



**The British Association of
Prosthetists and Orthotists**

MEASURING CHANGE:
AN INTRODUCTION TO
CLINICAL OUTCOME
MEASURES IN PROSTHETICS
AND ORTHOTICS

www.bapo.com

CONTENTS

Copyright, citation, acknowledgements and contact details	2
Contents	2
Introduction	3
Project overview	6
Summary of survey results	7
Key terms and measurement properties	9
Numeric pain rating scale (NRS-11)	11
Numeric pain rating scale (NRS-11): Case study	13
Socket comfort score (SCS)	16
Socket comfort score (SCS): Case study	17
Timed up and go (TUG)	19
Timed up and go (TUG): Case study	21
10 metre walk test (10MWT)	25
10 metre walk test (10MWT): Case study	27
Disability of the arm shoulder and hand (DASH)	31
Disability of the arm shoulder and hand (DASH): Case study	32
Question sheets	36
Further reading / resources	40

Published by the British Association of Prosthetists and Orthotists, 2015. The disabilities of the arm shoulder and hand (DASH) questionnaire is reproduced with permission – copyright Institute for Work and Health, 2006.

Citation:

Young J, Rowley L, Lator S, Cody C, Woolley H. Measuring Change: an Introduction to Clinical Outcome Measures in Prosthetics and Orthotics. Paisley: British Association of Prosthetists and Orthotists; 2015.

The BAPO Outcome Measures Working Group would like to acknowledge the general support and/or feedback of Paul Charlton, Jonathan Bull, Richard Nieveen, Sioned Steventon, Ashley Graham, BAPO Secretariat, and the BAPO Professional Affairs and Education Committees.

BAPO Secretariat,
Sir James Clark Building,
Abbey Mill Business Centre,
Paisley, PA1 1TJ
Tel: 0141 561 7217
Email: enquiries@bapo.com

ISBN: 978-0-9932010-0-4



In today's demanding and pressured healthcare environment it is essential that the effects of medical interventions, including prosthetic and orthotic care, are accurately assessed and recorded. Outcome measures (OMs) are useful in assessment, clinical decision making and evidencing the outcomes of treatment to either the service user or third parties. OMs also facilitate clinical audit and research. The BAPO Outcome Measures Working Group believes that understanding and using OMs should be a core aspect of prosthetic and orthotic practice. The primary aim of this document is to enable Prosthetists and Orthotists to understand and use simple OMs in clinical practice to improve patient care.

EVIDENCE BASED PRACTICE

- Which intervention is working best?
- Exactly what effect is your clinical practice having on the service users you work with?
- How do you know when the burdens of time consuming and expensive treatment on the service user and health service are justified?

Clinicians are required to ask these questions every day; answering them is a complex process which involves various components of evidence based practice (EBP). The concept of EBP states that decision making in healthcare should be informed by the best available evidence, clinician experience, and the patient's preferences¹.

OUTCOME MEASURES

'Outcome measure' (OM) is a term which describes various tools used to assess diverse aspects of health including physical ability, quality of life and pain. They commonly include clinical assessment procedures such as timed walking tests, and questionnaires. OMs such as timed walking tests are typically termed performance measures or Clinician Reported Outcome Measures (CROMs). Questionnaires completed by the patient are commonly termed Patient Reported Outcome Measures (PROMs). OMs are used to measure both baseline status, and any change in status due to healthcare interventions or natural progression of a condition. OMs sit within the EBP framework as they should be validated in research, often record patient perceptions, and may require clinician experience to administer and interpret. In the terms of the World Health Organisation's (WHO) International Classification of Functioning, Disability and Health (ICF), OMs may relate to body function, body structure and activities and participation². Appropriate use of OMs requires selection of validated and appropriate measures, standardised administration and evaluation of results³.

ALIGNMENT WITH BAPO STATEMENT OF PURPOSE

The BAPO strategic plan 2014-2017⁴ states the following goals of the organisation:

- Support our members to achieve and maintain clinical excellence
- Provide high-quality services
- Encourage professional learning and innovation
- Champion our professional role in modern healthcare

It is felt that Measuring Change supports each of these objectives.

SCOPE AND AIMS OF THE PROJECT

Measuring change was necessarily limited in its scope and pragmatic in its approach. The conditions treated by Prosthetists and Orthotists are very diverse, and the contexts that clinicians in the UK work in is varied. Informed by the results of a national survey of Prosthetists and Orthotists, the working group concluded the following:

- Available clinical time is the most commonly reported barrier to using OMs
- Clinicians identify the need for education in OMs
- Available resources, space and administrative support are also barriers to OM use
- Understanding of statistical and validity issues surrounding OMs is limited
- Only a minority of clinicians report routine use of OMs

CONSIDERING THE RESULTS OF THE SURVEY, IT WAS DECIDED TO CREATE A DOCUMENT WHICH;

- a) provides background information on the theory and use of OMs, and
- b) focuses on a small number of OMs which are quick, free and broadly applicable to prosthetic and orthotic populations.

The goal was therefore to create a document considering the context of prosthetics and orthotics in the UK, in contrast to existing work which makes recommendations on OMs in rehabilitation generally^{5,6}, and in individual populations⁷⁻¹².

SELECTED OUTCOME MEASURES

While measures of body structure such as joint range of motion and Cobb angle may be used as outcome measures, these are not considered in this document. Similarly instrumented gait analysis, plantar pressure analysis and other computerised forms of outcome measurement are not considered within this document.

In selecting OMs it was considered whether they were quick to use, free and broadly applicable to prosthetic and orthotic populations. Five OMs were selected – the Timed up and Go (TUG), ten metre walk test (10MWT), numeric pain scale (NRS-11), socket comfort score (SCS) and Disability of the Arm, Shoulder and Hand (DASH). Each of these has a relatively low time burden and is free to use. All of the OMs selected could be used with either prosthetic or orthotic patients, with the exception of the SCS. However the SCS was included due to its high potential applicability within prosthetics.

The five selected measures include the three most frequently reported OMs from the survey (TUG, SCS, NRS-11) and three OMs which are used by Prosthetists, Orthotists and those in dual practice (TUG, NRS-11, 10MWT). It was considered that providing information relating to measures which are already used to some extent in prosthetic and orthotic practice would be most likely to facilitate their wider and more accurate use and interpretation.

It is expected that the reader will need to consider recommended processes for selecting and implementing OMs^{3,13}, and emerging research, in order to identify further OMs which will be appropriate for use in their individual context and specialism. Due to the decision not to cover licensed OMs, one notable gap in Measuring Change is a generic quality of life measure such as the EQ-5D or SF-36 instruments.

INTRODUCTION REFERENCES

- 1 Sackett D, Rosenberg W, Gray J, et al. Evidence based medicine: what it is and what it isn't. *BMJ* 1996;312:71
- 2 World Health Organization. International Classification of functioning, disability and health. 2001, World Health Organization, Geneva.
- 3 Robinson C, Fatone S. You've heard about outcome measures, so how do you use them? Integrating clinically relevant outcome measures in orthotic management of stroke. *Prosthet Orthot Int.* 2013;37(1):30-42.
- 4 BAPO strategic plan 2014-2017. Paisley: British Association of Prosthetists and Orthotists; 2014.
- 5 Hunsaker FG, Cioffi DA, Amadio PC, et al. The American academy of orthopaedic surgeons outcomes instruments: normative values from the general population. *J Bone Joint Surg Am.* 2002;84-A(2):208-15.
- 6 National ageing research institute. Outcome Measures in Rehabilitation [Online]. National ageing research institute, 2001. Available at: <http://www.health.vic.gov.au/subacute/outcome.htm>
- 7 American Physical Therapy Association. Neurology Section Outcome Measures Recommendations [Online]. American Physical Therapy Association, 2011-2013. Available at: <http://www.neuropt.org/professional-resources/neurology-section-outcome-measures-recommendations>
- 8 Atkin K, Cole MJ, Cumming J, et al. BACPAR Toolbox of Outcome Measures: Version 2 [Online]. BACPAR, 2014. Available at: <http://bacpar.csp.org.uk/publications/bacpar-outcome-measure-toolbox-version-2>
- 9 Duncan PW, Jorgensen HS, Wade DT. Outcome Measures in Acute Stroke Trials: A Systematic Review and Some Recommendations to Improve Practice. *Stroke.* 2000; 31: 1429-1438.
- 10 Johanson NA, Liang MH, Daltroy L, et al. American Academy of Orthopaedic Surgeons lower limb outcomes assessment instruments. Reliability, validity, and sensitivity to change. *J Bone Joint Surg Am.* 2004;86-A(5):902-9.
- 11 McCarthy ML, Silberstein CE, Atkins EA, et al. Comparing reliability and validity of pediatric instruments for measuring health and well-being of children with spastic cerebral palsy. *Dev Med Child Neurol.* 2002;44(7):468-76.
- 12 Pencharz J, Young NL, Owen JL, et al. Comparison of three outcomes instruments in children. *J Pediatr Orthop.* 2001;21(4):425-32.
- 13 Stokes EK. Rehabilitation outcome measures. London: Churchill Livingstone Elsevier; 2010.

PROJECT OVERVIEW



WORKING GROUP

Joshua Young (Project Co-ordinator)	Orthotist, St Georges NHS Healthcare Trust, London	BAPO Professional Affairs Committee
Lynne Rowley (Survey Co-ordinator)	Orthotist, Team lead, Orthotics service, Stirling Community Hospital	BAPO Executive and Education Committees
Simon Lalor	Clinical Lead Orthotist, St Georges NHS Healthcare Trust, London	
Chris Cody	Senior Orthotist, St Georges NHS Healthcare Trust, London	
Howard Woolley	Prosthetist, Pace Rehabilitation	BAPO Education Committee

METHODS

The working group was formed in January 2014 with members of the BAPO Education and Professional Affairs Committees, with 2 additional members later recruited. At each stage, proposed methods and goals for the project were discussed and decided by consensus. Literature reviews were conducted on the selected OMs using Medline database and Google scholar. Relevant sections of the rehabmeasures.org website were searched for references. The process for the overall project is indicated below.

- Goals of project agreed first by working group, then BAPO Education and Professional Affairs Committees
- Survey devised, implemented and results undergo initial analysis
- OMs selected
- Literature reviews conducted on each OM
- Final document drafted by working group, including survey and review results
- Document approved by BAPO Education and Professional Affairs Committees

SUMMARY OF SURVEY RESULTS



METHOD

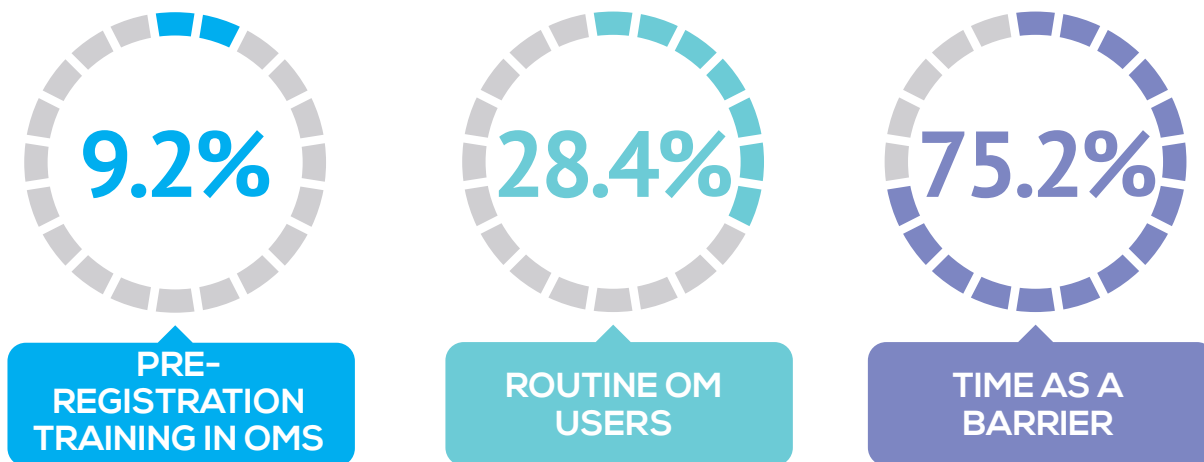
A national survey was conducted to establish current knowledge and usage of outcome measures by Prosthetists and Orthotists in the UK. Ethical approval is not required for research in the NHS recruiting professionals due to their role (National Research Ethics Service, 2012) and this was confirmed by the lead author's research governance office. The survey was completed by respondents online and ran for one month during July 2014, receiving 109 complete responses. Incomplete responses were excluded. There were 34 questions covering respondent characteristics (such as age, qualification, location & specialism), knowledge of OMs and use of OMs. A brief summary of the survey is presented here.

