

**Psychometric properties of the Assessment of Motor and Process Skills in patients undergoing rehabilitation following hand-related disorders**

Randsby, Thea Birch; Hansen, Alice Ørts; Rolving, Nanna

*Published in:*  
Hand Therapy

*DOI:*  
10.1177/1758998320912761

*Publication date:*  
2020

*Document version:*  
Accepted manuscript

*Citation for pulished version (APA):*

Randsby, T. B., Hansen, A. Ø., & Rolving, N. (2020). Psychometric properties of the Assessment of Motor and Process Skills in patients undergoing rehabilitation following hand-related disorders. *Hand Therapy*, 25(2), 63-72. <https://doi.org/10.1177/1758998320912761>

Go to publication entry in University of Southern Denmark's Research Portal

**Terms of use**

This work is brought to you by the University of Southern Denmark.  
Unless otherwise specified it has been shared according to the terms for self-archiving.  
If no other license is stated, these terms apply:

- You may download this work for personal use only.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying this open access version

If you believe that this document breaches copyright please contact us providing details and we will investigate your claim.  
Please direct all enquiries to [puresupport@bib.sdu.dk](mailto:puresupport@bib.sdu.dk)

## **Title page**

Psychometric properties of the Assessment of Motor and Process skills (AMPS) in patients undergoing rehabilitation following hand-related disorders

### **Authors:**

Ransby, Thea Birch (TBR)<sup>1</sup>

Hansen, Alice Ørts (AØH)<sup>2,3</sup>

Rolving, Nanna (NR)<sup>1,4</sup>

<sup>1</sup>Dep. of Physical and Occupational Therapy, Silkeborg Regional Hospital, Silkeborg, Denmark

<sup>2</sup>Department of Rehabilitation, Odense University Hospital, Odense, Denmark

<sup>3</sup>Department of Clinical Research, University of Southern Denmark, Odense, Denmark.

<sup>4</sup>DEFACTUM, Central Denmark region, Aarhus, Denmark

**Author for correspondence:** Thea Birch Ransby,

Address: VIA University College, Hedeager 2, 8200 Aarhus N, Denmark. Email: tbra@via.dk

### **Funding**

This work is supported by the Danish Occupational Therapist Association, which had no role in the design of this study, analyses, interpretation of the data, or decision to submit results.

### **Acknowledgements**

The author acknowledges the Department of Occupational Therapy and Physiotherapy, Regional Hospital of Silkeborg, Denmark for supporting the study and for recruitment of patients. A special acknowledgement to Helene Nørgaard Kristensen, OT and Lisa Bay Johansen, OT. Furthermore, we acknowledge the Danish Occupational Therapists Association for their financial support.

## **Title**

**Psychometric properties of the Assessment of Motor and Process Skills (AMPS) in patients undergoing rehabilitation following hand-related disorders**

## **Abstract**

**Introduction:** Assessment of Motor and Process Skills (AMPS) has proven to be a suitable measurement tool for assessing performance-based ADL ability, however its reliability and validity have not been tested on patients with hand-related disorders.

**Methods:** Patients referred for outpatient hand rehabilitation were assessed with AMPS, The Canadian Occupational Performance Measure (COPM), dynamometer and goniometer at baseline and after eight weeks of hand therapy. Construct validity and responsiveness of AMPS were assessed by hypothesis testing. Construct validity was assessed by correlating the baseline score of AMPS with the baseline score of the other measurement tools. Responsiveness was assessed by correlating the change scores of each measurement tool with a Global Rating Scale.

**Results:** Fifty-one patient were recruited. The construct validity of AMPS indicated that the various measurement tools captured different aspects to functioning from the AMPS, as the correlations between AMPS and the other measurement tools were generally weak to low ( $r < 0.25$  to  $0.49$ ). AMPS was less responsive than COPM when correlated with the GRS. The correlation between COPM and GRS was  $r = 0.62$  compared with the AMPS-motor,  $r = 0.45$  and AMPS-process,  $r = 0.35$ . Relative responsiveness of AMPS similar to that of the dynamometer  $r = 0.39$  and goniometer  $r = -0.34$ .

**Discussion:** This study found that the construct validity of AMPS seemed to be moderate while the responsiveness of AMPS seemed to be poor. Further studies are needed with larger samples.

## INTRODUCTION

Hand-related disorders are quite common. Around 30% of all patients at accident and emergency departments are treated for hand-related injuries (1). Some occur acutely because of an accident, while others are progressive diseases. The degree to which patients are affected in their activities of daily living following a disorder differs, but as we use our hands in almost all activities of daily living, a hand-related disorder often causes impaired functioning even after years (2-4). Although illness perception has gradually changed over recent decades from a narrow biomedical approach to a broader and more dynamic perception, the biomedical approach remains dominant for most health professionals (5). This also applies to hand therapy where successful treatment is often judged by improvements of range of motion (ROM) and handgrip strength rather than achieving client-centered and occupation focused goals (4, 6, 7). Studies exploring patients' recovery found that patients valued occupational performance as a more important outcome than improvements in objective measures, e.g. ROM and grip strength (4), and further, that a focus on occupation improved client motivation (4, 8, 9).

