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The relationship of disability (Oswestry) and pain drawings to functional testing

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Abstract There was much enthusiasm about the development of computerized dynamometry in providing large quantities of data to objectively assess muscle performance. However, a much more basic issue arose questioning what these machines actually measure, particularly in pain populations. The purpose of the present study was to determine whether patients' self-reported disability and pain expression, as evaluated with simple questionnaires, were related to isokinetic performance in low back pain patients. **Method:** Oswestry Disability Questionnaires and pain drawings were collected from 76 patients undergoing isokinetic testing upon entering a physical rehabilitation program. Isokinetic trunk testing was performed in the standing position and results recorded for flexion and extension at speeds of 50°, 100°, and 150° per second. **Results:** Patients indicating minimal disability on the Oswestry questionnaire performed better than those indicating greater levels of disability ($P < 0.05$; ANOVA with Tukey ad-

justment for multiple comparisons). Patients with greater pain drawing scores, indicating unusual pain patterns, performed more poorly during isokinetic testing than those with normal drawings ($P < 0.05$). Regression analysis revealed that the lifting question from the Oswestry questionnaire, pain drawings scores, and sex were all significantly related to isokinetic performance and could account for 37.6–48.1% of the variance in performance (varying with speed of test). **Conclusions:** The results of this study indicate that isokinetic test values are significantly influenced by a patient's self-reported disability and pain expression, which can be evaluated using simple tools such as pain drawings and the Oswestry questionnaire. This study supports the supposition that dynamometry testing is related to factors other than muscle performance.

Key words Low back pain · Oswestry disability questionnaire · Pain drawings · Isokinetic testing

Introduction

The great need for objective assessment of low back pain patient led to much enthusiasm for computerized dynamometry. During isokinetic trunk testing, the patient performs trunk flexion and extension movements at a speed selected by the evaluator. The dynamometers are

designed to increase resistance as the subject increases force, so that the velocity of the movements remains constant. Part of the reason for the enthusiasm about these devices was that they purportedly produced large volumes of objective data which were to be interpreted as representing the strength of the patient's trunk muscles. However, interpreting the data, and, in particular, trying to combine data from multiple studies in the literature to

draw broad-base conclusions is difficult at best. Many factors affect test results, some of which are dependent on the type of device being used and others that are directly influenced by the evaluator. Among the options available for testing and data recording are test speed, standing or sitting posture, endurance measures, peak torque, repeatability, and various other measures of a subject's performance. Among the factors controlled by the evaluator are test subject positioning, including methods to isolate trunk muscle groups, and the instructions delivered to the subject [9]. In a comprehensive review of testing with iso-machines, Newton and Waddell describe numerous factors reported to affect test results as well as problems relating to the lack of scientific investigation of these machines in patient populations [12]. They also identified the lack of studies relating test performance to pain and disability.

It seems that all aspects of a pain patient's evaluation and treatment are affected by the patient's pain, personality, and behavior. Many tools are available to help evaluate personality and behavior in back pain patients. There have now been a few studies addressing the effect of these factors on functional testing [4, 7, 16]. Hirsch et al. found that isoinertial performance was significantly worse among patients exhibiting excessive illness behavior as determined by Waddell scores [7, 21]. In a study by Estlander et al. it was found that a simple self-efficacy questionnaire could account for a significant portion of patients' isokinetic performance, particularly at higher test speeds [4]. Many simple evaluations are routinely used in clinical practice including pain drawings and Oswestry Disability Questionnaires. The purpose of this study was to determine whether self-reported disability, as assessed by the Oswestry questionnaire, and/or the patient's manner of expressing pain, as assessed by the pain drawing, were related to isokinetic performance in low back pain patients.

Materials and methods

Oswestry Disability Questionnaires and pain drawings were collected from 76 patients (44 male, 32 female; average age 45 years;

symptom duration greater than 6 months) undergoing isokinetic testing upon entering a physical rehabilitation program. The Oswestry questionnaires were scored as described by Fairbank et al. [5]. It was noted that some of the questions on the Oswestry questionnaire are directly related to physical activities (lifting, walking, etc.) and so the relationship of each question to isokinetic performance was investigated as well as the total score. Pain drawings were scored using the system described by Ransford et al. in which points are assigned for pain in unusual patterns [15]. Specifically, points are assigned for items unlikely to be associated with back pathology or that might be related to patients' overexpressing their pain. These include whole-body pain, bilateral foot pain, circumferential extremity pain, using extra words or symbols to draw attention to pain severity, and indicating pain outside the body.