RESPONDENTS

The majority of respondents practiced in orthotics (57%), with 34% in prosthetics and 9% in dual practice. Reported specialities are shown in the table below. Most clinicians possessed a Bachelor's degree (65%), while 5% also held Master's degrees. The remaining 30% possessed other qualifications. A wide variety of clinical experience was reported, with the largest single group having practised for between 0-5 years (24%), while 5% reported more than 36 years' practice. Most were employed by commercial companies (58%), with 33% working directly for the NHS, and 10% reporting other arrangements. Clinicians from every area of the UK responded (with two responses from Republic of Ireland), although the largest groups were Scotland (17%), South East (16%), and London (16%).

Prosthetic / Orthotic Specialism	Percentage*
Diabetes	35
General orthotics	46
Musculoskeletal	36
Neurological conditions	34
Older people	19
Paediatrics	50
Spinal	18
Vascular	11
General prosthetics	32
Hip Disarticulation prosthetics	17
Lower Limb prosthetics	34
Upper Limb prosthetics	21
Other	4

*Combination of prosthetics, orthotics and dual practice, and multiple specialities, mean that the total percentage equals >100%.



CURRENT UNDERSTANDING OF OMS

Only a small number (9.2%) reported any training in OMs during their pre-registration education. 16 yes/no questions were asked concerning a) possible uses of OMs and b) terminology and statistical / validity issues. In each case 'correct' answers were pre-determined. The mean correct response rate was 81.7% for uses of OMs, but only 32.3% for terminology and statistical issues.

CURRENT USE OF OMS

Routine use of OMs was defined as those reporting use 'most of the time' or 'for every episode of care'. 28.4% reported routine use. A large number (75) of individual OMs were reported. The timed up and go (TUG), socket comfort score (SCS) and numeric pain rating scale (NRS-11) were the most commonly used. The TUG, NRS and 10 metre walk test (10MWT) were all used by Prosthetists, Orthotists and those in dual practice.

BARRIERS TO USE OF OMS

The main reported barriers to use of OMs were time limitations (75.2%), insufficient training in OMs (56.0%), and availability of clinical time for review appointments (46.8%). Only 10.0% of participants in services without routine reviews were routine OM users, while the figure for services with routine reviews was 36.8%.

CONCLUSION

OMs are currently used by Prosthetists and Orthotists, but few are routine users. Knowledge concerning statistical issues, which are necessary to both assess measures and interpret results, appears to be limited.

REFERENCES

National Research Ethics Service. Changes to the remit of Research Ethics Committees [Online document]. National Research Ethics Service, 2012. Available at: nres.nhs.uk/EasySiteWeb/GatewayLink.aspx?allId=134047



The term **Outcome Measure** refers to a tool or instrument that is used to evaluate the change in the health of an individual, group of people or population which is attributable to a particular health care intervention. With the move towards Evidence Based Practice in the health sciences field, objective measures of health care outcomes are important to provide credible and reliable justification for treatments and interventions. When selecting and using outcome measure there are many factors to consider:

1) RELIABILITY:

Does the outcome measure provide results that are the same or similar regardless of who or where the test is administered?

2) VALIDITY:

Has the outcome measure been shown to evaluate the particular aspect of body function & structure, activity, or participation that it is reported to test in that particular population of patients?

3) RESPONSIVENESS:

Is the outcome measure able to evaluate this change over time?

4) TEST-RETEST RELIABILITY:

Is the instrument or tool capable of measuring a variable with consistency?

5) INTER RATER RELIABILITY:

How much difference is there between the results of the outcome measure between two or more raters who measure the same group of subjects? The smaller the difference the better the inter rater reliability for that tool.

6) INTRA RATER RELIABILITY:

How large is the difference in the results recorded by one individual across two or more trials of the same measure in the same patient population? The smaller the difference, the better Intra Rater Reliability for that tool.

7) FLOOR EFFECTS:

Floor effects occur when a measure's lowest score is unable to assess a patient's level of ability. For example a measure that assesses a patient's quality of life may not be sensitive enough to assess low or intermittent levels of depression among patients.

8) CEILING EFFECTS:

Ceiling effects occur when a measure's highest score is unable to assess a patient's level of ability. This might be particularly common for measures used over multiple occasions. For example, a patient's pre-rehab score may be in-range at the initial evaluation, but the patient's ability exceeds the measure's highest score over time. Therefore, it is unable to accurately assess progress as the patient improves.

INTERPRETING THE RESULTS

When considering and interpreting the results of an outcome measure, it is important to take into account the following aspects:

RELIABILITY:

- Do I know the **Standard Error of Measurement (SEM)** detected with scores for this outcome measure in this patient population?

Even the most reliable outcome measures produce a certain amount of error in the results. The SEM enables us to estimate the range within which an accurate score sits. e.g. a 10m walking test for a patient who has had a stroke has a SEM of 1.4 seconds. The baseline result for a patient is 17 seconds. We can be 68% sure that the patient's true ability is reflected by a score of 17 seconds +/- 1.4 seconds (15.6-18.4s).

- Do I know the **minimum detectable change?**

The minimum detectable change (MDC) is the minimum amount of change in a patient's score that ensures the change isn't the result of measurement error.

VALIDITY:

- Does it measure what I want it to measure?

Before we employ any outcome measure, we need to ensure that the instrument is able to measure what we want it to. In the example above with the 10 metre walk test, it is a suitable test to evaluate the change observed for this patient in the ICF domain of activity. We cannot say that the results from this measure prove that a particular intervention has had an overall effect on the health of the patient, but it has shown a difference in the domain of activity. It is also crucial to ensure the measure has been validated for use in the patient population. If the measure is untested in the patient population, we cannot know if any difference observed is relevant.

RESPONSIVENESS:

- Is there a known **Minimum Clinically Important Difference (MCID)**?

The MCID is a published value of change in an instrument that indicates the minimum amount of change required to be considered clinically important, or for your patient to feel a real difference in the variable you are measuring. In the example above, if the MCID for the 10 metre walk test was 2.4 seconds, then even though there was a positive change of 1.8 seconds, it may not represent a change that was significant enough for the patient to register or feel.

FURTHER READING:

Stokes EK. Rehabilitation outcome measures. London: Churchill Livingstone Elsevier; 2010.

Robinson C, Fatone S. You've heard about outcome measures, so how do you use them? Integrating clinically relevant outcome measures in orthotic management of stroke. Prosthet Orthot Int. 2013;37(1):30-42.

Thomas JR, Nelson JK, Silverman SJ. Research Methods in Physical Activity. Illinois: Human Kinetics; 2005.

INTRODUCTION

Assessing an individual’s experience of pain and the influence of treatment on pain is a key clinical skill which can inform the formation of a management plan as well as assessing the effectiveness of an intervention. Assessing pain is a difficult task due to its highly subjective nature, and healthcare professionals have been shown to underrate patients’ pain^{9,25}. In the face of this complex task a single dimension of pain, pain intensity, is commonly used to assess pain.

TABLE 1 – GENERAL INFORMATION

Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Typically a question which is administered verbally by clinician. May be structured in a written format.	Patients are asked to rate their pain as a whole number on a scale between 0 and 10, where 0 is ‘no pain’ and 10 is ‘worst pain imaginable’ ¹⁶	None	Around 30 seconds	None

TERMINOLOGY

A numeric rating scale (NRS) can be used to rate pain intensity. When an 11-point (0-10) scale is used the scale is termed the NRS-11. Various similar names are used for this scale, such as numeric pain rating scale^{4, 8,17,26}, verbal numeric rating scale^{3,11}, and verbal numeric scale 1. However the terminology NRS is commonly used^{2,5,10,14,15,18,21,22,29} and was also used in the earliest reference to the scale which was identified during this review⁷. 15 different anchors have been used with numeric rating scales¹² e.g. for the extreme end terms include ‘worst pain imaginable’, ‘worst possible pain’, ‘the most intense pain imaginable’. While it is unclear if the anchors make a difference, we will recommend the use of the anchors ‘no pain’ (0/10) and ‘worst pain imaginable’ (10/10) after McCaffery and Beebe¹⁶.

REASONS FOR SELECTING THE NRS-11

Some general information is summarised below in table 1. The NRS-11 is quick and easy to administer and has been validated with a broad range of conditions including adult and paediatric populations (see table 2). It has been recommended over other measures of pain intensity due to factors including ease of use, compliance and responsiveness¹².

CORRELATION WITH THE VAS

The NRS-11 has been shown to strongly correlate with another common measure of pain intensity, the visual analogue scale (VAS)^{2,6,13,19,20,23,24,27,28}, but has not always been found to be interchangeable with the VAS^{1,5, 12}. The VAS is a 100mm line with text anchors at each end which is physically marked by the patient to indicate their pain intensity. It is scored in millimetres between 0 and 100.

USING NRS-11 WITH CHILDREN

The NRS-11 has been validated for use with children ^{1,3,5,18,21,29} although this is limited to studies considering acute pain. It may be reliable with children as young as six years old ³ however this may vary depending on the individual child. Children are reported to prefer the NRS-11 to the VAS ¹, but prefer the Faces Pain Scale Revised in comparison with numeric rating scales ²¹.

ASSESSING CHRONIC OR VARIABLE PAIN

Not all patients can easily describe their pain with a number. This is made more difficult when the pain is chronic and occurs in varying levels, or when pain varies according to activity level. To overcome these difficulties, multiple NRS-11 scores can be collected, corresponding to different times or activity levels, and averaged ^{17,14}. See below for some examples. Use of this technique may depend on whether the treatment goal is to reduce pain generally, or pain during certain activities.

- A patient reporting pain intensity during walking of 3/10, and during running of 4/10, could be assigned an average NRS-11 score of 3.5.
- Following initial assessment, a patient records the following NRS-11 scores daily for one week to give the clinician a picture of pain experienced over time (see below). An average score of 3.6 is then assigned as a baseline prior to commencing treatment.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
2	3	8	3	2	4	3

LIMITATIONS

If a patient is unable for any reason to rate pain using the NRS-11, other scales such as the VAS or descriptive pain scales may be considered.

USE AND INTERPRETATION SUMMARY

When using the NRS-11, the patient should be asked to rate their pain intensity using a whole number between 0 and 10, where 0 equals no pain and 10 equals the worst pain imaginable. If needed, multiple scores can be averaged. For example, maximum and minimum pain intensity over a set time period.

For a post treatment reduction in score to be considered clinically important, it should be a change of between 1 - 2.17 points or 15-36%.

CASE STUDY: NUMERIC RATING SCALE (NRS-11)



PATIENT BACKGROUND

A new patient attends for assessment. The diagnosis is midfoot osteoarthritis. She reports that the pain in her left midfoot is relatively constant during weightbearing, and during the last month has been 2/10 at minimum and 6/10 at maximum.

