Feature Article

Sidebridge Muscle Endurance Testing: Normative Data for Adults

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Abstract

Objective: The "sidebridge" exercise has been shown to be optimal for challenging the quadratus lumborum. The purpose of this study was to develop age and gender based normative values for sidebridge endurance, from a healthy sample.

Subjects: There were 205 volunteers for this study, recruited from 10 cities across Canada.

Methods.: The current study examines static endurance of the quadratus lumborum musculature. Participants were individually instructed and supervised by experienced therapists specifically trained in the testing methodology. Subjects were instructed to hold the position for as long and as safely as possible and to repeat the test on both sides. In each of these tests, the mass of the upper body represented the load.

Analysis and Results: Results were analyzed by gender for four age groups. Quartile scores (25th, 50th and 75th percentiles) were determined for each age-sex category. Median values for males were higher than for females for all age categories. The difference in median values between males and females was smallest for the youngest age group (age 19-29). Results show that endurance decreased with increasing age for both sexes. No one side (right or left) had consistently higher median values, for both sexes.

Conclusion and Discussion: Referral to a normative data table allows comparison of an individual's scores obtained by a sample of normal adults. Percentile scores estimate the extent to which a patient's endurance deviates from the norm for his/her gender and age group. The age and gender-specific database generated from this investigation of normal subjects provides an objective instrument against which an endurance score can be compared with broad percentile categories.

Key Words: *sidebridge, quadratus lumborum, normative values, endurance*

Introduction

Lumbar muscles capable of generating intersegmental contraction are necessary to control multi-planar segmental spinal motion. The quadratus lumborum is one muscle group (in addition to transversus abdominis, psoas, and multifidus) that contributes to functional segmental motion control in the lumbar spine[1] The "sidebridge" exercise has been shown to be optimal for challenging the quadratus lumborum.[2] Static endurance of the trunk muscles is important for mechanical support; these muscles must have the ability to sustain an isometric contraction to support the trunk in any given position.

Decreased lumbar-pelvic (core) stability or endurance may contribute to the etiology of lower extremity injuries, particularly in females; thus, core stability has an important role in injury prevention[3] and rehabilitation.

When evaluating extremity muscle performance, examiners can compare normal and abnormal sides to quantify diminished function[4]. Since this type of intrinsic control is not available for trunk musculature evalu-

ation, it is necessary to reference a normative database to identify alterations from "normal".

With the use of normal endurance values as a baseline, clinicians can formulate an active, conservative strategy to restore function and possibly reduce or eliminate symptoms. Objective quantitative data provide benchmarks for setting specific goals to increase muscle performance capacity and provide outcome measures for evaluating the success of an intervention [5].

A few studies have addressed muscle endurance testing in symptomatic[3, 6] and asymptomatic samples[3] While some research has been performed on trunk rotation[7], most studies developed normative values for anterior and posterior trunk support leaving a void regarding lateral support. Only McGill et al[8] have reported on endurance times for low back stabilization exercises, including sidebridge testing for lateral support. Unfortunately, values were based on a relatively small sample size (75 subjects) and only tested young healthy subjects (mean age 23 years).

The current study examines two standardized trunk muscle endurance tests commonly applied in clinical practice. Each of the non-dynamometric techniques for measurement is simple to perform, safe for non-acute conditions, noninvasive, and inexpensive. The exercises isolate and help evaluate quadratus lumborum endurance. For the purpose of this study, muscular endurance was defined as the ability of a muscle to sustain a contraction over time at a certain level (static endurance)[9].

The purpose of this study was to develop age and gender based normative values for sidebridge endurance, from a healthy sample, to complement previously published norms for sagittal movement trunk endurance exercises[5].

Methods

Subjects

Volunteers for this study were recruited from 10 cities across Canada. All participants signed a standard consent and release form prior to the initiation of testing. All results were forwarded to the lead author.

There were 213 people who volunteered to participate. Recruitment began in 2002 with 169 subjects; another 44 were collected in 2006. Because the purpose of the study was to create a normative database, no subjects had missed work due to back or neck pain in the preceding six months.

