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The push-off test: Development of a simple, reliable test of upper extremity weight-bearing capability

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ABSTRACT

Study design: Longitudinal clinical measurement study.
Introduction: The push-off test (POT) is a novel and simple measure of upper extremity weight-bearing that can be measured with a grip dynamometer. There are no published studies on the validity and reliability of the POT. The relationship between upper extremity self-report activity/participation and impairment measures remain an unexplored realm.
Purpose: The primary purpose of this study is to estimate the intra and inter-rater reliability and construct validity of the POT. The secondary purpose is to estimate the relationship between upper extremity self-report activity/participation questionnaires and impairment measures.
Methods: A convenience sample of 22 patients with wrist or elbow injuries were tested for POT, wrist/elbow range of motion (ROM), isometric wrist extension strength (WES) and grip strength; and completed two self-report activity/participation questionnaires: Disability of the Arm, Shoulder and the Hand (DASH) and Work Limitations Questionnaire (WLQ-26). POT's inter and intra-rater reliability and construct validity was tested. Pearson's correlations were run between the impairment measures and self-report questionnaires to look into the relationship amongst them.
Results: The POT demonstrated high inter-rater reliability (ICC affected = 0.97; 95% C.I. 0.93–0.99; ICC unaffected = 0.85; 95% C.I. 0.68–0.94) and intra-rater reliability (ICC affected = 0.96; 95% C.I. 0.92–0.97; ICC unaffected = 0.92; 95% C.I. 0.85–0.97). The POT was correlated moderately with the DASH ($r = -0.47$; $p = 0.03$). While examining the relationship between upper extremity self-reported activity/participation questionnaires and impairment measures the strongest correlation was between the DASH and the POT ($r = -0.47$; $p = 0.03$) and none of the correlations with the other physical impairment measures reached significance. At-work disability demonstrated insignificant correlations with physical impairments.
Conclusion: The POT test provides a reliable and easily administered quantitative measure of ability to bear the load through an injured arm. Preliminary evidence supports a moderate relationship between loading bearing measured by the POT and upper extremity function measured by the DASH.
Level of evidence: 1b

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Introduction

Unlike the lower limb where weight-bearing is a predominant physical requirement for mobility, the need for weight-bearing through the upper limb is intermittent and is more related to stability. However, the importance of weight-bearing in the upper limb is often under-estimated. There are functional tasks such as pushing opening a heavy door, pushing up from a sitting position

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or moving a heavy object that require upper extremity weight-bearing. In conditions like stroke, spinal cord injury, or lower extremity musculoskeletal disorders the upper limb can assume a greater role in weight-bearing when performing day to day activities.[1–3] For instance, nearly half of the body weight is transferred through the upper limb during the use of walker in patients with lower extremity disorders.[4] Weight-bearing capacity can also reflect the stability of upper extremity joints since an unstable joint is not suitable for load-bearing. For these reasons, it might be clinically relevant to determine the amount of load that can be tolerated through the upper limb during rehabilitation of upper extremity injuries.

The distal radio-ulnar joint (DRUJ) plays a very important role as a weight-bearing mechanism.[5] There are various biomechanical studies that have explored the effect of the position of forearm that influences the contact area inside the DRUJ and the amount of force that passes through it. Shabaan and colleagues[6] have found that the contact area within the DRUJ was reduced in full pronation and was significantly decreased in extreme supination during axial loading. The same authors have determined that the pattern of loading of the forearm during weight-bearing increases with the loading of the hand; the axial loading was minimum at full pronation and maximum at full supination.[7] Also, grip strength was found to be maximum in neutral forearm for men and; supination and neutral forearm for women.[8] All the above mentioned factors play an important role in determining the amount of force that goes through the arm and in turn the weight bearing capability of the arm.

Ability to tolerate load through the upper extremity may also reflect the joint irritability or pain tolerance in much the same way that the pain free grip test assesses pain in response to loading of muscle.[9] The "Press-test" which is used as quick test for the diagnosis of triangular fibrocartilage complex (TFCC) injury has shown to have high sensitivity and specificity.[10] However, this test is used only for diagnosis and the results of this test cannot be quantified. Thus, potentially a quantifiable joint loading test might be a useful indicator of weight-bearing ability in bone and joint disorders like wrist and elbow arthritis, TFCC injury, ulnar sided wrist pain, fractures around wrist, elbow and forearm (post-union) and also help in tracking progress during the sub-sequent visits serving as a prognostic tool.

Assessment tools for the wrist and elbow have, in the past, focused on obtaining measures of impairment with the assumption that these reflect activity limitations.[11] Self-report measures are taking center stage in reporting activity limitations currently. The International Classification of Functioning, Disability and Health (ICF),[12] a biopsycho-social model which provides a coherent view of social, individual and biological perspectives of health calls for the examination of the relationships between physical impairments and activity limitations or participation restrictions. It is vital to explore these associations as this information would be of significance when assessing new methods of treatment and validating current and future clinical outcome scoring systems[13] and also to enable a better understanding of how one might focus rehabilitation interventions to maximize health. However, these relationships cannot be anticipated, because complex processes that involve personal and environmental factors can interact to determine the overall health impact.

This becomes particularly relevant as health care focus shifts toward a broader; more holistic view of optimal functioning that includes body functions, activities and societal participation. When considering the use of a new impairment measure to measure the load bearing capability of the upper limb, the value of such a measure is based on established key measurement principles. Fundamental is the reliability of the test. However, it is equally important to establish the relationship between any new measure and other health indicators that are used to reflect the upper extremity impairment or activity/participation like self-report questionnaires, so that it is clear to what extent the new measure provides unique information.

The push-off test (POT) was developed by one of the authors (SM) to measure the weight bearing through the upper limb using methods and tools feasible for clinical practice. It is a simple and easy test that does not require any extra equipment other than the grip dynamometer which is routinely used in hand clinics. A grip dynamometer was adapted by reversing the handle to perform this test (the details of the test are described later in this paper). There are no published studies on the validity and reliability of the POT. There is also an ongoing debate on the relationship between self-report activity/participation measures and impairment measures – whether they complement each other and provide similar information or do they tap into different constructs of the same problem.

Purpose

The primary purpose of this study was to analyze the inter-rater reliability, intra-rater reliability and construct validity of the push-off test (POT). The secondary purpose is to estimate the relationship between upper extremity self-report activity limitation/participation restriction questionnaires and impairment measures.

Methods

Subjects

Twenty-six subjects were identified by convenience sampling from the Roth-McFarlane Hand and Upper Limb Center, London ON, Canada. Potential subjects who were undergoing treatment at the center were initially identified through a search of medical records.

Patients were included as study participants if they satisfied the following criteria:

1) Attending the center with wrist or elbow problems
2) Between the ages of 18 and 65 years (adult working population)

The exclusion criteria included:

1) Pathologies affecting both arms
2) Shoulder pathologies affecting upper extremity function
3) Contraindicated for medical reasons including co-morbidity or status of presenting condition
4) Unable to comprehend/read questionnaires.

Two of the 26 participants were excluded following discovery of a concurrent shoulder injury. One other participant was found to have a fracture of the wrist that had not healed and another participant was unable to complete the testing due to alternate time commitments. Finally, twenty-two participants (male:female – 15:7; age range 22–61) with wrist or elbow injuries (wrist:elbow – 12:10) such as fractures and soft tissue injuries (mean post-injury period 32 weeks) were included in the study (see Table 1). Informed consent was obtained prior to inclusion in the study and their rights were protected. Of the 22 patients who participated in the study, four did not complete the WLQ-26 due to unemployment, and one participant failed to properly complete the questionnaire.

Procedure

Study design: Longitudinal clinical measurement study.

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