In order to assess functioning the International Classification of Functioning, Disability, and Health (ICF) recommend that body functions and structures, activities and participation are assessed (10). Therefore it is important that valid, reliable and responsive measurement tools are used (11). Many measurement tools measuring body function are available. Despite being poor predictors of occupational performance, they are still the preferred measurement tool for most hand therapists, along with an informal discussion about occupation (6, 7, 12).

There is no consensus on the most appropriate measurement tools to assess activity and participation in patients with a hand-related disorder (7, 13, 14). Measurement tools that are commonly used are the self-reported questionnaires Disabilities of the Arm, Shoulder and Hand (DASH), Patient Rated Wrist Hand Evaluation (PRWHE) or Michigan Hand Outcomes Questionnaire (MHQ) as well as the semi-structured interview Canadian Occupational Performance Measure (COPM) (7). Patient reported outcomes (PRO) measures are commonly used (14, 15), but have limitations in reporting of occupational performance, as

self-report is affected by the patients' expectations, coping strategies, cognitive skills, social and job status (16, 17). Correspondingly, studies have found that self-reported and observational occupation-based measures do not necessarily correlate well, indicating a need for the use of both types of outcome measures (16-19).

The Assessment of Motor and Process Skills (AMPS) has been shown to be a valid, reliable, and responsive occupation-based measurement tool which assesses observed performance-based activities of daily living (ADL) ability in a broad population across cultures and a variety of diagnosis (20-22). Following a thorough review of the literature, no studies were found that used AMPS for patients with hand-related disorders, and the psychometric properties of the AMPS for this population are therefore unknown.

Hence, the objective of this study was to evaluate the construct validity and responsiveness of the AMPS in a population of patients undergoing outpatient rehabilitation following hand-related disorders, compared with the self-reported Canadian Occupational Performance Measure (COPM), and objective measures of body functions (dynamometer and goniometer). These measurement tools are commonly used in hand therapy rehabilitation in Denmark.

## **METHODS**

### **Design**

This study is a psychometric study assessing construct validity and responsiveness of the AMPS.

### **Participants**

Patients were recruited from the Department of Physical and Occupational Therapy at Silkeborg Regional Hospital between October 2017 and August 2018. They were eligible for the study if they fulfilled the following inclusion criteria: (i) diagnosed with a hand-related disorder (ii) age  $\geq 18$  years (iii) referred to outpatient occupational therapy rehabilitation and (iv) surgically or conservatively treated. Exclusion criteria were: (i) movement restrictions following surgery (ii) impaired hand function due to damage to the nervous system (iii) no activity limitations at baseline or (iv) not able to understand and speak Danish.

Hand-related disorders include all types of fractures, lesions, contractures, nerve lesions, ligament lesions or tendon lesions/suture in the forearm, hand, and fingers, as well as trapezium resection due to arthrosis.

### **Standard care setting**

Three project occupational therapists (OT) with several years of hand rehabilitation experience were in charge of the hand rehabilitation during the study period. A typical hand rehabilitation program consists of treatment sessions each or every two weeks for an average of 2-3 months. The initial hand therapy consultation consists of informal discussion about occupation or a COPM interview, measurement of handgrip strength and joint ROM, instruction in exercises and instruction in ADL activities within the patient's capability. Between consultations, patients carry out exercises at home.

### **Data collection**

At the first consultation a project OT screened patients for eligibility according to the criteria. Eligible patients were asked about demographic data, a COPM interview was conducted, and grip strength and joint ROM were measured. At the end of the first consultation each patient selected two tasks from the AMPS manual to be performed at the following consultation, at a maximum of 7 days later. A different OT performed the baseline AMPS test at the patient's second visit, in order to ensure blinding of the baseline measurements of COPM, handgrip strength and joint ROM, performed at the first visit. After 8-weeks all tests were performed on the same day by the project OT who had been in charge of the rehabilitation, and who was blinded to the baseline score of AMPS. The following outcome measures were used:

#### *Performance-based ADL ability*

Performance-based ADL ability was measured using AMPS which is an occupation-based measure of the quality of a person's performance of individually selected activities of daily living in terms of observed ease, efficiency, safety, and independence. An activity could be mopping the floor or emptying the dishwasher.

The AMPS consists of two scales, one measures motor skills and the other measures process skills (21). Computer scoring of the AMPS provides logit values from -4 to +4, with higher scores indicating better ADL ability, and a change of 0.3 logit has been proposed as clinically meaningful (21). The competence cutoff value for the AMPS motor scale is 2.0 logits while the competence cutoff value for the process scale is 1.0 logit; those above the cutoff value demonstrate competent ADL task performance (21).

