Grip Strength Testing to Differentiate Sincere from Insincere Weakness

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Introduction
Injuries to the upper limb are a common presenting complaint to accident and emergency departments. These injuries may result in litigation where amount of compensation may be related to amount of functional impairment. There is therefore a powerful motivation for malingering patients to invent or exaggerate functional impairment. The objective assessment commonly used in the assessment of upper limb function is grip strength. Although a simple test to apply it is also open to manipulation, there has been extensive research into developing a technique to reliably discriminate feigned from genuine weakness but largely without success1-10.

We present the results of a prospective, randomised partially blinded trial developing a technique to discriminate feigned from sincere grip weakness through the use of a computer linked jamar dynamometer (Biometrics Ltd, Gwent UK) and sophisticated multi-variant analysis.

Materials and Methods

Subject Groups:
1. Patients: 50 patients recruited from the orthopaedic and hand therapy clinics of the RHCH, Winchester, with a genuine grip weakness.
2. Feigning Individuals: 50 Volunteers recruited from the junior medical and allied health professions of the RHCH, Winchester functioning with a 50% weakness on one hand
3. Control Group: The 50 volunteers were also tested at full strength.

All subjects were consented prior to participation.

Testing Regime:
4 researchers collected data using a standard technique and testing position (see fig 1) with a single calibrated Jamar dynamometer. Basic demographic data was recorded and grip strength was assessed in the following fashion:
1. 3 Baseline readings
2. Rapid exchange testing: 8 readings taken from each hand at an interval of 1.5s.
3. Endurance Grip: 3 Readings of 5 seconds from each hand with data sampling at 20Hz.

All readings were obtained with the dynamometer set at position 2.

Statistical Analysis:

Logistic Regression is a process that develops an equation to assess the probability that a subject will complaint to accident and emergency departments. These injuries may result in litigation where amount of weakness belong to one of two groups (feigned or genuine) based on available data. In our analysis all data for both hands of all patients was made available and Forward Conditional Logistic Regression was performed using SPSS 12.0 (SPSS Inc., USA). For comparison, the data was also assessed using standard Rapid Exchange Testing, Logistic Regression assessment of all Rapid Exchange data and Logistic Regression of Smith Variables.

Results

1. In our study the use of sophisticated multi-variant analysis techniques has allowed the development of an assessment technique that achieved sufficient power to be clinically useful.
2. Neither Rapid Exchange Testing nor Smith Criteria Analysis in isolation can be recommended as levels of sensitivity and specificity were too low to be reliable.
3. The additional analytical criteria developed for this study offer valuable additional information.
4. A further blinded trial is required to validate the technique developed in this study.

Data Analysis:

<table>
<thead>
<tr>
<th>Specific Test</th>
<th>Source Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Max. Rapid Exchange / Max. Baseline Reading</td>
<td>Westbrook et al 200111, Tredgett et al 200510, Hildreth et al 19891</td>
</tr>
<tr>
<td>% Max. Rapid Exchange / Max. from Baseline and Endurance readings</td>
<td>Novel Statistic</td>
</tr>
<tr>
<td>Coefficient of variation of Rapid Exchange Readings</td>
<td>Novel Statistic</td>
</tr>
<tr>
<td>Initial Force Application Rate</td>
<td>Gilbert et al 19833</td>
</tr>
<tr>
<td>Ratio of Gradients of Initial Force Application</td>
<td>Novel Statistic</td>
</tr>
<tr>
<td>Sustained Grip Analysis using analysis criteria devised by Smith et al (5 variables: D1-D5)</td>
<td>Smith et al 19899, Chengalur et al 198910</td>
</tr>
<tr>
<td>Plateau Phase Decay Gradient</td>
<td>Novel Statistic</td>
</tr>
<tr>
<td>Plateau Phase Decay Gradient Ratio</td>
<td>Novel Statistic</td>
</tr>
</tbody>
</table>

Table 1: Data analysis techniques used with source paper.

<table>
<thead>
<tr>
<th>Testing Parameter</th>
<th>Results from our Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Rapid Exchange Test</td>
<td>Sensitivity 76.50% Specificity 84%</td>
</tr>
<tr>
<td>Rapid exchange with multi-variant analysis</td>
<td>Sensitivity 84% Specificity 80%</td>
</tr>
<tr>
<td>Smith criteria</td>
<td>Sensitivity 86.30% Specificity 90%</td>
</tr>
</tbody>
</table>

Table 2: Sensitivity and specificity results for testing parameters.

Conclusion

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References: