulties in eating	Being able to independent eating	Training in eating d550
Grasping		Inability to grasp	Improve grasping ability	Training with grasping and moving objects by playing 'Solitary' game d445
Household tasks	DASH	Difficulties in doing household tasks	Being able to do independent household tasks	Oral instructions in doing household tasks d 630-49
Dressing	DASH, SF-36	Difficulties in dressing oneself	Being able to independent dressing	Oral instructions in dressing d540
Washing	DASH	Difficulties in washing oneself	Being able to independent washing	Oral instructions in washing d510
Coordination		Decreased coordination of voluntary movements	Increased coordination of voluntary movements	Training with computer b760
Joint motion	Goniometry, DASH	Stiffness in joints and other tissues	Increase in range of motion	Training of active and passive range of motion b710
Joint Motion	Goniometry, DASH	Stiffness in joints and other tissues	Increase in range of motion	Splinting b710
Muscle endurance		Muscle fatigue	Increase endurance	Training active movements b740
Grip strength	Jamar	Weakness in grip strength	Improve grip strength	Training muscle function, b730
Instability		Instability, pain	Increase in stability	Fixation of fingers and wrist by splinting, b715
Sensibility	DASH	Hypoesthesia, allodynia	Increase sensibility, reduction of allodynia	Exercises with different stimuli b280, 265
Oedema	DASH	Swollen hand	Reduction of oedema	Massage, bandaging and active movements, b415
Scar	Scar treatments	Adherence	Increase mobility of scar	Massage of scar tissue b820
Scar	Scar treatments	Deformation of scar tissue	Reduction of scar tissue	Compression bandage b820

BTE, Baltimore therapeutic equipment; DASH, disabilities of arm, shoulder and hand questionnaire; ICF, International Classification of Functioning, Disability and Health; SF-36, short form-36.

of following the patients' difficulties in doing household tasks. The aim of the intervention oral instruction in doing household tasks (d630–d649), was that the patient would be able to do household task independently.

Occupational therapy interventions linked to International Classification of Functioning, Disability and Health categories

At the baseline, patients' aims and interventions focused on seven ICF body functions, namely blood vessel function, touch and pain functions, mobility and stability of joint functions, muscle power functions and muscle endurance functions. One patient undertook interventions aimed at repairing functions of the skin.

The number of these interventions had decreased by the 3-month assessment and was lower still at the 6-month and 9-month follow-ups. One patient received a specific intervention aimed at improving movement coordination at the 3-month follow-up. For the purposes of this study, splints were assigned to the ICF category 'Environmental Factors' based on the definition of 'Products and technology'. Splints were used by most of the patients during the first 3 months of treatment and, in one case, up to 9 months.

Scar treatment was regarded as belonging to the category 'repair functions of the skin', and the interventions were aimed at reducing body structure deviation.

In the ICF domain 'Activity' goals of treatment and interventions at baseline fell mainly into the following categories: washing oneself (*n* = 11), dressing (*n* = 11), eating (*n* = 11), household tasks (*n* = 11) but these

activities had decreased 6 months later. Training in the same domain, in eating, was introduced somewhat later, after the starting point. Interventions in the form of oral instructions aiming to improve fine hand use occurred between the 3-month and the 6-month follow-ups.

At the ICF participation level, two patients were engaged in interventions aimed at return to remunerative employment, work preparation being undertaken between the 3-month and 6-month follow-ups.

During the early postsurgery phase, a pattern emerged with regard to the interventions. Generally, the interventions were very similar between the baseline and the 3-month follow-up and focused on the levels of body function, body structures, activities and environment. However, at the time of the 6-month assessment a shift could be observed (Table 3).

International Classification of Functioning, Disability and Health and outcomes

The time between hand surgery and the first assessment at baseline varied according to the type of hand injury (median = 10 weeks, range 1–18 weeks).