Trunk isokinetic testing was performed in the standing position on the LidoBack unit (Loredan Biomedical, Davis, Calif.). Results were recorded for flexion and extension at speeds of 50°, 100°, and 150° per second. Each patient completed 20 repetitions at each speed with a rest period between bouts. The total work performed was used for analysis. This value was selected for analysis because it was thought to be more representative of a patient's performance than is an isolated peak torque value.

The mean isokinetic test results were compared based on pain drawing scores and Oswestry scores using ANOVA with Tukey adjustment for multiple comparisons. The correlation coefficients for the Oswestry questionnaire, its individual questions, pain drawings, and isokinetic performance were calculated. Regression analyses were conducted to determine what percentage of the variation in isokinetic performance could be explained by demographic variables, Oswestry questionnaires, and pain drawings. All statistics were performed using SPSS PC/+ software (SPSS, Inc., Chicago, Ill.).

Results

Relationship between pain drawings and Oswestry questionnaire

The average total Oswestry score was significantly greater among patients providing the most unusual pain drawings (score of 3 or more) than for those whose drawings demonstrated no unusual patterns (a score of 0) (46.9 vs 27.23; $P < 0.05$; ANOVA with Tukey adjustment for multiple comparisons).

Table 1 Mean (standard deviation) of isokinetic work (J) in each of the Oswestry Disability categories

Test speed	Oswestry Disability			
	Minimal: score 0–20 (<i>n</i> = 11)	Moderate: score 21–40 (<i>n</i> = 33)	Severe: score 41–60 (<i>n</i> = 29)	Crippled: score >60 (<i>n</i> = 3)
50°/sec				
Flexion	914.8 (355.89)	506.8 (292.77)*	402.6 (321.38)*	25.7 (8.33)*
Extension	1095.2 (599.58)	593.7 (375.84)*	478.0 (444.19)*	29.7 (17.93)*
100°/s				
Flexion	726.5 (376.96)	347.2 (250.24)*	232.1 (197.28)*	19.3 (4.04)*
Extension	835.2 (614.30)	398.4 (298.40)*	277.2 (232.49)*	19.0 (9.64)*
150°/s				
Flexion	2032.6 (1191.74)	908.3 (770.85)*	606.8 (557.56)*	91.3 (16.80)*
Extension	1909.5 (1414.71)	1117.4 (964.76)	664.4 (672.40)*	44.7 (13.05)*

*Significantly less than those indicating minimal disability; $P < 0.05$; ANOVA with Tukey adjustment for multiple comparisons

Relationship between Oswestry questionnaire and isokinetic testing

In all six isokinetic evaluations, patients with minimal self-reported disability on the Oswestry questionnaire performed better than those indicating greater levels of disability (Table 1).

The total Oswestry scores were in negative correlation to isokinetic performance (correlation coefficients ranging from -0.47 to -0.38 , varying with test speed). Of the individual Oswestry questions, the one dealing specifically with lifting was more strongly related to isokinetic performance, accounting for 21.5–28.4% of variation in performance, than were any of the other items or the total score. Although there were only three patients who were classified as “crippled” based on the Oswestry score, their functional performance was less than 10% of the values of the other patient groups. Interestingly, the Oswestry question asking specifically about pain did not correlate significantly with functional testing at any speed in either flexion or extension.

Relationship between pain drawings and isokinetic testing

As can be seen in Table 2, in all isokinetic evaluations, patients with greater pain drawing scores performed more poorly than patients with normal drawings ($P < 0.05$;

ANOVA with Tukey adjustment for multiple comparisons). With the exception of testing performed at $150^\circ/\text{s}$, patients scoring 0 and 1 on the drawings performed quite similarly to each other, as did those with scores of 2 and greater than 2.

Regressions combining pain drawings and Oswestry questionnaire with isokinetic testing

A series of stepwise regression analyses were conducted to determine which factors were most strongly associated with isokinetic performance (Table 3). First, the demographic variables age, sex, height, and weight were put in as independent variables and the isokinetic performance as the dependent variable. While individually these variables (with the exception of age) were significantly related to performance, sex was the most strongly related, and once it was entered into the regression, the remaining demographic variables failed to explain any more of the variation in performance. The total Oswestry score could explain 15.6%–22.3% of the variation in isokinetic values, depending on the speed of the test. The Oswestry question dealing with lifting could account for 21.5–24.4% of test performance variation. Further regression analysis revealed that even after the Oswestry lifting question responses were entered, the pain drawing scores were significantly related to performance ($P < 0.05$) in the majority of the six test modes. When these two variable were

Table 2 Mean (standard deviation) of isokinetic work (J) based on pain drawing score. Means compared using ANOVA with Tukey adjustment for multiple comparisons

Test speed	Pain drawing score				Significantly different groups (<i>P</i> < 0.05)
	0 (<i>n</i> = 13)	1 (<i>n</i> = 22)	2 (<i>n</i> = 28)	>2 (<i>n</i> = 13)	
50°/s					
Flexion	767.9 (394.92)	625.5 (289.18)	350.7 (314.15)	382.5 (337.93)	(0,2) (0,3) (1,3)
Extension	971.2 (613.17)	649.1 (323.04)	464.1 (483.25)	437.5 (411.62)	(0,2) (0,3)
100°/s					
Flexion	607.9 (365.39)	438.3 (260.22)	212.6 (240.15)	210.8 (184.17)	(0,2) (0,3) (1,2)
Extension	724.9 (574.78)	451.3 (269.3)	292.0 (398.83)	223.1 (216.77)	(0,2) (0,3)
150°/s					
Flexion	1860.0 (1233.98)	1119.4 (801.73)	544.4 (554.98)	473.4 (348.30)	(0,1) (0,2) (0,3) (1,2)
Extension	1931.8 (1470.13)	1184.0 (839.53)	675.0 (798.38)	555.1 (456.83)	(0,2) (0,3)

Table 3 Percentages of variance in isokinetic performance that could be accounted for by the various factors (R^2 values from regression analyses)

	$50^\circ/\text{s}$		$100^\circ/\text{s}$		$150^\circ/\text{s}$	
	Flexion	Extension	Flexion	Extension	Flexion	Extension
Pain drawing	14.2	10.9	21.0	14.4	24.9	18.4
Oswestry total	20.4	15.6	22.3	15.7	18.9	54.3
Oswestry lifting	24.9	21.5	24.0	24.4	24.0	24.1
Pain drawing and Oswestry lifting	30.8	25.7	38.6	30.7	38.0	33.2
Pain drawing, Oswestry lifting, and sex	42.3	37.6	48.1	43.7	45.5	43.4

combined with sex, all three contributed significantly to the regression and accounted for 37.6–48.1% of the variance of isokinetic trunk performance.

Discussion

The results of this study indicate that there is a significant relationship between performance during isokinetic testing and patient self-reported disability and pain expression. Our results support those of other studies relating dynamometric testing to personality and behavioral factors as assessed by self-efficacy questionnaires, Waddell scores, Coopersmith self-esteem scores, and the Million index [4, 7, 11, 16].

In the current study, the single item best related to test performance was the lifting question from the Oswestry questionnaire. This was more strongly related to performance than was the total score. It may be that this question assesses the patient's self-perceived ability to perform a physically strenuous activity. It is well documented that pain-related fear, a component of pain behavior, is a significant factor in chronic back pain [2, 20]. Lifting is conceptually the most physically strenuous item asked about on the questionnaire. Isokinetic testing requires physical exertion. It may be that patients with a high level of pain-related avoidance of strenuous activities, such as lifting, also demonstrate the same avoidance during strenuous functional testing. This may explain, at least in part, the relationship we found between the lifting question and functional performance.