### Self-reported occupational performance

Self-reported occupational performance was assessed using the COPM which is designed to evaluate a person's own perception of their performance of several activities of daily living (23). The COPM is performed as a semi-structured interview aimed at identifying current occupational performance problems in self-care, productivity and leisure activities. After identifying their problems, the person rates their performance of the stated problems, and their satisfaction with the performance on a 0-10 scale (worst-best). Scores of performance and satisfaction are summed up separately and divided by the number of prioritized occupational performance problems (max 5), adding up to a total score of 0-10 for both subscales (performance and satisfaction, respectively) (23). The COPM has been shown to be valid, reliable and responsive in many different populations (24-26) including patients with hand-related disorders (27, 28).

### Handgrip strength

Handgrip strength was measured using a digital calibrated dynamometer (Biometrics Ltd.) and reported in kilograms (14, 29).

### Joint range of motion (ROM)

Active joint ROM was measured using a goniometer (14, 29) and reported in degrees. In this study, wrist extension was used as an expression of joint ROM for all patients.

Measurements of hand grip and ROM were performed according to the guidelines of the Danish Society of Hand Therapy which are based on the American Society of Hand Therapists recommendations (29).

#### The overall experience of their condition

The patient's overall experience of their condition was measured using a Global Rating Scale (GRS) (11).

The GRS questions used in this study was "Have you experienced a change in the condition of your hand/arm from your surgery/injury and until today?". The GRS has 15 response categories ranging from -7 'A very great deal worse' to +7 "A very great deal better".

#### Demographic data

Data about age, diagnosis, gender, civil status, co-morbidity, type of treatment, job status, and use of home care prior to and after the hand-related disorder were collected from the patients and medical records at baseline.

### **Assessment of psychometric properties**

The Consensus-based Standards for the selection of health Measurement INstruments (COSMIN) guidelines and recommendations for evaluating methodological quality were followed (30, 31). Hypotheses testing is an established method of confirming construct validity and responsiveness (11).

#### Construct validity

It was hypothesized a priori, that measures assessing similar constructs have a higher correlation, whereas measures that assess different constructs have a lower correlation.

Even when the constructs were similar, a weak to moderate correlation was expected since AMPS is an objective observational measure with standardized items whilst the COPM is a subjective self-reported measure without pre-defined items. See Table 1 for further details.



*Insert Table 1 and 2 here*

### Responsiveness

Responsiveness was evaluated with an anchor-based method using the GRS. In line with the COSMIN-guidelines, evaluation of responsiveness was based on testing a priori hypotheses regarding the strength of correlation between GRS and changes in score for the AMPS-motor, AMPS-process, COPM-performance, dynamometer and goniometer, respectively (31). It was hypothesized a priori, that the GRS would have a higher correlation with AMPS and COPM than with the dynamometer and goniometer, as GRS, AMPS and COPM are patient-centered (Table 2).

### **Statistical analysis**

Demographic characteristics of the patients were summarized using descriptive statistics. Baseline scores of handgrip strength, wrist extension, self-reported occupational performance and performance-based ADL ability, as well as the change scores for each measure were reported as mean values with the corresponding standard deviation (SD) and min-max range. On the basis of probability (QQ) plots and histograms a normal distribution of both baseline data and change scores were accepted.

For each outcome, the paired t-test was used to evaluate whether the within-group mean change score was statistically significantly different from zero.

Spearman's correlation coefficients were calculated between the measures. A correlation was considered weak or nonexistent if  $r < 0.25$ , low if  $r = 0.26-0.49$ , moderate if  $r = 0.50-0.69$ , good if  $r = 0.70-0.89$  and high if  $r = 0.90-1.00$  (32). A correlation coefficient of  $\geq 0.50$  was considered as an acceptable correlation between two measures, meaning that they measured the same construct (17). In accordance with De Vet et al. construct validity and responsiveness were considered to be high if  $> 75\%$  of the hypotheses were confirmed, moderate if  $50-75\%$  were confirmed and poor if  $< 50\%$  were confirmed in a (sub) group of at least 50 patients (11). Floor and ceiling effects were considered to be present if more than  $15\%$  of the

participants achieved the lowest and highest possible scores on each of the measurement tools, respectively (11).

Construct validity was assessed by i) correlating the baseline scores of the AMPS scales with the baseline score of COPM-performance, dynamometer and goniometer, respectively, and ii) assessing how many of the a priori hypotheses were fulfilled.

Responsiveness was assessed by i) correlating the change scores of each measure with a GRS, and ii) assessing how many of the a priori hypotheses were fulfilled.

Data were collected and managed using REDCap's electronic data collection tool (33). Statistical analyses were performed with STATA version 15 (Stata Corp, College Station, TX). All *P*-values <0.05 were considered statistically significant.

### **Sample size**

In validity and responsiveness studies, where correlation coefficients are calculated, it is recommended that at least 50 patients are included, but larger samples (e.g. over 100 patients) are preferred (11). Assuming a maximum 10% dropout rate, 55 patients were needed for this study as a minimum.

## **RESULTS**

A total of 51 patients were included in the assessment of construct validity and 45 patients in the assessment of responsiveness. Reasons for drop-out are presented in Figure 1. There were no differences between completers and non-completers in relation to gender or type of treatment (surgery or conservative treatment), but non-completers were slightly older (mean 66 years) and more likely to be retired.