As a preliminary screening procedure, subjects were required to complete a physical activity readiness questionnaire (PAR-Q)[10]. Individuals (n=8) who answered affirmatively to three or more questions were excluded. This resulted in a final sample size of 205 subjects (60.7% female).

Subjects represented a broad range of exercise experience (never/rarely, 1-2 times/week, 3-4 times/week, +4 times/week). There were no statistically significant differences in mean results by exercise experience; thus, higher trained athletes were not excluded from the study.

The mean age of the sample was 36.9 years, range 19-70, standard deviation 11.6 (women 35.9 years, range 20-70, standard deviation 11.4; men 38.1 years, range 19-68 standard deviation 11.8). For the purpose of constructing normative tables, males and females were classified into age groups of approximately 10-year intervals: 19-29, 30-39, 40-49, and 50+.

Procedure

Participants were individually instructed and supervised by experienced therapists specifically trained in the testing methodology. McGill et al.'s[8] description of the sidebridge test was used as a template for the testing protocol. Appendix 1 details starting positions, instructions to examiners and termination criteria for the test. In each of these tests, the mass of the upper body represented the load.

All tests were demonstrated and preceded by a practice trial. Subjects were instructed to hold the position for as long and as safely as possible and to repeat the test on both sides. Each test was measured once. In one case, a subject was unable to assume the correct starting position and unable to perform a test correctly, she was given a time score of zero.

Testing was conducted at multiple locations including clinics, public gymnasiums, work sites and homes. All sites provided a warm room and minimized variables such as excessive noise or visual distractions. Because individuals respond to competition in various ways and these results may not accurately represent normative data, instructors endeavoured to establish a non-competitive atmosphere. Subjects were initially encouraged to give their maximum effort, but the instructors provided no further motivation.

Results were analyzed by gender for four age groups. Histogram plots were generated to assess normality of the data. Based on the graph's shape of the distribution, percentiles were deemed a more appropriate format for the normative data than means and SD. Quartile scores (25th, 50th and 75th percentiles) were determined for each age-sex category.

Results

Histogram plots revealed that the distribution of data was right-skewed, with the long tail of observations at the upper end yielding large standard deviations. This lack of normality, as well as large variation in individual scores within age/sex categories provided evidence for the use of percentiles rather than means in the normative database. The normative percentile data are presented in Tables 1 through 4.

Median values for males were higher than for females for all age categories. The difference in median values between males and females was smallest for the youngest age group (age 19-29). Results show that median endurance decreased with increasing age for both sexes. No one side (right or left) had consistently higher median values, for both sexes.

Discussion

This study presents age and gender-referenced nor-

mative tables for an easily administered isometric test of quadratus lumborum muscle endurance. This research complements previously published norms for sagittal movement trunk endurance exercises (static 1/4 sit-up, chest raise , bilateral supine straight-leg raise, prone double straight-leg raise, half-squat, and dynamic 1/4 sit-up and chest raise)[4].

In clinical practice, these tests can be used at intake and throughout the course of treatment to quantify change over time. Identifying high or low endurance muscle groups can alert the patient and clinician to a need for possible modifications to the usual treatment regime. For example, if a patient tests at the 25th percentile for sidebbridge endurance, the clinician has helped quantify that time and energy in physical conditioning should be directed towards the quadratus lumborum muscle group.

As an outcome measure, this test battery can be used by comparing a patient's scores with the normative percentile data to assess which muscles exhibit dysfunction and to what degree. This measurement of outcome can be completed on assessment, when strength testing is appropriate during the client's recovery and/or throughout treatment to provide specific goals for the client and to track the client's progress as well as at discharge.

Well-standardized tests minimize variability and enhance reproducibility. The examiners for this study strictly followed prescribed procedures. All investigators were therapists with extensive training and experience in the testing protocol. This congruency reduced inter-examiner variation. Because good control and specificity of body positions during testing are essen-

Table 1: Sidebridge Muscle Endurance Testing (SMET) Quartile Data, in seconds, for 19-29 age group (n=67)

	Male		Female	
	Left SMET	Right SMET	Left SMET	Right SMET
percentile				
25	57.5	39.5	28.8	35.0
50	82.0	86.0	58.6	56.0
75	128.0	131.25	84.5	83.75

Table 2: SMET Quartile Data, in seconds, for 30-39 age group (n=70)

	Male		Female	
	Left SMET	Right SMET	Left SMET	Right SMET
percentile				
25	52.5	57.0	25.15	27.0
50	74.0	70.0	50.0	49.0
75	100.5	105.5	69.5	62.5

tial to produce reliable results, the investigators were instructed to be watchful for any alterations in posture.