INTERVENTION:

A prefabricated foot orthosis (FO) is prescribed, and the patient is reviewed after 6 weeks.

OUTCOME MEASURE EMPLOYED:

The NRS-11 is ideal to use where the treatment goal is to reduce pain intensity. It most closely relates the ICF framework body functions: Sensation of pain (b280).

RECORDING RESULTS:

To record OM results, standard tables may be used (see below). Alternatively the results may be written into the clinical notes. In any case, details of the prosthetic / orthotic device, any walking aids, and OM must be included. For example “NRS-11 following 6 weeks pre-fabricated FO use = 1/10 minimum, 3/10 maximum”.

INTERPRETATION

In this case, the NRS-11 scores are averaged to account for the variability of the pain, giving a mean pre-intervention score of 4/10 (2+6/2) and a post-intervention score of 2/10 (1+3/2). This represents a percentage reduction of 2 points, or 50% (2/4). 2 points is at the upper range of published MCID values, and 50% exceeds the upper range of published % MCID values (see measure review tables). As a result, we can conclude that the intervention has resulted in a clinically significant improvement.

USE OF RESULTS

Clinical – these results support the intervention and provide a reference against which any future change in status might be compared.

Patient – these results may help the patient to communicate their current and future experience of pain with their Orthotist.

Audit and research – These results may be used for clinical audit, service review or retrospective research.

Date	01.07.2014	12.08.2014
	Assessment	Review appointment
Prescription:	None	Pre-fabricated foot orthosis
NRS-11	2/10 minimum during weight bearing 6/10 maximum during weight bearing	1/10 minimum during weight bearing 3/10 maximum during weight bearing

TABLE 2 – RELEVANT POPULATIONS AND LINKS WITH OTHER FRAMEWORKS

Prosthetics/orthotics	Adult/children	Conditions/populations	Anatomical region	ICF Domains	NHS Outcomes framework
Orthotics (could apply to prosthetics in some instances)	Adults ^{2,4,8,10,11,14,15,17,22,26} Children ^{1,3,5,18,21,29}	Acute pain ² Acute pain in children ^{1,3,5,18,21,29} Amputees ¹⁰ Arthritis ²² Chronic pain ^{8,14,22} Older people ¹¹ Spinal cord injury ¹⁰	Lower limb ^{22,26} Upper limb ^{17,22,26} Spinal ^{4,8,22,26}	Body functions: Sensation of pain (b280).	2: Enhancing quality of life for people with long-term conditions 3: Helping people to recover from episodes of ill health or following injury

TABLE 3 – STATISTICAL VALIDITY

Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Interrater/Intrater Reliability
1.02 ⁴	Overall ranges are 1-3 points or 27%. 2 points in low back pain ⁴ 3 points or 27% in neck, upper limb or lower limb pain ²⁶ 1 point in acute paediatric pain ¹	Overall ranges are 1-2.17 points or 15-36% reductions. 1.3-1.39 points in acute pain ^{2,15} 1.5 points after 1 week or 2.2 points after 4 weeks in low back pain ⁴ 1-1.7 points or 15-27.9% in chronic musculoskeletal pain including osteoarthritis and low back pain ^{8,22} 2.17 points when using mean NRS-11 score for 3 conditions of pain, in shoulder pain ¹⁷ 1.8 points or 36% in spinal cord injury and amputees ¹⁰	Not available	Unknown	100% interrater agreement with a written NRS ¹¹

REFERENCES

- 1 Bailey B, Daoust R, Doyon-Trottier E, et al. Validation and properties of the verbal numeric scale in children with acute pain. *Pain* 2010; 149:216-221
- 2 Bijur PE, Latimer CT and Gallagher EJ. Validation of a verbally administered numerical rating scale of acute pain for use in the emergency department. *Acad Emerg Med* 2003; 10(4): 390-392.
- 3 Castarlenas E, Miro J, Sanchez-rodriguez E, 2013. Is the Verbal Numerical Rating Scale a Valid Tool for Assessing Pain Intensity in Children Below 8 Years of Age? *The Journal of Pain*, 14:3, pp 297-304
- 4 Childs JD, Piva SR and Fritz JM. Responsiveness of the numeric pain rating scale in patients with low back pain. *Spine* 2005; 30(11): 1331-1334.
- 5 Connelly M and Neville K. Comparative prospective evaluation of the responsiveness of single-item pediatric pain intensity self-report scales and their uniqueness from negative affect in a hospital setting. *J Pain* 2010; 11:1451-1460.
- 6 DeLoach LJ, Higgins MS, Caplan AB, et al. The visual analog scale in the immediate postoperative period: intrasubjective variability and correlation with a numeric scale. *Anesth Analg* 1998;86:102-6.
- 7 Downie WW, Leatham PA, Rhind VM, et al. Studies with pain rating scales. *Ann Rheum Dis* 1978;37:378-381
- 8 Farrar JT, Young JP, Lamoreaux L, et al. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain* 2001; 94(2): 149-158.
- 9 Grossman SA, Sheidler VR, Swedeen K, et al. Correlation of patient and caregiver ratings of cancer pain. *J Pain Symptom Manage* 1991; 6, 53-57.
- 10 Hanley MA, Jensen MP, Ehde DM, et al. Clinically significant change in pain intensity ratings in persons with spinal cord injury or amputation. *Clin J Pain* 2006; 22(1): 25-31.
- 11 Herr KA, Spratt K, Mobily PR, et al. Pain intensity assessment in older adults: use of experimental pain to compare psychometric properties and usability of selected pain scales with younger adults. *Clin J Pain* 2004; 20(4): 207-219.
- 12 Hjermstad MJ, Fayers PM, Haugen DF, et al. Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. *J Pain Symptom Manage*. 2011 Jun;41(6):1073-93.
- 13 Holdgate A, Asha S, Craig J, et al. Comparison of a verbal numeric rating scale with the visual analog scale for the measurement of acute pain. *Emerg Med (Fremantle)*. 2003; 15:441-6.
- 14 Jensen MP and McFarland CA. Increasing the reliability and validity of pain intensity measurement in chronic pain patients. *Pain* 1993; 55(2): 195-203.
- 15 Kendrick D and Strout T. The minimum clinically significant difference in patient-assigned numeric scores for pain. *Am J Emerg Med* 2005; 23: 828 – 832.
- 16 McCaffery M, Beebe A. *Pain: Clinical Manual for Nursing Practice*. London: Mosby; 1994.
- 17 Michener L A, Snyder AR, Leggin BG. Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effect of surgical status. *J Sport Rehabil*. 2011; 20:1, 115-128.
- 18 Miro J, Castarlenas E and Huguet A. Evidence for the use of a numerical rating scale to assess the intensity of pediatric pain. *Eur J Pain* 2009; 13:1089-1095.
- 19 Murphy DF, McDonald A, Power C, et al. Measurement of pain: a comparison of the visual analogue with a nonvisual analogue scale. *Clin J Pain* 1988;3:197-9.
- 20 Ohnhaus E, Adler R. Methodological problems in the measurement of pain: A comparison between the verbal rating scale and the visual analogue scale. *Pain*. 1975; 1:4, 379-384.
- 21 Pagé MG, Katz J, Stinson J, et al. Validation of the numerical rating scale for pain intensity and unpleasantness in pediatric acute postoperative pain: Sensitivity to change over time. *J Pain* 2012; 13:359-369.
- 22 Salaffi F, Stancati A, Silvestri CA, et al. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. *Eur J Pain* 2004; 8(4): 283-291.
- 23 Singer AJ, Gulla J, Thode HC Jr. Parents and practitioners are poor judges of young children's pain severity. *Acad Emerg Med*. 2002; 9:609-12.
- 24 Singer AJ, Richman PB, Kowalska A, et al. Comparison of patient and practitioner assessments of pain from commonly performed emergency department procedures. *Ann Emerg Med*. 1999; 33:652-8.
- 25 Sloman R, Rosen G, Rom M, et al. Nurses' assessment of pain in surgical patients. *Journal of Advanced Nursing* 2005; 52(2), 125-132.
- 26 Stratford PW, Spadoni G. FEATURE ARTICLES-The reliability, consistency, and clinical application of a numeric pain rating scale. *Physiotherapy Canada* 2001; 53(2): 88-91.
- 27 Sutherland JE, Wesley RM, Cole PM, et al. Differences and similarities between patient and physician perceptions of patient pain. *Fam Med*. 1988; 20:345-6.
- 28 Thomas SH, Borczuk P, Shackelford J, et al. Patient and physician agreement on abdominal pain severity and need for opioid analgesia. *Am J Emerg Med*. 1999; 17:586-90.
- 29 Von Baeyer CL, Spagrud LJ, McCormick JC, et al. Three new datasets supporting use of the Numerical Rating Scale (NRS-11) for children's self reports of pain intensity. *Pain* 2009; 143:223-227.

SOCKET COMFORT SCORE (SCS)



INTRODUCTION

The fit and resultant comfort of a prosthetic socket is an important aspect of both the prosthesis function, and user experience. Socket fit is a common concern in prosthetic research^{1,5,6} and has been identified as an important issue to prosthesis users⁴. The Socket Comfort Score (SCS) is commonly used to assess socket comfort by asking the patient to score their socket comfort at different stages; for example before and after a socket alteration.

TABLE 1 – GENERAL INFORMATION

Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Patient reported outcome measure	'on a 0 – 10 scale, if 0 represents the most uncomfortable socket fit you can imagine, and 10 represents the most comfortable socket fit, how would you score the comfort of the socket fit of your artificial limb at the moment?' ³	None	< 5 minutes	Free

REASONS FOR SELECTING THE SCS

Some general information is summarised below in table 1. The SCS is quick and easy to administer and has been validated for use with lower limb amputees (see table 2).

NORMATIVE DATA

No normative data is available in the published literature. However data from an unpublished study⁷ is included in table 4. The study looks at average SCS scores for primary prosthetic patients, and scores for patients before and after prosthetic episodes of care, across 3 prosthetic centres. Over 2000 SCS scores are included.

LIMITATIONS

The SCS is extremely relevant to prosthetic practice. However, current validation is limited. Further validation with lower limb amputees is planned in a current study at Queen Margaret University, Edinburgh (PhD Research Project: Clinimetric Properties of Outcome Measures of Physical Function Used with Lower Limb Amputees, Study 2) which is due for completion in June 2015. The SCS has not been validated with upper limb prostheses or paediatric patients. However, it seems reasonable to use it cautiously for these purposes until validation is available. It is likely that for the SCS to be used reliably with children the minimum age would be 6 years old. This age has been identified as the minimum age to use the similar 11-point numeric rating scale for pain².

USE AND INTERPRETATION SUMMARY

When using the SCS, the patient should be asked 'on a 0 – 10 scale, if 0 represents the most uncomfortable socket fit you can imagine, and 10 represents the most comfortable socket fit, how would you score the comfort of the socket fit of your artificial limb at the moment?'

The minimal clinically important difference is currently unknown.

CASE STUDY: SOCKET COMFORT SCORE (SCS)



PATIENT BACKGROUND

An existing prosthetic patient attends the clinic reporting pain in her residual limb, and poor fit of the socket following recent changes in her weight.

INTERVENTION:

A temporary adjustment to the socket can be made to accommodate the change in limb volume and optimise distribution of pressure.

OUTCOME MEASURE EMPLOYED:

The SCS is designed specifically to measure change in socket comfort, which is the patient's goal for this episode of care. It is unclear where socket comfort sits in the ICF framework; the closest concept may be Body functions: Sensation of pain (b280). In this case the SCS can be used before and after the socket adjustment, and also compared to previous SCS scores.