*Insert Figure 1: Flowchart around here*

The mean (min-max) age of the patients was 57 years (20-80), 82% were women and 88% had undergone surgery. The most common diagnosis was distal forearm fracture (59%). Fifty-five percent had no other diseases before the hand-related disorder, 18% had osteoporosis, while 20% had osteoarthritis or rheumatoid arthritis. No patients received homecare before they sustained their hand-related disorder. Demographic characteristics of the patients are presented in Table 3.

Significant improvements from baseline to follow-up were achieved on all outcome measures. No floor or ceiling effects were seen for AMPS and COPM at baseline or follow up. Baseline and follow-up scores with means, SD and 95% confidence interval (CI) for AMPS, COPM, dynamometer and goniometer can be seen in Table 4.

*Insert Table 3 and 4 around here*

### **Construct validity**

For the assessment of construct validity, 3 (hypotheses 1, 2 and 4) out of 6 (50%) of the hypotheses were confirmed, suggesting moderate construct validity of AMPS for patients with hand-related disorders. See the correlation coefficients in Table 1.

### **Responsiveness**

For the assessment of responsiveness, 2 (hypotheses 9 and 10) out of 5 (40%) hypotheses were confirmed, suggesting poor responsiveness of AMPS for patients with hand-related disorders. See the correlation coefficients in Table 2.

## **DISCUSSION**

The aim of the present study was to assess the construct validity and responsiveness of the AMPS in comparison to COPM, grip strength and ROM in a population of patients with hand-related disorders.

Overall the study found that the construct validity of AMPS was moderate whilst the responsiveness of AMPS was poor. Despite achieving clinically meaningful change on the AMPS scales, in terms of a change score of minimum 0.3 points, the responsiveness of the AMPS was still considered to be poor, as correlations between the GRS and the AMPS change scores were low to moderate. Unexpectedly, AMPS turned out to be less responsive than the COPM when correlated to the GRS. Instead, correlations between the change score of AMPS and GRS were more similar to the low correlations of the change scores on the dynamometer and goniometer with the GRS.

Our findings on construct validity of the AMPS concur with results from other studies, which also show a limited relationship between self-reported and observational occupation-based measures (16-19). The low correlations between the COPM and AMPS, may be explained by the COPM items being self-reported and patient-specific, whereas in AMPS they are standardized, although the activities are selected and adapted to the individual patient. In this study most of the patients had not attempted to use their hand by the time the baseline assessment took place, either due to the recent surgery or acute injury and therefore may have been unable to report their performance in a realistic and accurate way with the COPM which may explain the lower correlation.

An explanation of the higher than expected correlations between AMPS-motor scale and measures of body function may be that it requires some physical functioning to perform everyday activities (34). An explanation for the higher than expected correlations between AMPS-motor scale and handgrip strength could be that the AMPS activities chosen by the patients required a certain level of grip strength in both hands, for example changing bedsheets or washing the floor. Our findings are in accordance with a study by Tremayne et al who found a moderate to strong negative correlation ( $r = -0.51$  to  $-0.76$ ) between handgrip strength and an objective measure of hand activity whilst finding a weak to moderate negative correlation ( $r = -0.17$  to  $-0.55$ ) between joint ROM and an objective measures of hand activity in a population of patients with wrist fractures (35).

In this study 2 out of 5 (40%) hypothesis assessing responsiveness were confirmed, suggesting poor responsiveness of AMPS in patients with hand-related disorders. Two other studies have compared the responsiveness of AMPS and the Functional Independence Measure (FIM), using standardized response means (SRM) and effect sizes (ES) (22, 36). The study by Choo compared the subscales of The FIM and AMPS within three different inpatient rehabilitation populations, including an inpatient orthopedic group (22). Their results showed that the FIM motor subscale was more responsive than the AMPS scales in that population (22). The study by Fioravanti et al found no significant difference in the ability of the AMPS-motor and FIM-motor scales to detect change following inpatient rehabilitation in a population of geriatric and neuro-oncology patients (36). Overall, in both studies, the subscales of both AMPS and FIM demonstrated responsiveness (22, 36), which is not in accordance with our findings. An explanation could be that these studies used a different method to assess responsiveness as mentioned above and the study by Choo et al had a larger sample size (n=276) (22, 36).

The correlations between GRS and the change scores of all the measurement tools were low to moderate. An explanation for the low correlations could be that correlations are usually lower when assessing change scores than single scores (11). As discussed in other studies adhering to the COSMIN recommendations, it is difficult to develop hypothesis concerning correlations between change scores measured with different measures, since such hypothesis are mostly based on clinical experience (11, 30).

