RAPID REPEAT TESTING OF GRIP STRENGTH FOR DETECTION OF FAKED HAND WEAKNESS

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This study assessed the use of rapid, repeated measurement of grip strength to detect feigned hand weakness. Normal participants, performing with maximum effort or feigning hand weakness, and patients recovering from carpal tunnel surgery were asked to grip a Jamar dynamometer alternately with each hand on ten occasions.

The results showed that grip strength fatigued by an average of 23% during the test in the normal participants, 18% in participants faking weakness, and increased by 2% in the carpal tunnel decompression patients. An increase in grip strength after the first effort was found in 39% of normal participants, 52% of participants faking hand weakness and in 69% of the carpal tunnel decompression patients.

These results suggest that rapid, repeated measurement of grip strength is not a reliable discriminator of true and faked hand weakness.

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Grip strength is commonly used to assess hand function and monitor recovery after hand injury and surgery. However, it is not a pure objective measure as it relies heavily on the full co-operation of the patient. The detection of submaximal performance due to insincerity of effort is therefore important, as some participants may feign weakness for social or financial gain, and others may have psychological, rather than physical, hand weakness.

The five-position grip strength test (Stokes, 1983) and the rapid exchange and rapid simultaneous grip strength tests (Hildreth et al., 1989; Joughin et al., 1993) have been devised to detect faked hand weakness. However, the reliability of the five-position grip strength test has been questioned (Niebuhr and Marion, 1990; Tredgett et al., 1999), and the other two tests are time consuming and are frequently performed incorrectly in clinical practice.

Rapid repeat measurement of grip strength is used by some clinicians to assess whether hand weakness is real or feigned. It is thought that muscle fatigue should cause a decrease in grip strength during the test in patients with true weakness, whereas fatigue should not occur and grip strength should remain constant or increase when hand weakness is feigned. This study validates the use of rapid repeat measures of grip strength for the detection of feigned hand weakness.

STUDY DESIGN

Forty-one healthy volunteers with no history of upper limb pain, injury or disability underwent a rapid repeat grip strength test on both hands whilst giving maximum effort. Thirty-three of the 41 were female and the mean age was 33 years (range, 23–61). Three participants were left hand dominant.

Twenty-five of the 41 healthy participants repeated the rapid repeat grip strength test on both hands one week later, but on this occasion they were instructed to fake 50% weakness of one hand which was selected at random.

A group of 44 females and 21 males with a mean age of 54 years (range, 27–84) were asked to perform a rapid repeat grip strength test 6 weeks after undergoing a unilateral open carpal tunnel decompression. Seven of these patients were left hand dominant and they were all considered to have genuine hand weakness on the operated side.

Every participant in the study performed a rapid repeat grip strength test using a Jamar dynamometer (Asimow Engineering Co. Santa Monica, California) set at the second handle setting. This is usually the width at which maximum grip strength is obtained (Bechtol, 1954; Tredgett et al., 1999). A single calibrated Jamar dynamometer was used throughout the study, and standard instructions were given to each participant. Each participant was seated with the shoulder in neutral, the elbow at 90° of flexion and the forearm and wrist in neutral. The dynamometer was supported by the clinician and was gripped alternately with both right and left hands on ten occasions, or until the participant had to stop due to fatigue or discomfort. The repeated gripping was performed as fast as possible, but allowing the clinician to record each individual measure of strength (approximately every 2 seconds). No participant had any prior experience or knowledge of the rapid repeat grip strength test, and a single investigator supervised all the tests.

Sensitivities and specificities for various parameters of the rapid repeat grip test were calculated to assess their effectiveness in detecting faked hand weakness. Sensitivity was determined by calculating the percentage of participants faking hand weakness who were correctly identified. Specificity was calculated by combining the

results for the participants when performing with maximal effort and the carpal tunnel surgery patients, and determining the percentage of these people who the test considered were faking hand weakness.

RESULTS

All the 41 normal volunteers using maximum effort, and the 25 who undertook the second rapid repeat grip strength test whilst faking 50% weakness of one hand, completed the ten repetitions of grip strength measurement. Of the 65 carpal tunnel decompression patients, only two were unable to complete the ten repetitions due to discomfort. Thirty-nine of these 65 (60%) patients reported significant pain in the operated hand during the test, and another 13 (20%) predominantly experienced a feeling of hand weakness.

