ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2013;94:444-50

ORIGINAL ARTICLE

Applicability and Test-Retest Reliability of Isokinetic Shoulder Abduction and Adduction in Women Fibromyalgia Patients

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Abstract

Objective: To investigate the applicability and reliability of isokinetic strength measurements during concentric and eccentric actions of the shoulder muscles in fibromyalgia (FM) patients.

Design: Test-retest reliability study.

Setting: University laboratory.

Participants: Women with FM (N=25) aged 37 to 69.

Interventions: Not applicable.

Main Outcome Measures: Two isokinetic tests of the shoulder were repeated after an interval of 7 days. Each test involved 3 repetitions of abduction and adduction performed at a rate of 60°/s. The first test involved 2 concentric muscle actions (concentric/concentric test). The second test involved concentric abduction followed by eccentric adduction (concentric/eccentric test). Unilateral peak torque (Nm) and average work (J) were measured. Applicability was calculated as the proportion of participants who were able to complete every test. Reliability was analyzed by intraclass coefficient (ICC), standard error of measurement, and smallest real difference (SRD).

Results: Applicability was 84% for the concentric/concentric test and 52% for the concentric/eccentric test. The main factor influencing applicability was age. In the concentric/eccentric test, measurement of peak torque showed high reliability for the abduction (ICC=.88; standard error of measurement=1.82; SRD=5.05) and adduction (ICC=.89; standard error of measurement=3.83; SRD=10.62) phases. In the concentric/concentric test, measurement of peak torque showed low reliability in the abduction phase (ICC=.29; standard error of measurement=6.45; SRD=17.87) and excellent reliability in the adduction phase (ICC=.92; standard error of measurement=5.95; SRD=16.50).

Conclusions: The applicability of shoulder isokinetic tests in FM patients who are women may be affected by age. In comparison, the concentric/concentric test was more applicable and less reliable than the concentric/eccentric test during abduction and adduction. These findings will facilitate the clinical interpretation of changes in isometric and isokinetic shoulder adduction and abduction tests in women with FM.

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Patients with fibromyaliga (FM) present with widespread musculoskeletal pain, weakness, and fatigue.[1-6] Most FM patients report difficulties in everyday activities, such as climbing stairs, running, carrying objects, and working with their arms in an elevated position.[7,8] Individuals with FM therefore tend to be untrained, and some studies have shown that they have less muscle strength in the upper and lower extremities than healthy subjects.[3,7,9,10]

In the performance of daily activities, such as raising up and putting down an object, cleaning windows, hanging out clothes, and making beds, the shoulder muscles act concentrically or eccentrically to control the movement of the limb and/or prevent joint overloading.[11] Although the performance of daily activities necessitates frequent eccentric muscle action, only 2 previous studies have used eccentric contraction to evaluate isokinetic strength in FM,[11,12] and only 1 of these studies measured shoulder movements.[11] The infrequent use of tests involving eccentric muscle actions in FM research may be because these patients

Supported by a predoctoral fellowship by the Spanish Ministry of Education (FPU3839); and the Government of Extremadura and European Union Regional Development Fund (ERDF-FEDER) funds (GRI0127).

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated.

0003-9993/13/$36 - see front matter © 2013 by the American Congress of Rehabilitation Medicine
http://dx.doi.org/10.1016/j.apmr.2012.08.198

often report eccentric contraction to be painful.[13] However, measurement of eccentric muscle action provides useful and complementary information in the evaluation of global strength, and may also be used to calculate concentric/eccentric ratios, which are correlated with the degree of impairment in various disease states.[14]

Precise and sensitive tests of muscle strength are required to assess the relevance of the cross-sectional and longitudinal variability of muscle function in patients with FM. Such tests are important in assessing the effects of physical therapies on muscle strength in this population. One of the most widely used instruments for measuring muscle strength and power is the isokinetic dynamometer. However, many variables may affect the reliability of isokinetic dynamometry measures. These range from technical factors, such as axis alignment, to complex neurobehavioral factors, such as pain and motivation.[15]

Research has shown that isokinetic dynamometry of the knee and shoulder during the performance of concentric and eccentric muscle actions is reliable in healthy individuals, provided that they receive adequate instruction and are familiar with the equipment, and that the test procedures are standardized.[15-17]