Consecutive time points were compared pairwise on items displaying a significant simple main effect, and therefore the results do not include all the measures. Most improvements could be observed between the baseline and the 3-month follow-up. Total active motion increased significantly in the wrist joint, index finger, middle finger and little finger over time, as shown when data from the starting point were compared with the

Table 3 ICF categories, occupational therapy interventions provided and recorded at follow-ups

ICF category	Intervention, specified	Starting point	3 months	6 months	9 months
d(p)850 remunerative employment	Work training at work place			X	X
d(p)840 work preparation	Training with BTE work simulator		XX	XX	X
d560 drinking	Training in drinking				X
d440 fine hand use	Oral instructions and training in fine hand use	XX	XXXXX	XXXX	X
D550 eating	Training in eating	XX	XXXXXXXX	XX	
d 630–49 household tasks	Oral instructions in doing household tasks	XXXXXXXXXXXX	XXXXXXXX	XXXX	
D550 eating	Oral instructions in eating	XXXXXXXXXXXX	XXXXXXXX	XXXX	
d540 dressing	Oral instructions in dressing	XXXXXXXXXXXX	XXXXXXXX	XXXX	
d510 washing oneself	Oral instructions in self-care	XXXXXXXXXXXX	XXXXXXXX	XXXX	
d445 hand and arm use	Grasping and moving objects by playing 'Solitary' game	X	X		
b760 control of voluntary movement functions	Coordination training on computer		X		
b710, b740 mobility of joint functions and muscle endurance functions	Active movements	XXXXXXXXXXXX	XXXXXXXXXX	XXXX	XXXX
b730 muscle power functions	Muscle strength training	XXXXXXXXXX	XXXXXXXX		
b715, b710 stability of joint functions and mobility of joint functions	Fixation and increasing of ROM of fingers and wrist by splinting	XXXXXXXXXXXX	XXXXX		X
b280, 265 sensation of pain and touch	Desensitization treatment	XXXXX	XXXX	X	X
b415 blood vessel functions	Oedema treatment	XXXXXXXXXX	XXXXX	XX	XX
b820 repair functions of the skin	Scar treatments	X	X	X	
s810 structure of areas of skin	Scar treatments	X	X	X	
e 115 products and technology for personal use in daily living	Trying out of assistive products and technology, such as adapted knife, fork and spoon	X			
e115 products and technology for personal use in daily living	Training in using assistive products and technology, such as knife, fork and spoon	X			

b, body function; BTE, Baltimore therapeutic equipment; d, activity, d(p) participation; e, environmental factors; ICF, International Classification of Functioning, Disability and Health; ROM, range of motion; s, structural impairment; X, a patient receiving the intervention indicated and specified for body function.

3-month and 12-month follow-ups (Table 4). No significant difference was found between the 3-month and the 12-month follow-ups for the wrist joint or the middle and little fingers, indicating that most of the changes took place within the first 3 months. On the basis of the DASH item, self-reported hand/finger stiffness decreased between the baseline and the 12-month follow-up and also compared with the 3-month follow-up. No difference was found between the 3-month and the 12-month follow-ups.

Total grip strength increased significantly between the baseline and the 3-month and the baseline and the 12-month follow-ups (Table 4). No difference was found between the 3-month and the 12-month follow-ups, indicating once again that most of the changes occurred during the first 3 months. Self-reported weakness (DASH) decreased between the baseline and the 12-month follow-up, and also compared with the 3-month follow-up. There was no difference between the 3-month and the 12-month follow-ups.

On the basis of the individual DASH items, at the ICF activity and participation level, subjective improvements were found between start and the 12-month follow-up for items involving mobility (lifting and carrying objects), self-care (eating), household tasks (preparing a meal and opening a tight or new jar, doing housework, caring for household objects), socializing and recreation/leisure and remunerative employment (Table 5). The same was true when comparing the baseline with the 3-month follow-up, except for recreation/leisure, which needed more

time for improvement. There was no difference between the 3-month and the 12-month follow-ups. The mean value of the total DASH scores at baseline was 40.0, indicating a moderate degree of disability, however, by the 3-month follow-up this had improved to a mean value of 26.3 and to 26.7 at the 12-month follow-up.

