On the treatment of tennis elbow. Effectiveness and prognostics of braces and physical therapy
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The predictive value of the ‘extensor grip test’ for the effectiveness of bracing for tennis elbow

Struijs PAA, MSc; Assendelft WJJ, MD, PhD; Kerkhoffs GMMJ, MD; Souer S, MSc; van Dijk CN, MD, PhD
Abstract

Background Tennis elbow is a common complaint. Several treatment strategies have been described, such as corticosteroid injections, physical therapy and braces. In a randomised controlled trial, effectiveness of brace-only, physical therapy and the combination of both were compared. Aim of the presented subgroup analysis was to determine the predictive value of the extensor grip test for effectiveness of bracing as treatment strategy in patients with tennis elbow complaints.

Methods Patients with tennis elbow complaints were randomised. The extensor grip test was performed before randomisation on all patients. Outcome measures at 6 weeks follow-up were success rate, severity of complaints, pain, disability, inconvenience during daily life, satisfaction. Data were transformed into a 100 point scale and analysed using an intention-to-treat analysis.

Results In the brace-only group, significant differences were identified between patients with a positive test and patients with a negative test for three outcome measures. Success-rate in the test-negative group was 23% (5/22), compared to 47% (21/45) in the test-positive group. Mean decrease in pain was 23 (95% Confidence Interval (CI) –3.49) in the test-positive group compared to 11 (95% CI –6.28) in the test-negative group. Mean satisfaction in the test-positive group was 71 (95% CI 48.94) compared to 51 (95% CI 24.78) in the test-negative group. In the physical therapy and combination group, no differences were identified between test-positive and test-negative patients.

Conclusion The extensor grip test seems valuable as a predictive factor for effectiveness of a brace as treatment strategy for tennis elbow over the short-term.
Introduction

Tennis elbow, or lateral epicondylitis, is a common condition, characterised by pain at the lateral epicondyle, aggravated by resisted dorsiflexion of the wrist. The estimated annual incidence in general population is 1-3%. If untreated, the complaint is estimated to last from six months to two years. A variety of treatment strategies has been described over the years. Examples are an expectant waiting policy, corticosteroid injections, physical therapy, orthotic devices and surgery. In Dutch general practice, orthotic devices are prescribed in approximately a quarter of patients presenting with tennis elbow complaints. Theoretically, binding the muscle with a clasp, band or brace should limit expansion and decreases the contribution to force production made by muscle fibres proximal to the band. Despite its common use, the effectiveness has yet to be proven. To predict the effectiveness in a particular patient presenting in general practice, a simple test was applied. The 'Extensor Grip Test' was incorporated in a randomised clinical trial investigating different conservative treatment strategies for tennis elbow. Aim of the study presented was to determine the predictive value of the test for effectiveness of bracing as treatment strategy in patients with subacute and chronic tennis elbow.

Patients and methods

Between January 1999 and May 2000, patients were recruited by both general practitioners and primary care physiotherapists and referred to the 'tennis elbow consultation' in an outpatient clinic setting. Patients were included if they had clinically diagnosed tennis elbow: pain on the lateral side of the elbow, which aggravated with both pressure on the lateral epicondyle of the humerus and resisted dorsiflexion of the wrist. Complaints had to be present for at least six weeks. Exclusion criteria were bilateral complaints, a definite decrease of pain for the last two weeks, treatment for the tennis elbow episode in the last six months and inability to fill out questionnaires.

The hospital's medical ethics committee approved the study.

Study Design

Baseline assessments were undertaken by a doctor (GK) before randomisation and in a blinded setting. Assessments included patient demography, co-morbidity, and baseline values of the outcome measures. After retrieval of informed consent, patients were included in the trial by a researcher (PS). Patients were randomised using a computer program with minimisation strategy for the duration of complaints (i.e. < 3 months; 3-6 months and >6 months). Patients were allocated to one of three treatment groups: (1) brace-only (2) physical therapy (3) brace and physical therapy. All patients underwent the extensor grip test, which is described below.
Treatment
Patients in the brace-only group and the brace and physical therapy group were provided with the brace immediately after randomisation. The brace used was the Epipoint (manufacturer Bauerfeind, Zeulenroda Germany) and use and application were instructed immediately, using a standardised protocol. Patients were instructed to once visit a physiotherapist participating in the trial during the first week of the intervention period for instruction according to the standardised protocol. Patients were advised to wear the brace continuously, only during daytime.