RECORDING RESULTS:

To record OM results, standard tables may be used (see below). Alternatively the results may be written into the clinical notes. In any case, details of the prosthetic / orthotic device, any walking aids, and OM must be included. For example "Initial SCS in socket #1 while walking unaided = 5/10".

INTERPRETATION

In this case, the previous SCS score was 9/10. At presentation, the comfort had reduced to 5/10. Following the adjustment, the SCS improved to 8/10. Clearly when soft tissues have been subjected to increased stress, it will take time to see what the lasting effects of an alteration to the prosthetic socket are. Although no MCID value is available for the SCS, the improvement in score supports and quantifies the conclusion that the prosthetic episode of care has been successful. Ongoing review will be necessary to confirm this.

USE OF RESULTS

Clinical – these results support the intervention and provide a reference against which any future change in status might be compared.

Patient – these results may help the patient to communicate their current and future experience as a prosthetic user with their Prosthetist.

Audit and research – These results may be used for clinical audit, service review or retrospective research.

Date	03.09.2014	01.11.2014	01.11.2014
	(Previous review)	Review appointment - pre intervention	Review appointment - post intervention
Prescription:	PTB socket, no walking aid	PTB socket, no walking aid	PTB socket, no walking aid
SCS	9/10	5/10	8/10

TABLE 2 – RELEVANT POPULATIONS AND LINKS WITH OTHER FRAMEWORKS

Prosthetics/orthotics	Adult/children	Conditions/populations	Anatomical region	ICF Domains	NHS Outcomes framework
Prosthetics ³	Adults ³	Lower limb amputation ³	Lower limb ³	Unclear. Perhaps Body functions: Sensation of pain (b280) is the closest concept	2: Enhancing quality of life for people with long-term conditions

TABLE 3 – STATISTICAL VALIDITY

Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Interrater/ Intra-rater Reliability
Unknown	Unknown	Unknown	Some unpublished data available – see below	Unknown	Good inter rater reliability ³

TABLE 4 – NORMATIVE DATA⁷

Population	Mean SCS – primary patients	Mean SCS – pre episode of care	Mean SCS – post episode of care
Prosthetic Centre 1	7.0	6.0	8.1
Prosthetic Centre 2	7.3	5.2	8.3
Prosthetic Centre 3	8.3	4.8	7.7
All centres	7.2	5.6	8.0

REFERENCES

- 1 Åström I, Stenström A. Effect on gait and socket comfort in unilateral trans-tibial amputees after exchange to a polyurethane concept. *Prosthet Orthot Int.* 2004; 28:1, 28-36.
- 2 Castarlenas E, Miro J, Sanchez-rodriguez E. Is the Verbal Numerical Rating Scale a Valid Tool for Assessing Pain Intensity in Children Below 8 Years of Age? *The Journal of Pain.* 2013; 14:3, 297-304.
- 3 Hanspal RS, Fisher K, Nieveen R. Prosthetics socket fit comfort score. *Dis Rehabil.* 2003;25(22):1278-80.
- 4 Legro MW, Reiber G, del Aguila M, et al. Issues of importance reported by persons with lower limb amputations and prostheses. *J Rehabil Res Dev.* 1999 Jul;36(3):155-63.
- 5 Polliack AA, Sieh RC, Craig DD, et al. Scientific validation of two commercial pressure sensor systems for prosthetic socket fit. *Prosthet Orthot Int.* 2000; 24:1, 63-73.
- 6 Sewell P, Noroozi S, Vinney J et al. Developments in the trans-tibial prosthetic socket fitting process: A review of past and present research. *Prosthet Orthot Int.* 2000;24(2):97-107.
- 7 Ward C. National Review of Socket Comfort Scoring. *Opcare Annual Scientific Meeting.* Thursday 18 September 2014, Manchester.

TIMED UP AND GO (TUG)



INTRODUCTION

Assessing an individual's balance and mobility objectively may be done as part of an assessment, as well as for forming a baseline from which to measure change. Mobility is frequently correlated with other aspects of health, while poor balance may predict falls. The Timed Up and Go (TUG) is commonly used to assess balance and mobility. The TUG was developed as an extension of the Get Up and Go (GUG) measure originally developed by Mathias et al.²⁷ by adding a time component via Podsiadlo and Richardson³⁵.

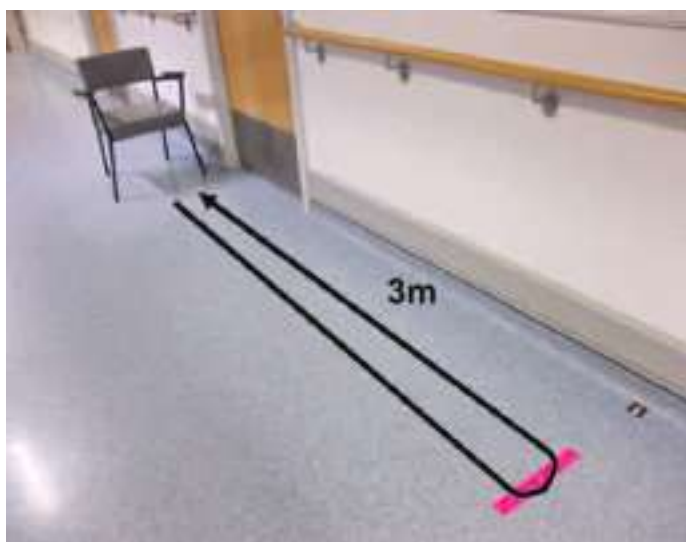


TABLE 1 – GENERAL INFORMATION

Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Clinician reported outcome measure	Patient starts sat in standard armchair (approximate seat height of 46cm) with arms on the arm rests, and any walking aid nearby. The patient is timed while standing, walking forwards 3 metres, turning, then returning to the chair and sitting down again. The patient is asked to walk at a comfortable and safe pace. No physical assistance is given, and the subject can use their normal footwear and walking aid as applicable (based on ³⁵)	Standard armchair (approximately 46 cm in height) and a stop watch. Space for a 3 metre walkway	< 5 minutes	Free

REASONS FOR SELECTING THE TUG

Some general information is summarised below in table 1. The TUG is quick and easy to administer and has been validated with a broad range of conditions including adult and paediatric populations (see table 2). It has been used in research to demonstrate improvements in ability following the use of orthotic devices, and when changing prosthetic prescription⁹.

ASSESSING MOBILITY WHICH IS VARIABLE

It is recommended that at any administration the TUG is repeated 3 times and an average score is calculated to maximise accuracy. This is especially important in patients whose walking ability is variable. Repeating the measure on multiple occasions even when the prosthetic/orthotic prescription has not changed may also be useful for the same reason.

USE AND INTERPRETATION SUMMARY

When using the TUG, the patient should be seated in standard armchair (approximate seat height of 46cm) with arms on the arm rests, and any walking aid nearby. The test should then be explained and demonstrated, before timing the time taken for the patient to stand, walk forwards 3 metres at a comfortable pace, turn, and then return to the chair and sit down again. No physical assistance is given, and the subject can use their normal footwear and walking aid as applicable.

For a change in score to be considered significant, it should be a change of between 2.9-11 seconds or 23-30%.

CASE STUDY: TIMED UP AND GO (TUG)



PATIENT BACKGROUND

A 40 year old male with a trans-femoral amputation is attending a prosthetic clinic to trial a new prosthetic knee. The patient is mainly a limited community ambulator but sometimes feels unstable with his current prosthetic knee. His goal is to increase knee stability to improve his walking.

PROSTHETIC PRESCRIPTION:

A prosthetic knee ('Knee 2') with microprocessor control is being trialled in the clinic today. The patient will then take the device home for a 1 week trial prior to any change in prescription.

OUTCOME MEASURE EMPLOYED:

To measure the stated goal of improving walking ability (ICF activities domain), the TUG may be appropriate, although other measures including the 10MWT could also be used. In this case the measure is used at assessment, fitting, and review.

RECORDING RESULTS:

To record OM results, standard tables may be used (see below). Alternatively the results may be written into the clinical notes. In any case, details of the prosthetic / orthotic device, any walking aids, and OM must be included. For example at assessment "TUG with Knee 1 = 15.0 seconds".

Date	01.08.2014		18.08.2014		25.08.2014	
	Assessment		Fitting		Review	
Prescription: Old knee – Knee 1 New knee – Knee 2	Knee 1	-	Knee 1	Knee 2	Knee 1	Knee 2
TUG (seconds)	15.0s	-	14.7s	13.2s	-	11.1s

INTERPRETATION

In this case, a score for the established knee 1 can be calculated from an average of the assessment and fitting scores ($15.0 + 14.7 / 2 = 14.85$). If this is compared to the score for the new knee 2 following one week of acclimatisation (11.1) then a decrease in time of 3.75s is concluded. This is more than the minimal detectable change of 3.6s for lower limb amputation (see measure review tables) meaning that we can conclude that this is a genuine change which has been observed.

USE OF RESULTS

Clinical – these results support the proposed change to the new prosthetic knee and provide a reference against which any future change in status might be compared.

Patient – these results can demonstrate the effects of treatment to the patient, enabling them to make a more informed decision. The positive results may also be encouraging to the patient.

Funding issues – demonstrating the results of expensive prosthetic components is sometimes necessary to secure funding for them. In addition to literature which may show the benefit of a specific intervention to general patient groups, these results indicate that the prescription is also beneficial in this individual case.

Audit and research – These results may be used for clinical audit, service review or retrospective research.

TABLE 2 – RELEVANT POPULATIONS AND LINKS WITH OTHER FRAMEWORKS

Prosthetics/orthotics	Adult/children	Conditions/populations	Anatomical region	ICF Domains	NHS Outcomes framework
Prosthetics ^{14,36,41} & Orthotics ^(various)	Adults ^{1-18,20-50,52} Children ^{19,51}	<ul style="list-style-type: none"> • Acute medical patients^{1,6,12} • Alzheimer's disease³⁷ • Cerebral palsy⁵¹ • Older people^{5,6,12,21,24,27,29,33,35,42,45,47,49,53} • Children⁵¹ • Lower limb amputations^{14,36,41} • Multiple Sclerosis³¹ • Osteoarthritis^{34,52} • Parkinson's^{3,8,11,13,16,18,20,25,28,32,38-40,44,46} • Rheumatoid Arthritis^{34,52} • Spinal cord injury^{22,23,48} • Stroke^{1,15,21,30} • Vestibular disorders^{4,7,10,17,26,50} 	Not applicable	Activities: Standing (d4104), Walking short distances (d4500) Sitting (d4103)	2: Enhancing quality of life for people with long-term conditions 3: Helping people to recover from episodes of ill health or following injury

TABLE 3 – STATISTICAL VALIDITY

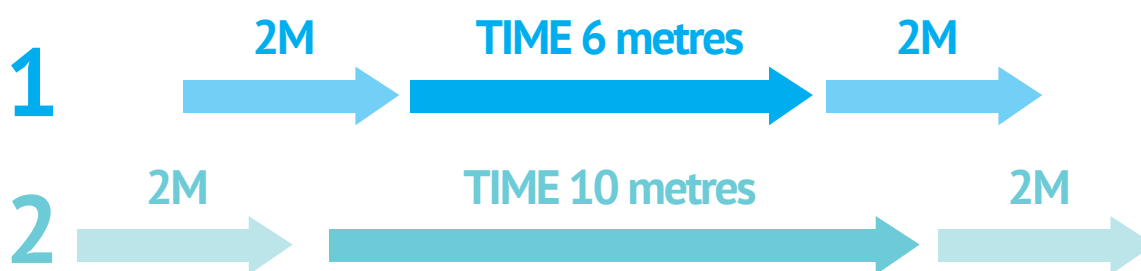
Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Interrater/ Intra-rater Reliability
1.14s in Stroke ¹⁵ 1.75s in Parkinson's ¹¹ 3.9s in Spinal cord injury ²²	Overall ranges are 2.9-11 seconds or 23-30%. 4.09s in Alzheimer's ³⁷ 3.60s in Lower limb amputation ³⁶ 2.9s in Stroke ¹⁵ . Smallest Real Difference (SRD) = 23% 3.5-11s in Parkinsons Disease ^{11,18,44} Smallest Real Difference (SRD) = 10.8 seconds, or 30%, in Spinal Cord Injury ²²	Unknown	Not available	Poor floor effects in older people (25-29.3%) ^{12,38}	Excellent ^{5,28,33,34,39,43,47,50}