When the healthy participants were asked to fake 50% weakness, the median value of the first measure of grip strength in the 'weak' hand was 40% (range, 8–91%) of their 'normal' hand. The median value for the initial grip strength of the operated hand of the carpal tunnel decompression group was 58% (range, 11–163%) of their normal hand.

Median grip strengths over the course of the rapid repeat grip strength test in all three groups are shown in Figure 1. Grip strength was found to decrease during the test, by a median of 23% (range of decrease, 17–41%) in normal healthy hands, and by a median of 18% (range, 66% decrease to 75% increase) in the 'weak' hands of participants faking hand weakness. Grip strength actually increased by a median of 2% (range,70% decrease to 300% increase) in the operated hands of the carpal tunnel decompression patients. The last (tenth) measure of grip strength was always weaker than the first in the normal participants performing with maximum effort, but was equal or stronger in seven of the 25 hands (28%) with faked weakness, and 34 of the 65 (52%) carpal tunnel surgery hands. Using this parameter as the determinant of faked hand weakness results in a test with 28% sensitivity and 68% specificity. The grip strength of each individual did not always steadily decrease with each repetition of the rapid repeat grip strength test. The second, third or fourth grip strength measurements were greater than the first measurement in 16/41 (39%) hands of the normal participants, 13/25 (52%) of the participants faking hand 'weakness' and 45/65 (69%) of the operated hands of the carpal tunnel patients (52% sensitivity and 43% specificity for detecting faked weakness). If grip strength at any stage of the rapid repeat test exceeding that recorded on the first of the ten grip measurements was used as the determinant of faked hand weakness, then 18/41 maximally performing patients and 49/65 of the carpal tunnel decompression patients would be suspected of malingering. In contrast, 37% of participants faking hand weakness would not have been detected. The sensitivity and specificity of this criterion for detecting malingering are 73% and 41% respectively.

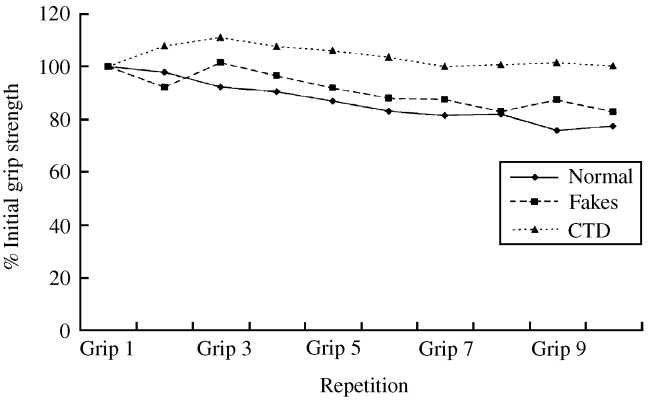

Fig 1 Graphs of median grip strengths in normal participants, participants faking 50% hand weakness and patients after carpal tunnel decompression (CTD) during the rapid repeat grip strength test. Large variability was present, and there was no statistical difference between the curves. Error bars not shown for clarity.

The percentage variability of the first three measurements of grip strength in the rapid repeat grip strength test was calculated, as described by Swanson et al. (1990) and Ashford et al. (1996). In normal hands the first three measurements varied by a median of 17% (range, 3–64%), and in hands with faked hand weakness the median variability was 38% (range, 0–92%). In the carpal tunnel decompression hands the median variability was 28% (range, 0–114%). A variability of over 20% has been suggested as a discriminator of true and faked hand weakness (Swanson et al., 1990). If this criterion were applied to the present study, 14 (35%) of 41 normal healthy hands and 36 (55%) of the 65 carpal tunnel surgery hands would have been classified as faking hand weakness (47% specificity). However, 18 (72%) of the 25 who faked weakness would have been correctly identified as faking hand weakness (72% sensitivity).

DISCUSSION

The Jamar dynamometer is widely used in clinical practice to measure grip strength and provides an accurate, reliable and valid measure of isometric grip strength in motivated participants (Mathiowetz et al., 1984). However, grip strength is determined by many factors, not least of which is patient compliance, and it is therefore an objective measure of a subjective physical attribute.