Isokinetic testing is most often used in a rehabilitation setting. If the results of the test are low and the patient demonstrates inappropriate illness behavior, care providers should pay particular attention to issues of fear-avoidance behavior and address these problems during the course of treatment. Rainville et al. found that, although patients anticipated that pain would increase with activity, in actuality fact it did not consistently increase [14]. They found that significant improvements could be attained in physical activities without a correlative increase in pain. Hazard et al. investigated the impact of disability exaggeration on the outcome of a comprehensive rehabilitation program [6]. They found that disability exaggeration, identified at time of program entry, was not associated with a poor treatment outcome. However, the program included components designed to address psychosocial issues. Both of these studies suggest that, while illness behavior certainly exists in back pain patients, it can be addressed during rehabilitation and its deleterious effects can be overcome.

In the present study there were only three patients who were classified as "crippled" on the basis of the Oswestry questionnaire. Among these patients, the isokinetic measures were grossly reduced compared to the rest of the study group. It is interesting to note that the question from

the Oswestry questionnaire dealing with pain was not related to isokinetic performance. However, this may be due to the question's relating pain to medication usage rather than asking about pain itself.

Our finding that the pain drawings were related to isokinetic performance is consistent with findings from other studies that related the drawings to Waddell signs [1] and the Waddell signs to dynamometric testing [7]. In the present study, the scoring system described by Ransford et al. was used to score the drawings [15]. In their paper, pain drawing scores of 0, 1, and 2 were considered normal and scores of greater than 2 were considered to indicate abnormal pain expression. This classification was related to the hysteria and hypochondriasis scales on the Minnesota Multiphasic Personality Inventory. Ohnmeiss et al. reported that when investigating the relationship of pain drawing scores to discographic pain responses, the relationship appeared to split between 2 and 3 of the Ransford scoring system [13]. However, in the present study, when considering isokinetic performance, the major difference was noted between Ransford scores 1 and 2. It cannot be determined from this study if this was due to differences between Finnish and American patients. Udén et al. reported that non-Scandinavians had a greater proportion of nonorganic drawings (this term was used to describe drawings from back pain patients with pain in patterns not thought to be explained by spinal pathology) than did Scandinavians [19]. Also, it should be noted that in one of the American studies [13] the population was comprised of patients who had failed to achieve sufficient relief after rehabilitation treatment and were undergoing discography, and who may have been in a more severe condition overall than the patients in the present study. Abnormal pain drawings from low back pain patients have been related to patients somatizing their pain [17]. This may be reflected in poor performance during physical functional testing.

It has been reported that back pain patients demonstrating inappropriate illness behavior indicate pain in nonanatomical patterns or magnified pain patterns on pain drawings [22]. In our study, such drawings were associated with reduced isokinetic test performance. This supports the supposition that both the drawings and compromised test performance are expressions of illness behavior.

Considering the individual correlation coefficients of the variables sex, height, and weight, all three were related to isokinetic performance. However, the regression analysis revealed that of these variables, sex was the one most strongly related to performance: once it was entered into the equation, height and weight did not significantly account for any more of the performance values. It is interesting to note that in this data set height was more closely related to performance than was weight. Some authors tend to report weight-adjusted values for isokinetic testing [8, 10, 18]. While such adjusting is intuitively appealing and probably does not have detrimentally influ-

ence results, the present study supports the work of Delitto et al. [3] indicating that such adjustments are unnecessary. In their review, Newton and Waddell were unable to find literature to support the practice of adjusting performance values for weight in patient populations [12]. The tendency to adjust for body weight may be related to a highly significant *P*-value generated in correlation tables for various measures of isokinetic performance and body weight. However, this is a measure of the linearity of the relationship of the variables, not the relationship of the variables themselves. To determine this, one needs to inspect the actual *r* and *r*² values associated with the correlation.

Poor performance on isokinetic testing has generally been thought to be reflective of poor neuromuscular function or strength deficit. The present study supports the hypothesis that a patient's perception of pain and level of disability affect performance and that these factors should be taken into account in the interpretation of isokinetic test results. The Oswestry questionnaire and pain drawings, which are inexpensive, easy to evaluate, and are already used routinely in many centers, may help clinicians to interpret isokinetic performance values and, particularly, to identify patients whose poor performance may be related to inappropriate illness behaviors.

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