According to SF-36, significant improvements were found between the baseline for the subscales RP (mean = 26.7) and SF (mean = 76.7) at the 3-month follow-up. There were also significant improvements between the baseline and the 12-month follow-up (RP, mean = 56.7; SF mean = 80.0).

There was in general low pain intensity at all time points (range: means 17–24 mm).

Agreement between occupational therapy interventions and outcome measures using the International Classification of Functioning, Disability and Health

Agreement between occupational therapy interventions and outcome measures was found for 11 pairs (Table 6). Eight of these pairs were at the activity and participation level and three were at the body function level subjective lifting capacity was followed up but no occupational therapy intervention was recorded. Fine hand use and hand and arm use were trained in functional games including reaching, grasping, manipulating, releasing and picking up objects of different shapes and sizes. However, the outcome measures here concerning turning or twisting, pushing, and throwing were not included in the earlier training. Most occupational therapy interventions concerned oral instructions in how to

Table 4 ICF body function level^a

ICF	Body function	Time points	Mean difference	Standard error	95% CI for difference		P value
					Lower	Upper	
Measurements							
b710	Total active motion of the wrist in extension and flexion	2 1	24	6	11	38	0.005
		3 2	14	11	-13	40	NS
		3 1	38	9	17	59	0.004
b710	Total active motion of dig II in extension and flexion	2 1	14	11	-13	40	NS
		3 2	68	25	7	129	0.035
		3 1	82	17	39	124	0.003
b710	Total active motion of dig III in extension and flexion	2 1	-49	10	-73	-24	0.003
		3 2	24	14	-11	59	NS
		3 1	73	19	26	119	0.009
b710	Total active motion of dig V in extension and flexion	2 1	68	23	10	125	0.028
		3 2	20	14	-14	55	NS
		3 1	88	24	29	146	0.011
b730	Total grip strength in both hands	2 1	20	7	1	39	0.036
		3 2	3	4	-6	13	NS
		3 1	30	8	3	44	0.022
DASH questionnaire							
b730	Weakness	2 1	-1	0	-2	0	0.009
		3 2	0	0	0	1	NS
		3 1	1	0	2	0	0.012
b710	Stiffness	2 1	1	0	1	0	0.068
		3 2	0	0	1	0	NS
		3 1	-1	0	-2	0	0.034

CI, confidence interval; DASH, disabilities of arm, shoulder and hand questionnaire; ICF, International Classification of Functioning, Disability and Health; NS, not significant.

^aPairwise comparison of items which displayed a significant main effect between different time points baseline (1), 3-month (2) and 12-month follow-ups (3).