A number of different methods have been described to distinguish true from faked hand weakness (Gilbert and Knowlton, 1983; Niebuhr et al., 1993; Smith et al., 1989). Previous studies have suggested that faked

weakness can be detected using dynamometers linked to computerized load cells (Gilbert and Knowlton, 1983; Smith et al., 1989), or by simultaneous EMG recordings (Janda, 1987), but neither of these methods is readily used in daily clinical practice.

The Jamar dynamometer has been used in a number of structured tests which attempt to determine sincerity of effort. The five-position grip strength test uses the five handle settings of this dynamometer to measure grip strength at five different grip widths. In normal motivated participants maximum grip strength occurs at the second or third grip width, and a maximum grip strength at the first or fifth width setting is indicative of malingering. This test has been reported to reliably detect feigned weakness (Stokes, 1983), but others have questioned its sensitivity and specificity (Niebuhr and Marion, 1990; Tredgett et al., 1999). Two other tests that use the Jamar dynamometer are the rapid exchange and rapid simultaneous grip tests. These both compare the maximum grip strength during a five-position grip strength test (static measure) with the maximum grip strength recorded when gripping the dynamometer repeatedly at a fast rate (80/min: dynamic measure). In normal healthy motivated participants the static measure of grip strength should be approximately 15% greater than the dynamic measure, while in participants faking weakness the dynamic measure is equal to, or greater than, the initial static measure (Hildreth et al., 1989). Both the rapid exchange and rapid simultaneous grip strength tests have been reported to accurately detect feigned hand weakness with up to 80% sensitivity and 87% specificity (Hildreth et al., 1989; Joughin et al., 1993), but they are relatively time-consuming and rarely performed properly in the clinical setting.

This study investigated whether a simpler test, in which grip strength is rapidly and repeatedly measured at a fixed grip width, can detect feigned hand weakness. This test is relatively frequently used in clinical practice, and often erroneously referred to as the rapid exchange grip strength test. It has never been validated, but is based on the assumption that muscle fatigue will occur if the patient is performing with maximum effort, and this will cause a gradual reduction in grip strength during the test. In people feigning hand weakness muscle fatigue should not occur and grip strength should either remain unchanged, or increase, during test. The results of the present study demonstrate that the first grip effort is not always the strongest in well motivated participants, and that even they do not always fatigue in a progressive manner. Also, the carpal tunnel decompression patients tended to show an initial increase in grip strength, before then fatiguing later in the test. This finding could be explained by a reticence to give maximum effort initially due to anticipated discomfort. Thus an increase in grip strength during the rapid repeat grip strength test cannot be used as a method of detecting faked hand weakness as it has poor sensitivity and specificity.

As well as the first grip not being the strongest, there was marked variability of grip strength during rapid repeat grip strength testing, even in normal motivated participants. If a variability of greater than 20% for the first three measurements of grip is used to define voluntary submaximal performance (Swanson et al., 1996), our results show that this test only has a sensitivity of 72% and a specificity of 47%.

The results of our study suggest that rapid and repeated measurement of grip strength is not a reliable discriminator of true and faked hand weakness. Thus the rapid exchange grip strength and rapid simultaneous grip strength tests remain the only validated methods of detecting feigned weakness, though even these have not been fully assessed. This is because these tests have only been assessed in normal participants either performing with maximum effort or feigning weakness (Hildreth et al., 1989) and in normal people, people suspected of feigning hand weakness and patients with partial hand amputations who were attending a prosthesis clinic (Joughin et al., 1993). Neither test has been assessed in motivated people with hand weakness secondary to pain. It is possible that, like the carpal tunnel patients in the present study, such patients may produce grip strength patterns which are indistinguishable from those of people feigning weakness.

It has been suggested that combining the results of different grip strength tests may be a more accurate discriminator of true and faked hand weakness (Stokes et al., 1995), and it is likely that no single test will reliably detect faked hand weakness. A full clinical evaluation with some objective measurements will often be required, but even then feigned disability and hand weakness may not be detected.

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