REFERENCES

- 1 Andersson AG, Kamwendo K, Seiger A, et al. How to identify potential fallers in a stroke unit: validity indexes of 4 test methods. *J Rehabil Med.* 2006; 38(3): 186-191.
- 2 Bohannon RW. Reference Values for the Timed Up and Go Test: A Descriptive Meta Analysis. *Journal of geriatric physical therapy* 2006; 29:2, 64-68.
- 3 Balash Y, Peretz C, Leibovich G, et al. Falls in outpatients with Parkinson's disease: frequency, impact and identifying factors. *J Neurol.* 2005; 252:11, 1310-1315.
- 4 Bennie S, Bruner K, et al. Measurements of balance: comparison of the Timed "Up and Go" test and Functional Reach test with the Berg Balance Scale. *Journal of Physical Therapy Science,* 2003;15:2, 93-97.
- 5 Bhatt T, Espy D, Yang F, et al. Dynamic gait stability, clinical correlates, and prognosis of falls among community-dwelling older adults. *Arch Phys Med Rehabil.* 2011; 92:5, 799-805.
- 6 Brooks D, Davis AM, Naglie G. Validity of 3 physical performance measures in inpatient geriatric rehabilitation. *Arch Phys Med Rehabil.* 2006; 87:1, 105-110.
- 7 Brown KE, Whitney SL, Wrisley DM, et al. Physical therapy outcomes for persons with bilateral vestibular loss. *Laryngoscope.* 2001; 111:10, 1812-1817.
- 8 Brusse KJ, Zimdars S, Zalewski KR, et al. Testing functional performance in people with Parkinson disease. *Phys Ther.* 2005; 85(2): 134-141.
- 9 Burnfield JM, Eberly VJ, Gronely JK, et al. Impact of stance phase microprocessor-controlled knee prosthesis on ramp negotiation and community walking function in K2 level transfemoral amputees. *Prosthet Orthot Int.* 2012;36:95.
- 10 Caixeta GC, Doná F, Gazzola JM. Cognitive processing and body balance in elderly subjects with vestibular dysfunction. *Braz J Otorhinolaryngol.* 2012;78:2, 87-95.
- 11 Dal Bello-Haas V, Klassen L, Sheppard MS, et al. Psychometric Properties of Activity, Self-Efficacy, and Quality-of-Life Measures in Individuals with Parkinson Disease. *Physiother Can.* 2011; 63:1, 47-57.
- 12 de Morton NA, Berlowitz DJ, Keating JL. A systematic review of mobility instruments and their measurement properties for older acute medical patients. *Health Qual Life Outcomes.* 2008;6:44.
- 13 Dibble LE, Lange M. Predicting falls in individuals with Parkinson disease: a reconsideration of clinical balance measures. *J Neurol Phys Ther.* 2006; 30:2, 60-67.
- 14 Dite W, Connor HJ, Curtis HC. Clinical identification of multiple fall risk early after unilateral transtibial amputation. *Arch Phys Med Rehabil.* 2007; 88:1, 109-114.
- 15 Flansbjerg UB, Holmback AM, Downham D, et al. Reliability of gait performance tests in men and women with hemiparesis after stroke. *J Rehabil Med.* 2005; 37:2, 75-82.
- 16 Foreman KB, Addison O, Kim HS, et al. Testing balance and fall risk in persons with Parkinson disease, an argument for ecologically valid testing. *Parkinsonism Relat Disord.* 2011;17:3, 166-171.
- 17 Gill-Body KM, Beninato M, Krebs DE. Relationship among balance impairments, functional performance, and disability in people with peripheral vestibular hypofunction. *Phys Ther.* 2000; 80:8, 748-758.
- 18 Huang SL, Hsieh CL, Wu RM, et al. Minimal detectable change of the timed "up & go" test and the dynamic gait index in people with Parkinson disease. *Phys Ther.* 2011; 91:1, 114-121.
- 19 Katz-Leurer M, Rotem H, Lewitus H, et al. Functional balance tests for children with traumatic brain injury: within-session reliability. *Pediatr Phys Ther.* 2008;20:3, 254-258.
- 20 Kerr G, Worringham C, Cole MH, et al. Predictors of future falls in Parkinson disease. *Neurology.* 2010;75:2, 116-124.
- 21 Knorr S, Brouwer B, Garland SJ. Validity of the Community Balance and Mobility Scale in community-dwelling persons after stroke. *Arch Phys Med Rehabil.* 2010; 91:6, 890-896.
- 22 Lam T, Noonan VK, Eng JJ. A systematic review of functional ambulation outcome measures in spinal cord injury. *Spinal Cord.* 2008;46:4, 246-254.
- 23 Lemay JF, Nadeau S. Standing balance assessment in ASIA D paraplegic and tetraplegic participants: concurrent validity of the Berg Balance Scale. *Spinal Cord.* 2010; 48:3, 245-250.
- 24 Lin MR, Hwang HF, Hu MH, et al. Psychometric comparisons of the timed up and go, one-leg stand, functional reach, and Tinetti balance measures in community-dwelling older people. *J Am Ger Soc.* 2004; 52:8, 1343-1348.
- 25 Mak MK, Pang MY. Balance confidence and functional mobility are independently associated with falls in people with Parkinson's disease. *Journal of neurology.* 2009; 256:5, 742-749.
- 26 Marchetti GF, Whitney SL, Redfern MS, et al. Factors associated with balance confidence in older adults with health conditions affecting the balance and vestibular system. *Arch Phys Med Rehabil.* 2011; 92:11, 1884-1891.
- 27 Mathias S, Nayak U, Isaacs B. Balance in elderly patients: the "get-up and go" test. *Arch Phys Med Rehabil.* 1986;67:6, 387.
- 28 Morris S, Morris ME, Lansek R. Reliability of measurements obtained with the Timed "Up & Go" test in people with Parkinson disease. *Phys Ther.* 2001;81:2, 810-818.

- 29 Nemmers TM, Miller JW. Factors influencing balance in healthy community-dwelling women age 60 and older. *J Geriatr Phys Ther.* 2008;31:3,93-100.
- 30 Ng SS, Hui-Chan CW. The timed up & go test: its reliability and association with lower-limb impairments and locomotor capacities in people with chronic stroke. *Arch Phys Med Rehabil.* 2005;86:8,1641-1647.
- 31 Nilsagard Y, Lundholm C, Gunnarsson G, et al. Clinical relevance using timed walk tests and 'timed up and go' testing in persons with multiple sclerosis. *Physiotherapy Research International.* 2007; 12:2, 105-114.
- 32 Nocera J, Stegemöller EL, et al. Using the Timed Up and Go Test in a Clinical Setting to Predict Falling in Parkinson's Disease. *Arch Phys Med Rehabil.* 2013.
- 33 Nordin E, Rosendahl E, Lundin-Olsson L. Timed "Up & Go" test: reliability in older people dependent in activities of daily living-focus on cognitive state. *Phys Ther.* 2006; 86:5,646-655.
- 34 Norén AM, Bogren U, Bolin J, et al. Balance assessment in patients with peripheral arthritis: applicability and reliability of some clinical assessments. *Physiotherapy Research International* 6.4 (2001): 193-204.
- 35 Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc.* 1991;39:2,142-148.
- 36 Resnik L, Borgia M. Reliability of outcome measures for people with lower-limb amputation: distinguishing true change from statistical error. *Phys Ther.* 2011; 91:4, 1-11.
- 37 Ries J, Echtermach J, Gagnon Blodgett M. Test-retest reliability and minimal detectable change scores for the timed "up & go" test, the six-minute walk test, and gait speed in people with Alzheimer disease. *Phys Ther.* 2009; 89:6,569-79.
- 38 Rockwood K, Awalt E, Carver D, et al. Feasibility and measurement properties of the functional reach and the timed up and go tests in the Canadian study of health and aging. *J Gerontol A Biol Med Sci.* 2000;55A:M70-3.
- 39 Schenkman M, Cutson TM, Kuchibhatla M, et al. Application of the continuous scale physical functional performance test to people with Parkinson disease. *Journal of Neurologic Physical Therapy.* 2002; 26:3, 130.
- 40 Schenkman M, Ellis T, Christiansen C, et al. Profile of functional limitations and task performance among people with early-and middle-stage Parkinson disease. *Physical therapy.* 2011; 91:9, 1339-1354.
- 41 Schoppen T, Boonstra A, Groothoff JW, et al. The Timed "up and go" test: reliability and validity in persons with unilateral lower limb amputation. *Arch Phys Med Rehabil.* 1999; 80:7, 825-828.
- 42 Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. *Phys Ther.* 2000; 80:9, 896-903.
- 43 Siggeirsdottir K, Jonsson BY, Jónsson H Jr, et al. The timed 'Up & Go' is dependent on chair type. *Clin Rehabil.* 2002;16:6,609-616.
- 44 Steffen T, Seney M. Test-retest reliability and minimal detectable change on balance and ambulation tests, the 36-item short-form health survey, and the unified Parkinson disease rating scale in people with parkinsonism. *Phys Ther.* 2008; 88:6, 733-746.
- 45 Steffen TM, Hacker TA, Mollinger L. Age and gender-related test performance in community-dwelling elderly people: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and gait speeds. *Phys Ther.* 2002; 82:2, 128-137.
- 46 Tanji H, Gruber-Baldini AL, Anderson KE, et al. A comparative study of physical performance measures in Parkinson's disease. *Mov Disord.* 2008; 23:13, 1897-1905.
- 47 Thomas JI, Lane JV. A pilot study to explore the predictive validity of 4 measures of falls risk in frail elderly patients. *Arch Phys Med Rehabil.* 2005; 86:8, 1636-1640.
- 48 van Hedel HJ, Wirz M, Dietz V. Assessing walking ability in subjects with spinal cord injury: validity and reliability of 3 walking tests. *Arch Phys Med Rehabil.* 2005; 86:2, 190-196.
- 49 Whitney JC, Lord SR, Close JC. Streamlining assessment and intervention in a falls clinic using the Timed Up and Go Test and Physiological Profile Assessments. *Age Ageing.* 2005;34:6, 567-571.
- 50 Whitney SL, Marchetti GF, Schade A, et al. The sensitivity and specificity of the Timed "Up & Go" and the Dynamic Gait Index for self-reported falls in persons with vestibular disorders. *J Vestib Res.* 2004; 14:5, 397-409.
- 51 Williams EN, Carroll SG, Reddihough DS, et al. Investigation of the timed 'up & go' test in children. *Dev Med Child Neurol.* 2005; 47:08, 518-524.
- 52 Wright AA, Cook CE, Baxter GD, et al. A comparison of 3 methodological approaches to defining major clinically important improvement of 4 performance measures in patients with hip osteoarthritis. *J Orthop Sports Phys Ther.* 2011; 41:5, 319-327.
- 53 Wrisley DM, Kumar NA. Functional gait assessment: concurrent, discriminative, and predictive validity in community-dwelling older adults. *Phys Ther.* 2010; 90:5, 761-773

10 METRE WALK TEST (10MWT)



INTRODUCTION

Assessing an individual's walking speed objectively may be done as part of an assessment, as well as for forming a baseline from which to measure change. In populations such as older people and people with neurological conditions, walking speed can be predictive of general mobility^{8,9,22}. Increasing walking velocity can also be associated with improved function and quality of life²⁷. The 10 Metre Walk Test (10MWT) is commonly used to assess walking speed. The 10MWT has been used in various formats by different authors, but always essentially measures walking velocity over a short distance. Self selected walking speed is usually measured, but fastest safely possible speed may also be measured.