Extensor Grip Test
The patient was asked to dorsiflex with the painful arm against resistance (Figure 1). After one minute rest, the patient was asked to perform the same test. However, this time the researcher (PS) gripped the patient’s arm, just below the elbow, thus simulating the effect of the brace. It was noted whether the second test was less painful (positive test) or not (negative test). The test was performed after inclusion and before the randomisation procedure.

Outcome assessment
Outcomes were assessed by the blinded assessor (GK) at six weeks after randomisation. Thus, the assessor was unaware of the result of the extensor grip test. The outcome measures were:
(a) global measure of improvement assessed on a 6-point scale (1. completely recovered;
2. much improved; 3. little improved; 4. not changed; 5. little worse; 6. much worse). This measure was dichotomised: patients reporting to be completely recovered or much improved were noted as a success.
(b) Severity of the patient’s complaints (11-point numeric scale, 0 = no complaints 10 = severe complaints).
(c) Patients were asked to score the pain intensity of their most important complaint (11-point numeric scale, 0 ‘no pain’ 10 ‘severe pain’);

(d) Pain free function questionnaire (PFFQ) describing ten activities frequently affected in patients with lateral epicondylitis. Each activity was rated 0-4 (0 ‘no discomfort’ - 4 ‘severe discomfort’) by the patient, for a total score ranging from 0-40.\(^\text{10}\)

(e) Satisfaction of the patient with the assigned treatment (11-point numeric scale: 0 ‘not satisfied’ 10 ‘very satisfied’). In the analysis, all outcome measures were transformed to a 100 point scale to be able to compare between outcome measures.

**Statistical Analysis**

The subgroup analyses for extensor grip test result was planned a priori. We determined the predictive value of this extensor grip test for effectiveness of bracing by comparing the results of patients with a negative test to patients with a positive rest. This comparison was performed for all three intervention groups. Because randomisation was not stratified for extensor grip test result, baseline characteristics of all groups were compared. The differences in improvement between the groups with corresponding 95% confidence interval (95% CI) were computed and were compared using one-way analysis of variance (ANOVA). Logistic regression was used to analyse dichotomous outcomes. A linear regression model was applied to determine any correlation between the results and other possible prognostic variables. The prognostic value of the test result was determined comparing all three randomisation groups.

**Results**

*(figure 2; table 1,2)*

Baseline characteristics were comparable for all groups. (Table 1)

**Figure 2 – Success rates at six weeks follow-up (dichotomized outcome measure)**

* Significant difference between groups at 6 weeks at the p<0.05 level
Table 1 - Baseline Characteristics comparing patients with a positive and negative extensor grip test in a trial comparing Brace, Physical Therapy or Both.

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Brace</th>
<th>Physical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive Test (n=46)</td>
<td>Negative Test (n=22)</td>
</tr>
<tr>
<td>Mean age in years (SD)</td>
<td>48 (10)</td>
<td>44 (11)</td>
</tr>
<tr>
<td>Mean duration of complaints in weeks (SD)</td>
<td>18 (15)</td>
<td>24 (24)</td>
</tr>
<tr>
<td>Sex, male (%)</td>
<td>22 (48)</td>
<td>10 (45)</td>
</tr>
<tr>
<td>Dominant arm affected (%)</td>
<td>36 (78)</td>
<td>14 (64)</td>
</tr>
<tr>
<td>Neck / shoulder complaints (%)</td>
<td>12 (26)</td>
<td>7 (32)</td>
</tr>
<tr>
<td><strong>Outcome measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severity of complaints, mean (95% CI) *</td>
<td>48 (29.67)</td>
<td>46 (25.67)</td>
</tr>
<tr>
<td>Pain most important complaint, mean (95% CI) *</td>
<td>77 (60.94)</td>
<td>70 (49.91)</td>
</tr>
<tr>
<td>Pain Free Function Questionnaire, mean (95% CI) †</td>
<td>53 (37.69)</td>
<td>48 (31.65)</td>
</tr>
<tr>
<td>Inconvenience, mean (95% CI) ‡</td>
<td>64 (42.86)</td>
<td>66 (46.86)</td>
</tr>
</tbody>
</table>

* Range 0-100, a score of 100 indicates severe pain
† Pain Free Function Questionnaire, modified score (range 0-100), 100 indicates severe disability.
‡ Range 0-100, a score of 100 indicates severe inconvenience.