Several isokinetic dynamometry studies of the knee and shoulder have evaluated joint function[1,18,19] and the effect of therapy[11,20] in patients with FM. Although the reliability of isokinetic knee tests in FM has been reported previously,[21] no previous study, to our knowledge, has investigated the reliability of shoulder isokinetic procedures adapted for use in FM patients with poor muscle strength. Reliability is an important prerequisite for the correct interpretation of isokinetic dynamometry data, which indicate to the clinician whether or not a genuine change has occurred. Reliability is dependent in turn on the consistency of the results, and thus on a relatively low rate, or absence, of measurement error. In particular, reliability over 2 sessions, that is, test-retest reliability, is important in view of the clinical importance of long-term follow-up. Good test-retest reliability enables comparisons to be made over a period of time.[22]

The present study analyzed the test-retest reliability indices of measures obtained from 2 isokinetic shoulder tests in FM patients. Both tests involved 3 repetitions of an abduction phase followed by an adduction phase. In the first test, both phases involved a concentric contraction (concentric/concentric test). The second test involved a concentric abduction and an eccentric adduction (concentric/eccentric test).

The applicability was considered as the proportion of participants who were able to complete every test. Analysis of the applicability of any proposed shoulder abduction test protocol is crucial. FM patients have a limited range of motion (ROM) during shoulder abduction,[23] and eccentric adduction may induce pain.[13] Both of these factors may cause significant dropout rates.

The aim of the present study was to evaluate the applicability as the percentage of participants who could perform the tests and test-retest reliability of 2 isokinetic dynamometry shoulder tests, 1 of which assessed eccentric muscle action.

List of abbreviations:

FM	**fibromyalgia**
FIQ	**Fibromyalgia Impact Questionnaire**
ICC	**intraclass correlation coefficient**
ROM	**range of motion**
SRD	**smallest real difference**

Methods

Participants

The sample size was calculated to achieve a power of .90 for an intraclass correlation coefficient (ICC) under the following assumptions: alpha = .05; the null hypotheses was that the ICC was good according to the criteria used (.70)[24]; and the alternative hypothesis was that the ICC was excellent (.93), according to previous studies of healthy participants.[25] A minimum of 16 participants was required for each test. However, to account for potential study dropouts, some additional participants were allocated to perform each test.

Figure 1 shows the flow of participants. All members of 3 local FM associations were contacted and given preliminary information about the study (n = 221). A total of 30 women requested further information and were informed of the details of the study protocol. All 30 individuals agreed to participate and provided written informed consent. All participants were assessed by a clinician who assigned a diagnosis of FM according to the American College of Rheumatology criteria[26] by reviewing medical records and clinical status, and assessing tender points. All participants were asked not to take pain medication 24 hours before the tender points evaluation and the strength assessments. The following exclusion criteria were applied: other rheumatic diseases; other severe somatic or psychiatric disorders, such as Alzheimer disease; severe coronary disease; hypertension; or any disorder of the shoulder or spine. Four participants were excluded on the basis of these criteria and 1 other participant withdrew from the study because of the distance to the study laboratory. The study was approved by University Bioethics Committee and was performed in accordance with the Declaration of Helsinki.

Instrumentation

All tests were performed using a Biodex System 3 Quick-Set isokinetic dynamometer and System 3 software (version 3.40).[a] Peak torque (Nm) and work (J) were measured during the isokinetic period of shoulder abduction and adduction. All participants completed the Spanish version of the Fibromyalgia Impact Questionnaire (FIQ) (measured in points 0–100)[27,28] to measure the subjective severity of FM symptoms.

Procedures

The same test procedure was performed on 2 separate occasions (days 1 and 2), which were separated by an interval of 7 days in accordance with previous studies of the reliability of isokinetic parameters in healthy subjects.[17,29] Testing was always conducted at the same time of day to reduce the effect of diurnal variation. The study was conducted by 2 raters. To reduce intertester variability, each participant was assessed by the same rater on days 1 and 2.

Only the dominant arm was tested, which was defined as the arm used to write. The participant was seated in a comfortable position with the seatback at an angle of 70° relative to the seat. The mechanical axis of the dynamometer was aligned with the axis of movement of the shoulder. Maximal abduction and adduction of the shoulder were measured at a rate of 60°/s from 45° to 135° with the elbow in 90° flexion, according to standardized protocols,[15] and as performed previously in this population.[11]

Familiarization with the 2 tests involved 3 submaximal and 3 maximal concentric or eccentric actions of the arm abductor