TABLE 1 – GENERAL INFORMATION

Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Clinician reported outcome measure	<p>The 10MWT can be performed at preferred walking speed or fastest speed possible. Assistive devices can be used and must be documented from test to test.</p> <p>Method 1: Subject walks 10 metres and the time is measured for the central 6 meters to allow for acceleration and deceleration. Timing starts when the toes of the leading foot cross the 2 metre mark. Timing is stopped when the toes of the leading foot cross the 8 meter mark. Velocity is calculated for the 6 metre distance.</p> <p>Method 2: Subject walks 14 meters. A 2m "flying start" is used. Timing starts when the toes of the leading foot cross the 2 meter mark. Timing is stopped when the toes of the leading foot cross the 12 metre mark. The walking speed is calculated for the central 10 metres²⁴.</p>	A walkway of at least 10 metres (method 1) or 14 metres (method 2). Stop watch	< 5 minutes	Free

REASONS FOR SELECTING THE 10MWT

Some general information is summarised below in table 1. The 10MWT is quick and easy to administer and has been validated with a broad range of conditions including adult and paediatric populations (see table 2).

ASSOCIATION BETWEEN 10MWT AND AMBULATORY STATUS

Walking speed has been used to predict ambulatory status in post stroke patients using cut off scores as follows: <0.4 m/s = household ambulator, 0.4-0.8 m/s = limited community ambulator, and >0.8 m/s community ambulator³.

ASSESSING MOBILITY WHICH IS VARIABLE

It is recommended that the 10MWT is repeated 3 times and an average score is calculated to maximise accuracy. This is especially important in patients whose walking ability is variable. It is also preferable to repeat the test at every patient contact where possible which may reveal variation due to factors such as fatigue or condition status.

USE AND INTERPRETATION SUMMARY

When using the 10MWT, the patient should be instructed to walk at their own comfortable pace (or alternatively as fast as safely possible). A 2 metre 'run up' is allowed and the time taken to walk 6 metres (method 1) or 10 metres (method 2) is then timed, using the times at which the toes cross the start and end lines. The walking speed (metres per second) should then be calculated by dividing the distance travelled by the time.

For a post treatment reduction in score to be considered clinically important, it should be a change of between 0.06-0.25 m/s.

CASE STUDY: 10 METRE WALK TEST (10MWT)



PATIENT BACKGROUND

50 year old female, currently an inpatient following a cerebrovascular accident (CVA) 6 weeks ago, resulting in left hemiplegia. Following several weeks' rehabilitation the physiotherapy team report that she can walk approximately 10-15 metres with the aid of a single quad stick and assistance of one person just to her side. Her main goal for orthotic treatment is to improve her walking ability.

ORTHOTIC PRESCRIPTION:

Custom rigid/solid Ankle Foot Orthosis (AFO)

OUTCOME MEASURE EMPLOYED:

To measure the stated goal of improving walking ability (ICF activities domain), the 10MWT may be appropriate, although other measures including the TUG could also be used. In this case the measure is used at assessment, fitting, and review.

RECORDING RESULTS:

To record OM results, standard tables may be used (see below). Alternatively the results may be written into the clinical notes. In any case, details of the prosthetic / orthotic device, any walking aids, and OM must be included. For example "10MWT barefoot with quad stick = 24.0 seconds (speed = 0.42 m/s)". Note that for the 10MWT, speed as well as time is stated as different methods of administering the test will require different calculation to get the speed. For method 1 the calculation would be "6/24.0", as 6 metres is timed, while for method 2 the calculation would be "10/24.0" as 10 metres is timed. In this case, method 2 has been used.

INTERPRETATION

In this case, interpreting the results is potentially complex as both recovery and orthotic treatment may influence the outcome. We can see that between assessment and review the barefoot 10MWT changes from 24.0s (0.42m/s) to 19.2s (0.52m/s). This represents an increase in velocity of 0.10m/s. We would conclude that this is a clinically important change, as MCID is reported as 0.06-0.14 m/s for CVA. This change may be attributable to recovery and the inpatient rehabilitation programme. In this case there is a larger increase in velocity of 0.37m/s associated with AFO use, looking at velocity with (10/11.2 = 0.89m/s) and without (10/19.2 = 0.52m/s) at review. We would again conclude that this is a clinically important change. In fact, as velocity increases beyond 0.8m/s, this potentially represents a change from being a limited community ambulator to a community ambulator given published cut off scores (see measure review).

USE OF RESULTS

Clinical – these results support the orthotic intervention and provide a reference against which any future change in status might be compared.

Patient – these results can demonstrate the effects of treatment to the patient, enabling them to make a more informed choice concerning their use of the orthoses. The positive results may also be encouraging to the patient.

Multidisciplinary team – results can be included in communication with referrers and the wider team, giving them better information on the outcome of treatment.

Audit and research – These results may be used for clinical audit, service review or retrospective research.

Date	01.08.2014		18.08.2014		29.09.2014	
	Assessment		Fitting		Review/Discharge	
Prescription: Rigid AFO, quad stick	Without	With	Without	With	Without	With
10 MWT (seconds)	24.0s (0.42m/s)		22.8s (0.44m/s)	19.3s (0.52m/s)	19.2s (0.52m/s)	11.2s (0.89m/s)

TABLE 2 – RELEVANT POPULATIONS AND LINKS WITH OTHER FRAMEWORKS

Prosthetics/orthotics	Adult/children	Conditions/populations	Anatomical region	ICF Domains	NHS Outcomes framework
Prosthetics ^{1,34} & Orthotics ⁴⁰	<ul style="list-style-type: none"> • Adults^{1-22,26-41} • Children^{23,25,34} 	<ul style="list-style-type: none"> • Children with neurological conditions^{23,34} • Older people^{8,21} • Neurological conditions^{25,34,38} • Hip fracture^{10,13} • Lower limb amputation^{1,32} • Multiple Sclerosis²⁰ • Parkinson's disease^{26,31} • Spinal cord injury^{4,5,11-14,18,19,28,35-38} • Stroke^{3,6,7,15,22,27,29,30,33,42} • Traumatic brain injury^{16,39} 	Lower limb ¹⁻⁴²	Activities Walking short distances (d4500)	2: Enhancing quality of life for people with long-term conditions 3: Helping people to recover from episodes of ill health or following injury

TABLE 3 – STATISTICAL VALIDITY

Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Interrater/ Intra-rater Reliability
Overall range 0.03-0.06 m/s	Overall range 0.05-0.18 m/s	Overall range 0.06-0.25 m/s	1.27 – 1.46 m/s comfortable walking in healthy adults, 1.93 – 2.53 fast walking in healthy adults ² (see table 4 below)	None identified	Excellent ^{6,28,34,37,42}
0.06 m/s in Older people ²¹	0.17 m/s in Hip fracture ^{10,13}	0.13 m/s in Older people ²¹	1.3 m/s for unilateral tran-tibial amputees, 1.0 m/s for bilateral tran-tibial amputees ¹		
0.03 m/s in Hip fracture ¹⁰	0.18 m/s in Parkinson's disease ³¹	0.06 m/s in SCI ^{12,18}			
0.05m/s in SCI ^{4,7,17,37}	0.13 m/s in Spinal cord injury ⁵	0.06-0.14 m/s in Stroke ^{21,33}			
0.04m/s in Stroke ²¹	0.05 m/s in Traumatic brain injury ⁴¹	0.15-0.25 m/s in TBI ^{39,41}			

TABLE 4 – NORMATIVE DATA FOR HEALTHY ADULTS²

Age	Men	Men	Women	Women
	Self selected speed (m/s)	Fast speed (m/s)	Self selected speed (m/s)	Fast speed (m/s)
20-29	1.39	2.53	1.41	2.47
30-39	1.46	2.45	1.42	2.34
40-49	1.46	2.46	1.39	2.12
50-59	1.39	2.07	1.40	2.01
60-69	1.36	1.93	1.30	1.77
70-79	1.33	2.08	1.27	1.74

REFERENCES

- 1 Akarsu S, Tekin L, Safaz I, et al. Quality of life and functionality after lower limb amputations: comparison between uni vs. bilateral amputee patients. *Prosthet Orthot Int.* 2013; 37:1, 9-13.
- 2 Bonhannon RW. Comfortable and maximum walking speed of adults aged 20-79 years: reference values and determinants. *Age Ageing.* 1997; 26:1, 15-19.
- 3 Bowden M, Balasubramanian C, Behrman AL. Validation of a speed-based classification system using quantitative measures of walking performance poststroke. *Neurorehabil Neural Repair.* 2008; 22:6, 672.
- 4 Bowden MG, Behrman AL. Step Activity Monitor: accuracy and test-retest reliability in persons with incomplete spinal cord injury. *J Rehabil Res Dev.* 2007; 44:3, 355-362.
- 5 Burns AS, Delparte JJ, Patrick M. The reproducibility and convergent validity of the walking index for spinal cord injury (WISCI) in chronic spinal cord injury. *Neurorehabil Neural Repair.* 2011; 25:2, 149-157.
- 6 Collen F, Wade D, Bradshaw CM. Mobility after stroke: reliability of measures of impairment and disability. *Int Disabil Stud.* 1990; 12:1, 6-9.
- 7 Flansbjerg UB, Holmback AM, Downham D, et al. Reliability of gait performance tests in men and women with hemiparesis after stroke. *J Rehabil Med.* 2005; 37:2, 75-82.
- 8 Fritz S, Lusardi M. White paper: "walking speed: the sixth vital sign". *Journal of geriatric physical therapy.* 2009; 32:2, 2-5.
- 9 Guralnik JM, Ferrucci L, Pieper CF, et al. Lower Extremity Function and Subsequent Disability: Consistency Across Studies, Predictive Models, and Value of Gait Speed Alone Compared With the Short Physical Performance Battery. *J Gerontol A Biol Sci Med Sci.* 2000; 55:4, 221-231.
- 10 Hollman JH, Beckman BA, Brandt RA, et al. Minimum detectable change in gait velocity during acute rehabilitation following hip fracture. *J Geriatr Phys Ther.* 2008; 31:2, 53-56.
- 11 Jackson AB, Carnel CT, Ditunno JF, et al. Outcome measures for gait and ambulation in the spinal cord injury population. *J Spinal Cord Med.* 2008; 31:5, 487-499.
- 12 Lam T, Noonan V, Eng JJ. A systematic review of functional ambulation outcome measures in spinal cord injury. *Spinal Cord.* 2007; 46:4, 246-254.
- 13 Latham N, Mehta V, Nguyen AM, et al. Performance-based or self-report measures of physical function: which should be used in clinical trials of hip fracture patients? *Arch Phys Med Rehabil.* 2008; 89:11, 2146-2155.
- 14 Lemay JF, Nadeau S. Standing balance assessment in ASIA D paraplegic and tetraplegic participants: concurrent validity of the Berg Balance Scale. *Spinal Cord.* 2010; 48:3, 245-250.
- 15 Lin JH, Hsu MJ, et al. Psychometric comparisons of 3 functional ambulation measures for patients with stroke. *Stroke.* 2010; 41:9, 2021-2025.
- 16 Moseley AM, Lanzarone S, Bosman JM, et al. Ecological validity of walking speed assessment after traumatic brain injury: a pilot study. *J Head Trauma Rehabil.* 2004; 19:4, 341-348.
- 17 Musselman K. Clinical significance testing in rehabilitation research: what, why, and how? *Physical Therapy Reviews.* 2007; 12:4, 287-296.
- 18 Musselman KE, Fouad K, Misiaszek JE, et al. Training of walking skills overground and on the treadmill: case series on individuals with incomplete spinal cord injury. *Phys Ther.* 2009; 89:6, 601-611.
- 19 Olmos LE, Freixes O, Gatti MA, et al. Comparison of gait performance on different environmental settings for patients with chronic spinal cord injury. *Spinal Cord.* 2008; 46:5, 331-334.
- 20 Paltamaa J, Sarasoja T, Leskinen E, et al. Measures of physical functioning predict self-reported performance in self-care, mobility, and domestic life in ambulatory persons with multiple sclerosis. *Arch Phys Med Rehabil.* 2007; 88:12, 1649-1657.
- 21 Perera S, Mody S, Woodman RC, et al. Meaningful change and responsiveness in common physical performance measures in older adults. *J Am Geriatr Soc.* 2006; 54:5, 743-749.
- 22 Perry J, Garrett M, Gronley JK, et al. Classification of walking handicap in the stroke population. *Stroke.* 1995; 26:6, 982.
- 23 Pirpiris M, Wilkinson AJ, Rodda J, et al. Walking speed in children and young adults with neuromuscular disease: comparison between two assessment methods. *J Pediatr Orthop.* 2003; 23:3, 302.
- 24 Rehab measures. 10 Meter Walk Test. <http://www.rehabmeasures.org/PDF%20Library/10%20Meter%20Walk%20Test%20Instructions.pdf> (Accessed 29th August 2014)