### **Strengths and limitations of the study**

This study design and execution was in accordance with the COSMIN guidelines (31). We chose a pragmatic study design to reflect the diagnostic heterogeneity among the patients seen in a hand therapy rehabilitation unit, which implies that the results may be generalizable to other patients with a hand-related disorder seen in a similar orthopedic outpatient setting. The study was designed to allow for a

maximum of 7 days from inclusion and performance of baseline COPM, handgrip strength and joint ROM until baseline AMPS was performed. Due to logistic reasons, there was a range between 1-22 days, mean 7.25 (4.27), which may have weakened the correlations. In this early phase of recovery with pain and inflammation after injury or surgery, a few days more or less between tests could have influenced the patient's pain and function. In an ideal study, all tests would have been conducted on the same day, but this was not considered possible for ethical reasons, due to the condition of the patients at baseline e.g. because of fatigue or pain. A strength of the study was that all measurements with a goniometer and dynamometer were performed according to the national guidelines based on the ASHT recommendations which , increases the reliability of the measurements (29). Furthermore, the OT who measured AMPS at baseline were blinded to the baseline scores of COPM, dynamometer and goniometer.

The small sample size of 51 patients is a further limitation of the study, although the drop-out rate was acceptable. For psychometric studies, De Vet et al recommend a minimum of 50 patients per subgroup (11). In this study, it was not possible to conduct a subgroup analysis due to the small sample size. Another limitation of this study is that there were 21.6% missing values on AMPS because 6 persons dropped out before follow up and 5 were not able to perform AMPS at follow up because of pain, tendon lesion of the shoulder or because they were not willing to perform AMPS. Another limitation was the use of wrist extension as an expression of joint ROM. As wrist extension was not relevant for all patients e.g. patients with a finger fracture there were fewer patients in these analyzes. It could have been relevant to measure finger or thumb ROM, forearm and wrist rotation as this also affects ADL. The reason for choosing wrist extension was that many patients had a distal forearm fracture and because tasks involving precision are best performed with the wrist extended 40-45 degrees (35). Other self-reported measurement tools of disability and function could have been applied in the present study, e.g. DASH or PRWHE, which have also been found valid and reliable self-report measures in similar populations (37). The choice of the COPM was

partly pragmatic, as it was already being used at the hospital, but we also consider COPM like the AMPS is more client-centered as each patient individually chooses the activities to be assessed (23).

The GRS used in this study may be considered a limitation, as it might measure a different construct than AMPS. The question posed in the GRS was related to their overall experience of their condition, and not to their overall experience of their ability to perform everyday activities, which would have been more in concordance with the purpose of the hand therapy provided in this study. This may have reduced the strength of the correlation between AMPS and the GRS. It can be discussed whether the hypothesis in this study were set out in the most appropriate manner as some of the hypothesis were dependent upon each other, which makes it harder to fulfill them (11). For example, although the correlation between COPM and GRS as hypothesized was moderate, hypothesis 8 was not confirmed as it should be similar or lower than the correlation between GRS and AMPS-motor.

### **Recommendations for future research**

The present study indicates that AMPS is not applicable to patients with a hand-related disorder, but due to study limitations such as a rather small sample size and the limited number of comparable measurement tools, it would be relevant to conduct a larger study before a final decision is made as to whether AMPS is applicable to patients with a hand-related disorders. Valid, reliable, and responsive observation-based measurement tools to assess activity and participation are needed in hand therapy. Mostly activity and participation are measured with self-reported questionnaires as DASH and PRWHE (7, 14, 15), but as studies have found that self-reported and observational measurement tools do not necessarily correlate well (16-19) both types of measurement tools should be used. AMPS is a standardized measure assessing observed ADL ability and might be useful in hand therapy as it has good psychometric properties in other diagnosis (20-22). In the present study COPM was found to be the most responsive measurement tool but since the present study does not assess the psychometric properties of COPM, this should be tested in a future study.

## **CONCLUSION**

This study showed that the construct validity of AMPS is moderate while the responsiveness is poor in patients with hand-related disorders. Furthermore, it highlights that different types of measures captured different aspects of functional ability, therefore making it necessary to use a combination of different kind of measures.