Malchaire and Masset[11] concluded that a number of factors including weight, height, muscularity, and sports and leisure activities were significantly associated with trunk performance. The trunk performance measures investigated in that study were range of motion, maximum isometric strength and maximum trunk velocity. Endurance was not specifically examined. In the absence of research demonstrating an effect of anthropometric or occupational variables on trunk and lower extremity endurance, we confined the stratification of our normative data to age and gender. Further stratification would require a much larger sample.

Human strength measurements are subject to motivational influences[12]. Reliability in endurance testing is compromised if the subject does not cooperate to give a maximum effort to the point of fatigue. To limit the psychogenic effects on testing and gain the compliance and motivation required for maximum performance, study subjects were voluntary participants fully informed about the nature of the tests.

A potential consequence of voluntary participation is sample bias. The exercise habits of this group suggest that the individuals who took part in this study might have been more fit than the general population. However, the large range of test results indicate varying degrees of endurance. If this sample had consistently higher levels of fitness, the results would have been more positively skewed.

Table 3: SMET Quartile Data, in seconds, for 40-49 age group (n=36)

	Male		Female	
	Left SMET	Right SMET	Left SMET	Right SMET
percentile				
25	38.25	38.5	19.0	10.5
50	70.5	70.0	36.0	38.0
75	102.0	107.25	69.5	67.0

Table 4: SMET Quartile Data, in seconds, for 50+ age group (n=32)

	Male		Female	
	Left SMET	Right SMET	Left SMET	Right SMET
percentile				
25	25.75	29.25	13.13	11.48
50	48.0	53.0	18.5	21.5
75	81.5	76.75	58.5	46.5

Conclusion

Normative values have been established according to age and gender for quadratus lumborum muscle endurance that require minimal instrumentation and cost. Referral to a normative data table allows comparison of an individual's scores obtained by a sample of normal adults. Percentile scores estimate the extent to which a patient's endurance deviates from the norm for his/her gender and age group. When the goal of treatment is to return to an able-bodied lifestyle, i.e. injury recovery or symptom resolution and resume an active role in society, then comparison to able-bodied values is the most appropriate choice; hence, the need for normative data.

The age and gender-specific database generated from this investigation of normal subjects provides an objective instrument against which an endurance score can be compared with broad percentile categories. This objective data combined with information about the physical demands of the work environment and primary activities of daily living can help guide or evaluate the effectiveness of the rehabilitation.

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Appendix 1.
Instructions for Sidebridge Muscle Endurance Testing

Pre-test Cueing

- To ensure the subject is able to cue the Transversus Abdominus, instruct them to pull their "navel to spine".
- Monitor to ensure the subject is able to properly cue T-A.

Starting Position

- Lying on side with legs extended, top foot placed over lower foot on the mat for support. Please ensure that the subject has removed their shoes.
- Torso supported off the mat by the arm with elbow placed directly below shoulder.

Subject Instructions

- Instruct patient to cue T-A by drawing navel to spine.
- Instruct the subject to lift hips off the mat to maintain a straight line over their body length so they are supporting self on one elbow and their feet only.
- To help protect the shoulder girdle it will be necessary to instruct the subject to draw his shoulder toward his/her ipsilateral hip.
- Uninvolved arm is placed across the chest so that the hand rests on the opposite shoulder.
- One practice trial allowed ensuring subject able to assume position only (i.e. not held).
- Instruct the subject to hold the position as long as safely possible.
- Record the time in the space provided on the Modified Physical Activity Questionnaire.
- Repeat on the other side

Termination Criteria:

- When the hips return to the exercise mat
- Subject unable to assume position on practice trial
- Subject terminates the test
- Subject refuses to attempt test
- Subject unable to properly cue T-A