Table 5 ICF activity and participation level^a

ICF	Activity and participation	Time points	Mean difference	Standard error	95% CI for difference		
					Lower	Upper	P value
d430	DASH questionnaire Carry a heavy object (over 5 kg)	2 1	-0.9	0.3	-1.5	0.2	0.012
		3 2	0.1	0.3	-0.8	0.5	NS
		3 1	-1.0	0.4	-1.8	0.2	0.020
d550	Use a knife to cut food	2 1	-0.7	0.3	-1.3	0.1	0.019
		3 2	0.1	0.3	-0.9	0.6	NS
		3 1	-0.9	0.3	-1.4	-0.3	0.005
d630	Prepare a meal	2 1	-0.6	0.2	-1.0	0.1	0.014
		3 2	-0.1	0.2	-0.5	0.4	NS
		3 1	-0.6	0.2	-1.0	-0.2	0.007
d630	Open a tight or new jar	2 1	-1.1	0.4	-1.9	-0.4	0.007
		3 2	0.1	0.2	-0.2	0.5	NS
		3 1	-1.0	0.4	-1.9	-0.1	0.03
d640	Do heavy household chores (e.g. wash walls, wash floors)	2 1	-0.9	0.3	-1.5	-0.2	0.02
		3 2	0.1	0.3	-0.5	0.8	NS
		3 1	-0.7	0.3	-1.4	-0.0	0.045
d650	Garden or do yard work	2 1	-0.6	0.3	-1.3	-0.0	0.045
		3 2	-0.1	0.3	-0.7	0.6	NS
		3 1	-0.7	0.3	-1.3	-0.1	0.019
d640	Make a bed	2 1	-0.8	0.2	-1.2	0.4	0.001
		3 2	-0.2	0.2	-0.6	0.2	NS
		3 1	-1.0	0.2	-1.4	-0.6	0.000
d920	Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g. golf, hammering, tennis)	2 1	-0.6	0.5	-1.7	0.4	NS
		3 2	-0.6	0.3	-1.2	0.0	0.055
		3 1	-1.2	0.4	-2.1	-0.3	0.013
d859	SF-36 Role physical	2 1	32.1	10.0	10.6	53.7	0.007
		3 2	0.0	9.5	-20.4	20.4	NS
		3 1	32.1	15.4	-1.1	65.4	0.057
d9205	Social functioning	2 1	12.9	4.4	3.5	22.4	0.011
		3 2	-0.7	3.1	-7.4	5.9	NS
		3 1	-12.2	4.5	-22.1	-2.4	0.019

CI, confidence interval; DASH, disabilities of arm, shoulder and hand questionnaire; ICF, International Classification of Functioning, Disability and Health; NS, not significance; SF-36, short form-36.

^aPairwise comparison of items, which displayed a significant main effect between different time points baseline (1), 3-month (2) and 12-month follow-ups (3).

perform household tasks; preparing meals, doing housework and self-care tasks such as drinking, eating, dressing and washing oneself. The only actual activity training was in eating and drinking. In all, nine occupational therapy interventions were not assessed before and after the actual intervention provided.

Discussion

Occupational therapy interventions as International Classification of Functioning, Disability and Health categories

The occupational therapy interventions during the rehabilitation process focused on body function at the baseline and up to the 3-month period. Later on in the rehabilitation process, between three and nine months, work training and training in specific activities were introduced. This result merits reflection as an over riding general principle of occupational therapy is to use interventions at the activity and participation level, whereas in this study of occupational therapy in hand rehabilitation, a substantial part took place at body function level. This supports the findings of other researchers and similar occupational therapy interventions have been used in earlier research such as active and passive mobilization exercise, splinting, and oedema treatment (Muenzen

et al., 2002; Bücher, 2004; Ellis, 2004; Pratt *et al.*, 2004). In conclusion, these results and earlier research show that occupational therapy interventions often belong to the body function level.

Agreement between occupational therapy interventions and outcome measurements/assessments using the International Classification of Functioning, Disability and Health

The results show that ICF categories can be used to describe occupational therapy interventions in postsurgery hand rehabilitation after trauma and the instruments used. An advantage of this is the possibility of linking interventions with measurements (here in the form of baseline and follow-up measurements). The experience gained is that such comparisons made at the beginning of a project reduce the risk of discrepancies between rehabilitative interventions and choice of outcome measurements methods.

As the prerequisite of this project was to study the occupational therapy interventions used in a regular clinical setting, the interventions was not decided in advance and analysed at a later stage for the agreement to the assessments used. If such a strategy is applied

Table 6 Agreement (bold letters) among the outcome measures (e.g. ROM, grip strength, etc., DASH, SF-36) linked to the ICF codes and the occupational therapy interventions used (classified according to the ICF)