## References

1. Jackson LL. Non-fatal occupational injuries and illnesses treated in hospital emergency departments in the United States. *Inj Prev*. 2001;7 Suppl 1:i21-6.
2. Nielsen TL, Dekkers MK. Progress and prediction of occupational performance in women with distal radius fractures: a one-year follow-up. *Scand J Occup Ther*. 2013;20(2):143-51.
3. Bell J, Gray M, Kingston G, Hannah S, Adams J. The longer term functional impact of a traumatic hand injury on people living in a regional metropolitan Australian location...including commentaries by Hannah S and Adams J. *International Journal of Therapy & Rehabilitation*. 2011;18(7):370-82.
4. Burley S, Di Tommaso A, Cox R, Molineux M. An occupational perspective in hand therapy: A scoping review. *British Journal of Occupational Therapy*. 2018;81(6):299-318.
5. Wade D. Rehabilitation--a new approach. Overview and Part One: the problems. *Clin Rehabil*. 2015;29(11):1041-50.
6. Robinson LS, Brown T, O'Brien L. Embracing an occupational perspective: Occupation-based interventions in hand therapy practice. *Aust Occup Ther J*. 2016;63(4):293-6.
7. Leshner DAM, Mulcahey MJ, Hershey P, Stanton DB, Tiedgen AC. Alignment of outcome instruments used in hand therapy with the Occupational Therapy Practice Framework: Domain and Process and the International Classification of Functioning, Disability and Health: A scoping review. *American Journal of Occupational Therapy*. 2017;71(1).
8. Astifidis RP, Koczan BJ, Dubin NH, Burke FD, Wilgis EFS. Patient satisfaction with carpal tunnel surgery: self-administered questionnaires versus physical testing. *Hand Therapy*. 2009;14(2):39-45.
9. Bates E, Mason R. Coping strategies used by people with a major hand injury: a review of the literature. *British Journal of Occupational Therapy*. 2014;77(6):289-95.
10. World Health O. International classification of functioning, disability and health: ICF. Geneva: World Health Organization; 2001. 299 s. p.
11. Vet HCWd. *Measurement in medicine : a practical guide*. Cambridge  
New York: Cambridge University Press; 2011. x, 338 s., illustreret p.
12. Powell RK, von der Heyde RL. The inclusion of activities of daily living in flexor tendon rehabilitation: A survey. *Journal of Hand Therapy*. 2014;27(1):23-9.
13. van de Ven-Stevens L, Munneke M, Spauwen PHM, van der Linde H. Assessment of activities in patients with hand injury: a review of instruments in use. *British Journal of Hand Therapy*. 2007;12(1):4-14.
14. van de Ven-Stevens LA, Graff MJ, Selles RW, Schreuders TA, van der Linde H, Spauwen PH, et al. Instruments for assessment of impairments and activity limitations in patients with hand conditions: A European Delphi study. *J Rehabil Med*. 2015;47(10):948-56.
15. Valdes K, Macdermid J, Algar L, Connors B, Cyr LM, Dickmann S, et al. Hand therapist use of patient report outcome (PRO) in practice: A survey study. *Journal of Hand Therapy*. 2014;27(4):299-308.
16. Waehrens EE, Bliddal H, Danneskiold-Samsoe B, Lund H, Fisher AG. Differences between questionnaire- and interview-based measures of activities of daily living (ADL) ability and their association with observed ADL ability in women with rheumatoid arthritis, knee osteoarthritis, and fibromyalgia. *Scand J Rheumatol*. 2012;41(2):95-102.
17. Nielsen KT, Waehrens EE. Occupational therapy evaluation: use of self-report and/or observation? *Scand J Occup Ther*. 2015;22(1):13-23.
18. Rallon CR, Chen CC. Relationship between performance-based and self-reported assessment of hand function. *Am J Occup Ther*. 2008;62(5):574-9.
19. Wæhrens EE, Amris K, Fisher AG. Performance-based assessment of activities of daily living (ADL) ability among women with chronic widespread pain. *Pain*. 2010;150(3):535-41.

20. Donnelly C, Carswell A. Individualized outcome measures: a review of the literature. *Can J Occup Ther.* 2002;69(2):84-94.
21. Fisher AG, Jones KB. *Assessment of Motor and Process Skills. Development, Standardization, and Administration Manual.* Seventh edition ed. Colorado, USA: Three Star Press, INC.; 2011.
22. Choo SX, Stratford P, Richardson J, Bosch J, Pettit SM, Ansley BJ, et al. Comparison of the sensitivity to change of the Functional Independence Measure with the Assessment of Motor and Process Skills within different rehabilitation populations. *Disabil Rehabil.* 2017:1-8.
23. Larsen AE, Morville A-L, Hansen T. Translating the Canadian Occupational Performance Measure to Danish, addressing face and content validity. *Scandinavian Journal of Occupational Therapy.* 2019;26(1):33-45.
24. Malcus Johnsson P, Sandqvist G, Stureson A-L, Gulfe A, Kopylov P, Tägil M, et al. Individualized outcome measures of daily activities are sensitive tools for evaluating hand surgery in rheumatic diseases. *Rheumatology (Oxford, England).* 2012;51(12):2246-51.
25. Eyssen ICJM, Steultjens MPM, Oud TAM, Bolt EM, Maasdam A, Dekker J. Responsiveness of the Canadian occupational performance measure. *Journal of rehabilitation research and development.* 2011;48(5):517-28.
26. Carswell A, McColl MA, Baptiste S, Law M, Polatajko H, Pollock N. The Canadian Occupational Performance Measure: A Research and Clinical Literature Review. *Canadian Journal of Occupational Therapy.* 2004;71(4):210-22.
27. Eyssen ICJM, Beelen A, Dedding C, Cardol M, Dekker J. The reproducibility of the Canadian Occupational Performance Measure. *Clinical rehabilitation.* 2005;19(8):888-94.
28. Ven-Stevens LAWvd, Graff MJL, Peters MA, Linde Hvd, Geurts AC. Construct validity of the canadian occupational performance measure in participants with tendon injury and dupuytren disease. *Physical Therapy.* 2015;95(5):750-7.
29. Puggård H, Pedersen K, Hansen AØ. *National Målestandard - Ledmåling - kraftmåling.* Dansk Selskab for Håndterapi; 2014.
30. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. *Journal of Clinical Epidemiology.* 2010;63(7):737-45.
31. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. *An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation - Official Journal of the International Society of Quality of Life Research.* 2010;19(4):539-49.
32. Carter RE, Lubinsky J. *Rehabilitation research : principles and applications.* Fifth edition ed. St. Louis, Missouri: Elsevier; 2016. ix, 489 pages, illustrations p.
33. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics.* 2009;42(2):377-81.
34. Amini D. Occupational therapy interventions for work-related injuries and conditions of the forearm, wrist, and hand: a systematic review. *The American journal of occupational therapy : official publication of the American Occupational Therapy Association.* 2011;65(1):29-36.
35. Tremayne A, Taylor N, McBurney H, Baskus K. Correlation of impairment and activity limitation after wrist fracture. *Physiother Res Int.* 2002;7(2):90-9.
36. Fioravanti AM, Bordignon CM, Pettit SM, Woodhouse LJ, Ansley BJ. Comparing the responsiveness of the Assessment of Motor and Process Skills and the Functional Independence Measure. *Canadian Journal of Occupational Therapy.* 2012;79(3):167-74.
37. Schoneveld K, Wittink H, Takken T. Clinimetric evaluation of measurement tools used in hand therapy to assess activity and participation. *J Hand Ther.* 2009;22(3):221-35; quiz 36.