- 25 Reuben DB, Magasi S, McCreath HE, et al. Motor assessment using the NIH Toolbox. *Neurology*. 2013; 80:11, S65-S75.
- 26 Schenkman M, Cutson TM, Kuchibhatla M, et al. Reliability of impairment and physical performance measures for persons with Parkinson's disease. *Phys Ther*. 1997; 77:1, 19-27.
- 27 Schmid A, Duncan P, Studenski S, et al. Improvements in speed-based gait classifications are meaningful. *Stroke*. 2007; 38:7, 2096.
- 28 Scivoletto G, Tamburella F, Laurenza L, et al. Validity and reliability of the 10-m walk test and the 6-min walk test in spinal cord injury patients. *Spinal Cord*. 2011; 49:6, 736-740.
- 29 Severinsen K, Jakobsen JK, et al. Normalized muscle strength, aerobic capacity, and walking performance in chronic stroke: a population-based study on the potential for endurance and resistance training. *Arch Phys Med Rehabil*. 2011; 92:10, 1663-1668.
- 30 Smania N, Picelli A, Gandolfi M, et al. Rehabilitation of sensorimotor integration deficits in balance impairment of patients with stroke hemiparesis: a before/after pilot study. *Neurol Sci*. 2008; 29:5, 313-9
- 31 Steffen T, Seney M. Test-retest reliability and minimal detectable change on balance and ambulation tests, the 36-item short-form health survey, and the unified Parkinson disease rating scale in people with parkinsonism. *Phys Ther*. 2008; 88:6, 733-746.
- 32 Tekin L, Safaz Y, Göktepe AS, et al. Comparison of quality of life and functionality in patients with traumatic unilateral below knee amputation and salvage surgery. *Prosthet Orthot Int*. 2009; 33:1, 17-24.
- 33 Tilson JK, Sullivan KJ, Cen SY, et al. Meaningful gait speed improvement during the first 60 days poststroke: minimal clinically important difference. *Phys Ther*. 2010; 90:2, 196-208.
- 34 Tyson S, Connell L. The psychometric properties and clinical utility of measures of walking and mobility in neurological conditions: a systematic review. *Clin Rehabil*. 2009; 23:11, 1018-1033.
- 35 van Hedel H, Wirz M, Curt A. Improving walking assessment in subjects with an incomplete spinal cord injury: responsiveness. *Spinal Cord*. 2006; 44:6, 352-356.
- 36 van Hedel HJ, Dietz V, Curt A. Assessment of walking speed and distance in subjects with an incomplete spinal cord injury. *Neurorehabil Neural Repair*. 2007; 21:4, 295-301.
- 37 van Hedel HJ, Wirz M, Dietz V. Assessing walking ability in subjects with spinal cord injury: validity and reliability of 3 walking tests. *Arch Phys Med Rehabil*. 2005; 86:2, 190-196.
- 38 van Hedel HJ, Wirz M, Dietz V. Standardized assessment of walking capacity after spinal cord injury: the European network approach. *Neurol Res*. 2008; 30:1, 61-73.
- 39 van Loo MA, Moseley AM, Bosman JM, et al. Test-re-test reliability of walking speed, step length and step width measurement after traumatic brain injury: a pilot study. *Brain Inj*. 2004; 18:10, 1041-1048.
- 40 Wang RY, Yen L, Lee CC, et al. Effects of an ankle foot orthosis on balance performance in patients with hemiparesis of different durations. *Clin Rehabil*. 2005; 19:1, 37-44
- 41 Watson MJ. Refining the ten-metre walking test for use with neurologically impaired people. *Physiotherapy*. 2002; 88:7, 386-397.
- 42 Wolf SL, Catlin PA, Gage K, et al. Establishing the reliability and validity of measurements of walking time using the Emory Functional Ambulation Profile. *Phys Ther*. 1999; 79:12, 1122-1133.

DISABILITIES OF THE ARM, SHOULDER AND HAND (DASH)



INTRODUCTION

Assessing upper limb function is complex due to the complex and diverse ways in which the upper limb functions, combined with the various ways that an individual may use their hands and/or arms in various environments. The Disabilities of the Arm, Shoulder and Hand (DASH) was developed to assess various aspects of upper limb function, as perceived by the patient¹². It features 30 questions that ask about difficulties encountered during daily activities, with additional optional modules covering work and sports. A score of between 0 and 100 is generated, with a higher score indicating greater disability.

The DASH is reproduced at the end of the section, and can be freely downloaded along with further information at the web address below:

<http://dash.iwh.on.ca/home>

TABLE 1 – GENERAL INFORMATION

Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Patient reported questionnaire	Full instructions are included in the instrument	Printed questionnaire An Iphone app version is also available	Around 7 minutes ⁹	Free for non commercial use. Iphone app costs £2.99

REASONS FOR SELECTING THE DASH

Some general information is summarised below in table 1. The DASH is relatively quick and easy to use – it has been reported that mean time for completion is around 7 minutes⁹. The measure has been validated with a range of conditions (see table 2). Although an abbreviated version has been validated^{7,16}, there is some question over its unidimensionality⁸. As a result we currently recommend use of the full DASH if possible.

LIMITATIONS

The DASH has been validated with adults aged 18-64, but has not been designed for use with children. For example, one question concerns sexual activity. The DASH normally requires the patient to complete the questionnaire, meaning that a reasonable level of literacy is required. The questionnaire may be administered by the clinician, although this will increase clinical time required. The DASH is also available in other languages. A ceiling effect is present in athletes, meaning that the DASH may not be a challenging enough measure in this group¹¹. Validation of the DASH directly with prosthetic and orthotic populations interventions is limited, but it has been used with these interventions^{6,17,22}.

USE AND INTERPRETATION SUMMARY

When using the DASH, a printed copy of the questionnaire should be supplied to the patient, and sufficient time and support provided to allow its completion.

For a post treatment reduction in score to be considered clinically important, it should be a change of between 10-10.83 points or 20%.

CASE STUDY: DISABILITIES OF THE ARM, SHOULDER AND HAND (DASH)



PATIENT BACKGROUND

An existing prosthetic patient using a myoelectric prosthesis would like to use a multi articulating myoelectric prosthesis to improve his ability to use his prosthetic hand for functional tasks such as cooking and household jobs.

PROSTHETIC PRESCRIPTION:

Modular trans-radial prosthesis with multi articulating myoelectric hand.

OUTCOME MEASURE EMPLOYED:

To measure the stated goal of improving functional tasks including household chores the DASH may be appropriate as it features questions relating to these tasks. The DASH covers multiple ICF items, mainly within the activities domain, such as “Doing housework, other specified (d6408)”.

RECORDING RESULTS:

The DASH normally requires a paper questionnaire for the patient to complete. Where clinical notes are paper based, this can easily be added to the clinical notes as a record of the results. Computer based clinical notes may require alternative strategies such as use of a digital question sheet (see DASH website for details) or simply recording the overall DASH score. In any case, details of the prosthetic / orthotic device must be included. For example “DASH with myoelectric hand 1 = 34”. See the DASH question sheets for instructions on scoring. The optional modules are scored separately.

- Add the scores for all questions together (resulting in a score between 30 and 150 for the core 30 questions)
- Divide this score by the number of questions answered (at least 27 out of the core 30 questions must be answered to enable scoring)
- Then subtract 1 from the result
- Multiply by 25

INTERPRETATION

The baseline score is 34. At initial fitting the DASH score is 31, a very small but positive change. We can see that between fitting and review the patient is able to spend time practicing with the prosthesis and the DASH score reduces to 26. This represents an improvement in score of 8 points, or a 24% reduction of the baseline score. We would conclude that this is a clinically important change, as percentage MCID is reported as 20% (see measure review). MCID is also reported as 10-10.83 points which is greater than the change here, however, percentage change is more useful as it takes into consideration the ratio between initial score and change.

USE OF RESULTS

Clinical – these results support the prosthetic intervention and provide a reference against which any future change in status might be compared.

Patient – these results can demonstrate the effects of treatment to the patient, enabling them to make a more informed choice concerning their use of the prosthesis. The positive results may also be encouraging to the patient.

Multidisciplinary team – results can be included in communication with referrers and the wider team, giving them better information on the outcome of treatment.

Audit and research – These results may be used for clinical audit, service review or retrospective research.

Date	10.05.2014	30.05.2014	25.06.2014
	Assessment	Fitting	Review
Prescription:	Myoelectric hand 1 -	Myoelectric hand 2	Myoelectric hand 2
DASH score	34 -	- 31	- 26

TABLE 2 – RELEVANT POPULATIONS AND LINKS WITH OTHER FRAMEWORKS

Prosthetics/orthotics	Adult/children	Conditions/populations	Anatomical region	ICF Domains	NHS Outcomes framework
Prosthetics and orthotics	Adults	<ul style="list-style-type: none"> • Carpal tunnel syndrome⁹ • Elbow Arthroplasty^{2,3} • Mixed wrist disorders¹⁴ • Neck pain^{13,16} • Osteoarthritis^{15,21} • Rheumatoid arthritis⁵ • Sports injuries¹ • Trauma¹⁹ • Upper limb Amputees^{6,17} 	Upper limb ^{1-12,14,15,17,19-21} Upper limb and neck ^{13,16}	Main modules include the following: Body functions Sensation of pain (b280) Muscle power functions (b730) Activities and participation Writing (d170) Carrying in the hands (d4301) Moving around using transportation (d470-d489) Washing oneself (d510) Putting on clothes (d5400) Eating (d550) Preparing meals, unspecified (d6309) Doing housework, other specified (d6408) Taking care of plants, indoors and outdoors (d6505) Informal social relationships (d750) Sexual relationship (d7702) Work and employment (d840-d859) Recreation and leisure (d920)	2: Enhancing quality of life for people with long-term conditions 3: Helping people to recover from episodes of ill health or following injury