ICF codes of outcome measurement/assessments used	ICF codes of occupational therapy intervention
d(p)9200 play (cards)	–
d(p) 9203 crafts (knitting)	–
d(p)850 remunerative employment assessed with work simulator	d(p)850 remunerative employment: work training d(p)840 work preparation: training with work simulator
d7702 sexual relationships	–
d760 family relationship	–
d7500 informal relationship friends	–
d7501 informal relationships neighbours	–
d7504 informal relationships with peers	–
d630 preparing meals,	d630 household tasks: preparing meals: oral instructions
d640 doing housework	d640 household tasks: doing housework: oral instructions
d660 assisting others	–
d6501 maintaining dwelling and furnishings	–
d6505 taking care of plants, indoors and outdoors	–
d5202 caring for hair	–
d5100 washing body parts Not assessed	d510 washing oneself: oral instructions d560 drinking: training
d550 eating	d550 eating: oral instructions, training
d5400 putting on clothes	d540 dressing: oral instructions
d470 using transportation Not assessed	–
d4452 reaching	d440 fine hand use: oral instructions, training grasping, manipulating, releasing and picking up
d4453 turning or twisting the hands or arms	d445 hand and arm use: training, reaching
d4451 pushing	–
d4454 throwing	–
d4301 carrying objects in the hands	–
d170 writing Not assessed	–
b710 mobility of joint functions	b760 control of voluntary movement functions: training b710, mobility of joint functions: training, splinting
Not assessed	b715 stability of joint functions: splinting
b730 muscle power functions	b730 muscle power functions: training
Not assessed	b740 muscle endurance functions: training
b280 sensation of pain	b280 sensation of pain: stimuli training
Not assessed	b265 sensation of touch: stimuli training
Not assessed	b415 blood vessel functions: massage, bandaging, training
Not assessed	b820 repair functions of the skin: massage, compression bandage
b130 energy and drive functions	–
b134 sleep functions	–
Not assessed	e115 products and technology for personal use in daily living: trying out and training in using assistive technology such as knife, fork and spoon

Minus sign (–), no agreement between assessment and intervention.

b, body function; d, activity; DASH, disabilities of arm, shoulder and hand questionnaire; d(p) participation; ICF, International Classification of Functioning, Disability and Health; ROM, range of motion; SF-36, short form-36.

in clinical routine, some of the discrepancies between intervention and outcome measurements/assessments can be avoided. In all, nine occupational therapy interventions were not assessed before and after the actual intervention

provided. This can be a result from the design of the research project in which the measurements selected were SF-36, DASH questionnaire, range of motion and grip strength. In best practice there should be agreement between initial assessment, interventions and outcome measurements in the ICF framework. The agreement between assessments used for work capacity evaluations, predictors for work return and the ICF have been studied earlier (Schult and Ekholm, 2006).

International Classification of Functioning, Disability and Health and outcomes

ICF categories can be used to follow changes in functioning during a rehabilitation process. As no comparative group was used in this study it cannot be concluded that the occupational therapy interventions resulted in the demonstrated improvement in functioning, part of or all of the improvement may have been because of the natural recovery or healing process. However, improvements occurred in functioning at the ICF body function, activity and participation levels. Other studies, too, show effects of occupational therapy (MacDermid *et al.*, 2002; Muenzen *et al.*, 2002; Case-Smith, 2003; MacDermid, 2004; MacDermid and Stratford, 2004; Harth *et al.*, 2008).

Methodological considerations

The small number of participants and the lack of a comparative group make generalizations impossible. However, the aim was to gain experience using ICF concepts to describe occupational therapy interventions during a postsurgery phase, to describe development in functioning in ICF categories in the special hand rehabilitation programme and to analyse the occurrence of agreements between the categories of occupational therapy interventions and the outcome measurements/assessments used. One hypothesis would be that if there are complete agreements between the assessments and the interventions used, by applying the ICF as a framework, it would lead to better clinical results than if such agreements are incomplete.

Conclusion

We conclude that the ICF categories can be used to describe occupational therapy interventions in postsurgery hand rehabilitation after trauma. The use of ICF as a reference framework provides a clear picture of which health domains are addressed. A consistent use of ICF categories facilitates linking between rehabilitation interventions and outcome measurements/assessments thereby increasing the possibility to show the effects of the interventions.

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