38. Porter S. Occupational performance and grip function following distal radius fracture: A longitudinal study over a six-month period. *Hand Therapy*. 2013;18(4):118-28.
39. van Oosterom FJ, Ettema AM, Mulder PG, Hovius SE. Impairment and disability after severe hand injuries with multiple phalangeal fractures. *J Hand Surg Am*. 2007;32(1):91-5.

## Tables and figures

*Table 1 Hypothesis regarding construct validity of AMPS including expected and observed values*

Hypothesis	Expected values	Correlation coefficient*	Argument
1. A low to moderate correlation was expected between COPM-performance scale and AMPS-motor scale.	(0.26-0.69)	0.41	Previous studies have shown a limited association between self-reported and observational occupation-based measurement tools (16, 17, 19). Studies found a better association between the motor scale than the process scale of the AMPS and self-reported measurement tools (16, 17).
2. A weak to low correlation was expected between COPM-performance scale and AMPS-process scale.	(<0.25-0.49)	0.09	
3. A weak negative correlation was expected between goniometer and AMPS-motor scale.	(-0.25-0.0)	- 0.39	Measurement tools of body function are a weak predictor of the ability to perform activities of daily living (6, 7, 12). The correlation between hand strength (dynamometer) and observational occupation-based measurement tool has been found to be higher than the correlation of ROM (goniometer) with observational occupation-based measurement tools (35).
4. A weak negative correlation was expected between goniometer and AMPS-process scale.	(-0.25-0.0)	- 0.05	
5. A weak to low correlation was expected between dynamometer and AMPS-motor scale.	(<0.25-0.49)	0.56	
6. A weak correlation was expected between dynamometer and AMPS-process scale.	(<0.25)	0.32	

\*Spearman's correlation r

Table 2 Hypothesis regarding responsiveness with expected and observed values

Hypothesis	Expected values	Correlation coefficient*	Argument
7. The correlation between GRS** and change score on the AMPS-motor scale was expected to be moderate and thus higher than the correlations in hypothesis 8-11.	(0.50-0.69)	0.45	We expect a moderate correlation as previous studies showed a limited correlation between self-reported and observational occupation-based measurement tools at baseline (16, 17, 19). A study by Wæhrens et al showed that the AMPS-motor scale was able to measure change over time in a population of patients with chronic pain while the AMPS- process scale did not capture this change (19).
8. The correlation between GRS and change score on COPM-performance scale was expected to be low to moderate and thus lower than or similar to the correlation between GRS and the change score on AMPS-motor scale.	(0.26-0.69)	0.62	Several studies have shown that there is a higher correlation between measurement tools measuring the same construct (8, 19, 38). COPM and GRS are both self-reported measurement tools, but since the GRS asks for improvement of your arm / hand, only a moderate correlation is expected.
9. The correlation between GRS and change score on AMPS-process scale was expected to be low and thus lower than the correlation between GRS and the change score on AMPS-motor scale.	(0.25-0.49)	0.33	A study by Wæhrens et al showed that the AMPS-process scale was not able to measure change over time in a population of patients with chronic pain (19).
10. The correlation between GRS and change score on dynamometer was expected to be weak to low and thus lower than the correlation between GRS and the change score on AMPS-motor scale.	(<0.25-0.49)	0.39	Studies found a weak to low correlation between grip strength and self-reported measurement tools in a population of patients with distal radius fracture and a population of patient following carpal tunnel decompression (8, 38).
11. The correlation between GRS and change score on goniometer was expected to be weak negative and thus lower than the correlation between GRS and the change score on AMPS-motor scale.	(-0.25-0.0)	- 0.34	No statistically significant correlation was found between a self-reported measurement tool and the physicians assessment of the hand (body function) in patients with a severe hand injury (39).