TABLE 3 – STATISTICAL VALIDITY

Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Interrater/ Intra-rater Reliability
Overall range 2.27-5.82 points 3.61 in athletes ¹¹ (calculated by ¹⁸) 2.27 in osteoarthritis at 3 months ²¹ 5.82 in humeral fractures ¹⁹	Overall ranges are 10-16.1 points 10 in athletes ¹¹ 16.1 in humeral fractures ¹⁹ (calculated by ¹⁸)	Overall ranges are 10-10.83 points or 20% 10.83 points in mixed physiotherapy patients ⁸ 10 points (‘somewhat better’) in post operative patients ¹⁰ 10 in athletes ¹¹ 10 points in atraumatic conditions of the hand, wrist, and forearm ²⁰ 20% in elbow arthroplasty ²	Mean score 55.3 in people with elbow disorders ³ Mean score 36.7 in post operative patients with 1st CMC osteoarthritis ¹⁵ Mean score 44.52 in post operative patients with rheumatoid arthritis ⁵ Mean score 44.2 in people with wrist disorders ¹⁴ Mean score 21.6 1 year post humeral fracture ¹⁹	65.1% Ceiling effect in athletes ¹¹ 7% Ceiling effect in humeral fractures ¹⁹ Overall 1% ceiling effect in elbow disorders ³	Excellent test-retest reliability (ICC = 0.928) ¹⁹

REFERENCES

- 1 Alberta FG, ElAttrache NS, Bissell S, et al. The development and validation of a functional assessment tool for the upper extremity in the overhead athlete. *Am J Sports Med.* 2010; 38:5, 903-911.
- 2 Angst F, Goldhahn J, Drerup S, et al. Responsiveness of five outcome measurement instruments in total elbow arthroplasty. *Arthritis Care Res* 2012; 64(11): 1749-1755.
- 3 Angst F, John M, Pap G, et al. Comprehensive assessment of clinical outcome and quality of life after total elbow arthroplasty. *Arthritis Rheum* 2005; 53(1): 73-82.
- 4 Beaton DE, Davis AM, Hudak P, et al. The DASH (Disabilities of the Arm, Shoulder and Hand) outcome measure: What do we know about it now? *British Journal of Hand Therapy.* 2001; 6:4,109-118.
- 5 Chiari-Grisar C, Koller U, Stamm TA, et al. Performance of the disabilities of the arm, shoulder and hand outcome questionnaire and the Moberg picking up test in patients with finger joint arthroplasty. *Arch Phys Med Rehabil.* 2006; 87:2, 203-206.
- 6 Davidson J. A comparison of upper limb amputees and patients with upper limb injuries using the Disability of the Arm, Shoulder and Hand (DASH). *Disabil Rehabil.* 2004; 5:26, 917-23.
- 7 Franchignoni F, Vercelli S, Giordano A, et al. Minimal clinically important difference of the disabilities of the arm, shoulder and hand outcome measure (DASH) and its shortened version (QuickDASH). *J Orthop Sports Phys Ther.* 2014; 44:1, 30-9.
- 8 Gabel CP, Yelland M, Melloh M, et al. A modified QuickDASH-9 provides a valid outcome instrument for upper limb function. *BMC Musculoskelet Disord.* 2009;10:161.
- 9 Greenslade JR, Mehta RL, Belward P, et al. Dash and Boston questionnaire assessment of carpal tunnel syndrome outcome: what is the responsiveness of an outcome questionnaire? *J Hand Surg Br.* 2004; 29:2,159-64.
- 10 Gummesson C, Atroshi I, Ekdahl C. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: longitudinal construct validity and measuring self-rated health change after surgery. *BMC Musculoskelet Disord.* 2003; 4:11, 11.
- 11 Hsu JE, Nacke E, Park MJ, et al. The Disabilities of the Arm, Shoulder, and Hand questionnaire in intercollegiate athletes: validity limited by ceiling effect. *J Shoulder Elbow Surg.* 2010; 19:3, 349-354.
- 12 Hudak P, Amadio PC, Bombardier C, et al. Development of an Upper Extremity Outcome Measure: The DASH (Disabilities of the Arm, Shoulder, and Hand). *American Journal of Industrial Medicine.* 1996; 29:602-608.
- 13 Huisstede BM, Feleus A, Bierma-Zeinstra SM, et al. Is the disability of arm, shoulder, and hand questionnaire (DASH) also valid and responsive in patients with neck complaints. *Spine (Phila Pa 1976).* 2009; 34:4, E130-138.
- 14 Imaeda T, Uchiyama S, Wada T, et al. Reliability, validity, and responsiveness of the Japanese version of the Patient-Rated Wrist Evaluation. *J Orthop Sci.* 2010; 15:4, 509-517.
- 15 MacDermid JC, Wessel J, et al. Validity of self-report measures of pain and disability for persons who have undergone arthroplasty for osteoarthritis of the carpometacarpal joint of the hand. *Osteoarthritis Cartilage.* 2007; 15:5, 524-530.
- 16 Mehta S, Macdermid JC, Carlesso LC, et al. Concurrent validation of the DASH and the QuickDASH in comparison to neck-specific scales in patients with neck pain. *Spine.* 2010; 35:24, 2150-2156.
- 17 Ostlie K, Franklin RJ, Skjeldal OH, et al. Assessing Physical Function in Adult Acquired Major Upper-Limb Amputees by Combining the Disabilities of the Arm, Shoulder and Hand (DASH) Outcome Questionnaire and Clinical Examination. *Arch Phys Med Rehabil.* 2011; 92:10, 1636-1645.
- 18 Rehab measures. Disabilities of the Arm, Shoulder, and Hand Questionnaire. <http://www.rehabmeasures.org/Lists/RehabMeasures/DispForm.aspx?ID=1008> (Accessed 1st August 2014)
- 19 Slobogean GP, Noonan VK, O'Brien PJ. The reliability and validity of the Disabilities of Arm, Shoulder, and Hand, EuroQol-5D, Health Utilities Index, and Short Form-6D outcome instruments in patients with proximal humeral fractures. *J Shoulder Elbow Surg.* 2010; 19:3, 342-348.
- 20 Sorensen AA, Howard D, Tan WH, et al. Minimal clinically important differences of 3 patient-rated outcomes instruments. *J Hand Surg Am.* 2013; 38:4, 641-9.
- 21 Vermeulen GM, Brink SM, Sluiter J, et al. Ligament reconstruction arthroplasty for primary thumb carpometacarpal osteoarthritis (weilby technique): prospective cohort study. *J Hand Surg Am.* 2009; 34:8, 1393-1401.
- 22 Young J. Improved Activity and Participation in Poliomyelitis with Elbow Orthoses: More 'Right-tech' than 'High-tech': A Case Study. In: Nollet F. (ed.) 2nd European Polio Conference: 'Post-Polio Syndrome Conference. A condition without boundaries' Amsterdam, The Netherlands June 25-27, 2014. *J Rehabil Med.* 2014; 46:568-608

THE

DASH

INSTRUCTIONS

This questionnaire asks about your symptoms as well as your ability to perform certain activities.

Please answer *every question*, based on your condition in the last week, by circling the appropriate number.

If you did not have the opportunity to perform an activity in the past week, please make your *best estimate* on which response would be the most accurate.

It doesn't matter which hand or arm you use to perform the activity; please answer based on your ability regardless of how you perform the task.



DISABILITIES OF THE ARM, SHOULDER AND HAND

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response:

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
9. Make a bed.	1	2	3	4	5
10. Carry a shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

DISABILITIES OF THE ARM, SHOULDER AND HAND

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22. During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? (circle number)	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? (circle number)	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. (circle number)

	NONE	MILD	MODERATE	SEVERE	EXTREME
24. Arm, shoulder or hand pain.	1	2	3	4	5
25. Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27. Weakness in your arm, shoulder or hand.	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? (circle number)	1	2	3	4	5

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. (circle number)	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = $\frac{[(\text{sum of } n \text{ responses}) - 1]}{n} \times 25$, where n is equal to the number of completed responses.

A DASH score may not be calculated if there are greater than 3 missing items.

DISABILITIES OF THE ARM, SHOULDER AND HAND

WORK MODULE (OPTIONAL)

The following questions ask about the impact of your arm, shoulder or hand problem on your ability to work (including home-making if that is your main work role).

Please indicate what your job/work is: _____

I do not work. (You may skip this section.)

Please circle the number that best describes your physical ability in the past week. Did you have any difficulty:

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. using your usual technique for your work?	1	2	3	4	5
2. doing your usual work because of arm, shoulder or hand pain?	1	2	3	4	5
3. doing your work as well as you would like?	1	2	3	4	5
4. spending your usual amount of time doing your work?	1	2	3	4	5

SPORTS/PERFORMING ARTS MODULE (OPTIONAL)

The following questions relate to the impact of your arm, shoulder or hand problem on playing your *musical instrument* or *sport* or *both*. If you play more than one sport or instrument (or play both), please answer with respect to that activity which is most important to you.

Please indicate the sport or instrument which is most important to you: _____

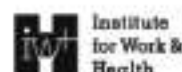
I do not play a sport or an instrument. (You may skip this section.)

Please circle the number that best describes your physical ability in the past week. Did you have any difficulty:

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. using your usual technique for playing your instrument or sport?	1	2	3	4	5
2. playing your musical instrument or sport because of arm, shoulder or hand pain?	1	2	3	4	5
3. playing your musical instrument or sport as well as you would like?	1	2	3	4	5
4. spending your usual amount of time practising or playing your instrument or sport?	1	2	3	4	5

SCORING THE OPTIONAL MODULES: Add up assigned values for each response; divide by 4 (number of items); subtract 1; multiply by 25.

An optional module score may not be calculated if there are any missing items.



**Institute
for Work &
Health**

Research Excellence
Advancing Employee
Health

© INSTITUTE FOR WORK & HEALTH 2006. ALL RIGHTS RESERVED.

For further information or to download the DASH go to
<http://dash.iwh.on.ca/home>



- Sackett, D., Rosenberg, W., Gray, J., Haynes, R., Richardson, W., 1996. Evidence based medicine: what it is and what it isn't. *BMJ*;312:71
- World Health Organization. International Classification of functioning, disability and health. 2001, World Health Organization, Geneva.
- Stokes EK. Rehabilitation outcome measures. London: Churchill Livingstone Elsevier; 2010.
- Robinson C, Fatone S. You've heard about outcome measures, so how do you use them? Integrating clinically relevant outcome measures in orthotic management of stroke. *Prosthet Orthot Int.* 2013 Feb;37(1):30-42.
- Atkin K, Cole MJ, Cumming J, et al. BACPAR Toolbox of Outcome Measures: Version 2. (2014) Available at: <http://bacpar.csp.org.uk/publications/bacpar-outcome-measure-toolbox-version-2> [Accessed 10:20 26th November 2014]
- British Society of Rehabilitation Medicine. Measurement of outcome in Rehabilitation: The British Society of Rehabilitation Medicine "Basket" of Measures. (2005) Available at: <http://www.bsrm.co.uk/Publications.html#BSRMstandards> [Accessed 18:50 25th November 2014]
- Hawkins AT, Henry AJ, Crandell DM, Nguyen LL. A systematic review of functional and quality of life assessment after major lower extremity amputation. *Ann Vasc Surg.* 2014 Apr;28(3):763-80.
- Condie E, Scott H, Treweek S (2006). Lower limb prosthetic outcome measures: a review of the literature 1995 to 2005. *Journal of Prosthetics and Orthotics* 18:15:13-45
- Rehabilitation Measures Database: <http://www.rehabmeasures.org/>
- American Academy of orthopedic surgeons outcome measure resources: <http://www.aaos.org/research/outcomes/outcomes.asp>
- Physiopedia page on outcome measures: http://www.physio-pedia.com/Outcome_Measures
- NHS Outcomes Framework: <https://www.gov.uk/government/publications/nhs-outcomes-framework-2014-to-2015>