Table 2 – Results at 6 weeks comparing patients with a positive and negative extensor grip test in a trial comparing Brace, Physical Therapy or Both

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Brace</th>
<th>Physical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive Test (n=46)</td>
<td>Negative Test (n=22)</td>
</tr>
<tr>
<td>Severity of complaints, mean decrease (95% CI) *</td>
<td>12 (-5.29)</td>
<td>6 (-10.26)</td>
</tr>
<tr>
<td>Pain most important complaint, mean decrease (95% CI) *</td>
<td>23 (-3.49)</td>
<td>11 (-6.28)</td>
</tr>
<tr>
<td>Pain Free Function Questionnaire, mean decrease (95% CI) †</td>
<td>11 (-7.29)</td>
<td>9 (-11.29)</td>
</tr>
<tr>
<td>Inconvenience, mean decrease (95% CI) ‡</td>
<td>24 (-7.55)</td>
<td>18 (-10.46)</td>
</tr>
<tr>
<td>Satisfaction, mean (95% CI) ‡</td>
<td>71 (48.94)</td>
<td>51 (24.78)</td>
</tr>
</tbody>
</table>

* Range 0-100, a score of 100 indicates severe complaints
† Pain Free Function Questionnaire, modified score (range 0-100), 100 indicates severe disability.
‡ Range 0-100, a score of 100 indicates severe inconvenience.
§ Range 0-100, a score of 100 indicates very satisfied.
Predictive Value of the Test

In the brace-only group, significant differences were identified between patients with a positive test and patients with a negative test. (Table 2) Statistical significant differences were identified for three of six outcome measures. Success-rate in the test-negative group was 23% (5/22), compared to 47% (21/45) in the test-positive group. Mean decrease in pain for the patient’s main complaint was 23 (95% CI –3.49) in the test-positive group compared to 11 (95% CI –6.28) in the test-negative group. Mean satisfaction in the test-positive group was 71 (95% CI 48.94) compared to 51 (95% CI 24.78) in the test-negative group.
A comparable trend was present for all other outcome measures in the brace-only group. However, differences were not statistically significant. Severity of complaints decreased 12 (95% CI -5.29) in the test-positive group compared to 6 (95% CI -10.26) in the test-negative group. Mean decrease in the pain free function questionnaire was 24 (95% CI -7.55) in the test-positive group and 9 (95% CI -11.31) in the test-negative group. For inconvenience, the test-positive group showed a mean decrease of 24 (95% CI -7.55) and the test-negative group showed a mean decrease of 18 (95% CI -10.46).

For the physical therapy group and the combination group, no statistically significant differences between test-positive and test-negative patients were found. Therefore, no predictive value of the test for success of these treatment strategies could be identified.

**Discussion**

The extensor grip test seems valuable as prognostic test for effectiveness of brace, when used as single treatment.

The test-positives in the brace-only group performed better on success-rate, decrease in pain for the patient’s most important complaint and satisfaction over the short-term. Other outcomes were not statistically significant different, although the results showed a similar trend. However, in the physical therapy group nor the combination group, the test showed any predictive value.

Braces are widely applied for treatment of tennis elbow. However, effectiveness has yet to be proven. The brace supported the patient during daily activities and limited pain during these activities. The reason why the brace seems effective in some, and does not seem effective in other patients is not clear. The extensor grip test was used in an attempt to at least partially predict the effectiveness of a brace in the individual patient. The test is simple, and proved able to discriminate between patients expected to have a successful result and patients with an unsatisfactory outcome after 6 weeks.

Consequently, the test could implicate direction for treatment choice. The results in the test-positive brace-only group were comparable with results on effectiveness of physical therapy and the combination therapy. Thence, in case of a positive test, a brace could be started as initial treatment strategy for the patient with sub-acute and chronic tennis elbow complaints. Braces are relatively cheap and about 47% of patients will be much improved or completely recovered at six weeks. This is comparable with the success rates of the physical therapy group (50%) and the combination group (44%) in the present study. For patients with a negative test, application of a brace as single initial treatment is not advisable, since it is successful in less
than a quarter of the patients at 6 weeks, which is substantially worse than the success rates in the physical therapy and combination groups.

Concluding, the extensor grip test seems valuable as a predictive factor for effectiveness of a brace as treatment strategy for tennis elbow over the short-term. The test can easily be incorporated in daily practice.

**Acknowledgement**

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**Contributors**

PS planned and co-ordinated the data collection, analysed the data, and wrote the paper. WJJA designed the trial and supervised the planning, co-ordination and collection of the data. GK participated in the collection of the data, SS contributed to the data-analysis and CvD contributed to the design of the trial and discussed clinical issues. All trialists contributed substantial in writing the manuscript.

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**Reference List**