Test-Retest Reliability of Handgrip Strength as an Outcome Measure in Patients With Symptoms of Shoulder Impingement Syndrome

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Abstract

Objective: The purpose of this study was to investigate the degree of test-retest reliability of grip strength measurement using a hand dynamometer in patients with shoulder impingement syndrome.

Methods: A total of 19 patients (10 women and 9 men; mean ± standard deviation age, 33.2 ± 12.9 years; range 18-59 years) with shoulder impingement syndrome were measured using a hand dynamometer by the same data collector in 2 different testing sessions with a 7-day interval. During each session, patients were encouraged to exert 3 maximal isometric contractions on the affected hand and the mean value of the 3 efforts (measured in kilogram-force [Kgf]) was used for data analysis. The intraclass correlation coefficient ($ICC_{2,1}$) as well as the standard error of measurement (SEM) and Bland-Altman plot were used to estimate the degree of test-retest reliability and the measurement error, respectively.

Results: Grip strength data analysis revealed an $ICC_{2,1}$ score of 0.94, which, based on the Shrout classification, is considered as excellent test-retest reliability of grip strength measurement. The small values of SEMs reported in both sessions (SEM_1, 2.55 Kgf; SEM_2, 2.39 Kgf) and the small width of the 95% limits of agreement in the Bland-Altman plot (ranging from −7.39 Kgf to 7.03 Kgf) reflected the measurement precision and the narrow variation of the differences during the 2 testing sessions.

Conclusions: Results from this study identified excellent test-retest reliability of grip strength measurement in shoulder impingement syndrome, indicating its potential use as an outcome measure in clinical practice. (J Manipulative Physiol Ther 2018;41:252-257)

Key Indexing Terms: *Hand Strength; Muscle Strength Dynamometer; Shoulder Impingement Syndrome*

Introduction

Shoulder impingement syndrome (SIS) is a general term that describes decreased movement of the glenohumeral joint as a result of shoulder pain and muscle weakness.[1-3] Shoulder pain is second only to low back pain in prevalence, affecting 16% to 21% of the general population.[4-6] SIS is considered the main cause of shoulder pain, affecting 44% to 60% of all patients with shoulder pain complaints, suggesting a frequent appearance of this syndrome in everyday clinical practice.[7,8] SIS is responsible for work disability and physical limitations in daily life, and recent studies have reported that it has become a considerable socioeconomic burden.[9-12]

Patients with SIS often report a clicking sensation along with pain during arm elevation or overhead activities.[13,14] To prevent pain exacerbation, most patients avoid daily movements or activities of the affected upper limb.[1,15,16] However, these activity limitations can cause muscle imbalances in the whole upper limb kinematic chain.[3,17-19] Several studies have identified glenohumeral and scapulothoracic muscle imbalances caused by deficits in muscle flexibility and strength.[20-22] Alterations in humeral and scapular position and motion have been linked to decreased muscle activity of serratus anterior, lower and middle trapezius, and the rotator cuff, coupled with tightness of the upper trapezius, pectorals, and levator scapula muscles.[5,22-24] Based on kinetic chain principles, the upper extremity is a system of linked segments that work together to perform

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daily movements.[25-27] As a result, muscles imbalances in patients with SIS could affect grip strength (GS). This notion is supported by studies that have reported a positive correlation between GS and shoulder muscle strength and flexibility.[28-30]

Clinicians often use dynamometers to assess the before and after treatment effect on GS in patients with SIS.[28,29] Therefore, test-retest reliability of GS measurement (GSM) seems to be one of its most important measurement properties because as an outcome measure it is used by the same treatment provider across repeated trials.[31,32]

Although GSM is widely used in clinical practice, to date no study has explored whether this outcome measure can yield consistent results of GS when applied across separate measures in patients with SIS. Therefore, the objective of this study was to investigate the degree of test-retest reliability of GSM using a dynamometer in patients with SIS.

Methods

Study Design

A prospective, observational, nonexperimental design was used to explore the test-retest reliability of GSM in patients with SIS.[31,33] The GS of consecutive patients presenting to a rehabilitation clinic with SIS was evaluated by the same data collector. To prevent possible learning or fatigue effects, patients were assessed at 2 different periods with an interval of 7 days between each period.[31,34]

A double-blind procedure was used to prevent research outcomes from being influenced by several biases that could affect interval validity. The data collector who measured the patients' GS was blinded to the purpose and nature of the study design to prevent potential recorder bias.[35] During GS trials, patients were blinded to their GS scores to address potential expectation bias.[36]

Clinical Settings and Study Participants

Data collection was conducted between December 2015 and May 2016, in the outpatient physiotherapy department of Nicosia General Hospital. Consecutive patients diagnosed by orthopedic surgeons as having SIS, based on radiographs or magnetic resonance imaging, were referred to the outpatient physiotherapy department and were initially recruited. An independent physiotherapist not involved in assessment of the patients' GS screened all referred patients and determined eligibility for participation (n = 25). Participants were eligible if they reported (1) painful shoulder range of movement, (2) shoulder weakness, (3) clicking sensation in the shoulder, and (4) a positive result on Hawkins and Neer tests.[37,38] Participants were excluded if they had a history of shoulder surgery on the symptomatic side; had shoulder pain caused by major shoulder trauma; had a history of frozen shoulder, traumatic shoulder dislocation, or instability in the last 3 months; or had undergone physiotherapy treatment during the last 2 months.[5,39] Participants were also excluded if they had been receiving any prescription or over-the-counter analgesia or anti-inflammatory medication within 2 weeks before the study.[14]

Of the 25 consecutive patients, 6 were excluded because they did not meet the inclusion criteria. A total of 19 patients (mean ± standard deviation [SD] age = 33.2 ± 12.9 years; range 18-59 years) met the inclusion criteria and were enrolled in the study. A difference in reliability of 0.9 and 0.7 at 80% power and a 5% level of significance using 2 ratings was set. Based on 2 testing sessions, an α value of .05, and a power of 0.80, a minimal sample size of 19 patients was identified. Specifically, 10 women (mean age ± SD, 35 ± 14.3 years) and 9 men (mean age ± SD, 32.2 ± 11.7 years) were included.[40,41]

Ethical Considerations

On meeting the requirements for inclusion, participants gave written informed consent before participation. The study was approved by the Cyprus National Bioethics Committee.

Instrument

The hydraulic hand dynamometer (Saehan Corporation, Busan, South Korea) was designed after the Bechtol in 1954 was used to measure the patients' GS.[42] The outcomes from this dynamometer are read in kilogram-force (Kgf) with 2-kg gradations.[42,43] The hand dynamometer has been reported to have excellent test-retest reliability, with intraclass correlation coefficient ($ICC_{2,1}$) values varying between 0.81 and 0.98.[44,45] The specific dynamometer was chosen for the present study because it produces similar and constant results of GS when applied by the same data collector across repeated GS trials and has been recommended by the American Society of Hand Therapists (ASHT).[46-48]

Procedure

Patients were assessed for GS on 2 different testing sessions with an interval of 7 days between sessions.[31,34] Time of testing was standardized and patients were advised to attend in morning sessions between 8:00 and 12:00. Also, patients followed a standardized protocol for GS data collection as recommended by the ASHT.[47,48]

Grip strength measurements were applied in the position recommended by the ASHT: sitting position with the feet flat on the floor, shoulder at 0° of flexion, abduction, and rotation; elbow flexed to 90°; forearm and wrist rested in a neutral position.[43,49] In this standardized arm position, patients underwent a familiarization trial as they were instructed to hold the handle and squeeze the hand dynamometer set at the second handle space.[50] In addition,