\*Spearman's correlation r

\*\*GRS=Global Rating Scale

Figure 1 flowchart of patients in the study

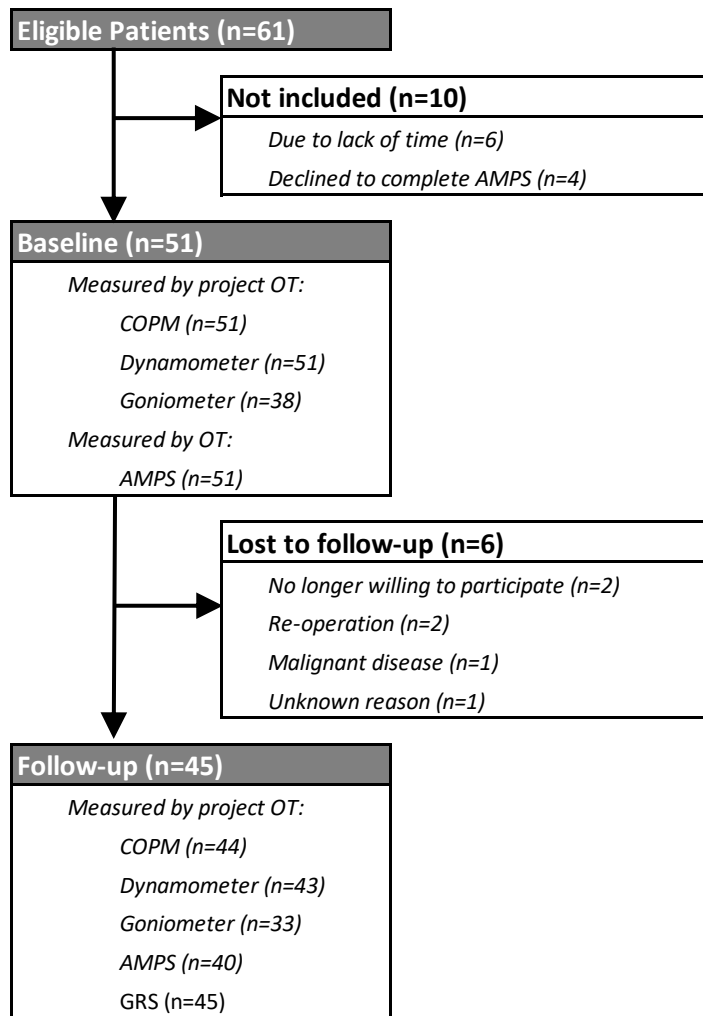


Table 3 Baseline characteristics of study population (n=51)

		n (%)
<b>Gender</b>	Women	42 (82)
<b>Marital status</b>	Living with spouse (or other)	40 (78)
	Living alone	11 (22)
<b>Dominant hand</b>	Right	47 (92)
	Missing data about dominant hand	1 (2)
<b>Diagnosis</b>	Fracture	34 (67)
	Tendon- and ligament injuries/lesion	9 (17)
	Carpometacarpal (CMC) arthrosis	4 (8)
	Other	4 (8)
<b>Job status</b>	Employed	21 (41)
	Retirement/+early retirement	23 (45)
	Sick leave	3 (6)
<b>Comorbidity</b>	No other diseases	28 (55)
	Osteoporosis	9 (18)
	Osteoarthritis or Rheumatoid Arthritis	10 (19))
	Other diseases	4 (8)
<b>Homecare before the hand-related disorder</b>	No	51 (100)

**Table 4** Mean score for AMPS, COPM, dynamometer and goniometer at baseline and follow up and the mean change score of each measurement tool.

	<b>Baseline</b> Mean (SD) N=51	<b>Follow up</b> Mean (SD) N=45	<b>Mean change score</b> Mean (95% CI)	<b>N=</b> <b>change</b> <b>score</b>	<b>P-value</b>
<b>AMPS-motor scale</b>	1.71 (0.44)	2.39 (0.49)	0.62 (0.41;0.83)	40	<0.0001
<b>AMPS-process scale</b>	1.31 (0.35)	1.72 (0.34)	0.37 (0.21;0.52)	40	<0.0001
<b>COPM</b>	3.29 (1.51)	7.52 (2.21)	4.10 (3.41;4.79)	44	<0.0001
<b>Dynamometer</b>	9.87 (8.03)	18.44 (8.05)	7.87 (5.67;10.06)	43	<0.0001
<b>Goniometer*</b>	25.66 (15.99)	9.71 (12.85)	-15.91 (-20.57;-11.25)	33	<0.0001

\* The difference in wrist extension between the affected and non-affected wrist (wrist deficit)  
CI = confidence interval, SD= standard deviation, N= number