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The Predictive Value of the Extensor Grip Test for the Effectiveness of Bracing for Tennis Elbow

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Background: Tennis elbow is a common complaint. Several treatment strategies, such as corticosteroid injections and physical therapy and braces, have been described.

Hypothesis: The extensor grip test has predictive value in assessing the effectiveness of bracing in tennis elbow.

Study Design: Cohort study (prognosis); Level of evidence, 1.

Methods: Patients with tennis elbow complaints were randomized into 3 groups: brace only, physical therapy, and combination brace and physical therapy. The extensor grip test was performed before randomization on all patients. Outcome measures at 6-week follow-up were success rate, severity of complaints, pain, disability, inconvenience during daily life, and satisfaction.

Results: In the brace-only group, significant differences were identified between patients with a positive test result and patients with a negative test result for 3 outcome measures. The 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, –3 to 49) in the test-positive group compared to 11 (95% confidence interval, –6 to 28) in the test-negative group, and mean satisfaction in the test-positive group was 71 (95% confidence interval, 48 to 94) compared to 51 (95% confidence interval, 24 to 78) in the test-negative group. In the physical therapy and combination groups, no differences were identified between test-positive and test-negative patients.

Conclusion: The extensor grip test seems valuable as a predictive factor for the effectiveness of bracing as treatment for tennis elbow over the short term.

Keywords: tennis elbow; randomized controlled trial; treatment; orthotic device; evidence-based medicine; diagnostics

Tennis elbow, or lateral epicondylitis, is a common condition that is characterized by pain at the lateral epicondyle, aggravated by resisted dorsiflexion of the wrist.[5] The estimated annual incidence in the general population is 1% to 3%.[1,4] If untreated, the complaint is estimated to last from 6 months to 2 years.[5,10] A variety of treatment strategies have been described over the years.[5,7] 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 with tennis elbow complaints.[16] Theoretically, binding the muscle with a clasp, band, or brace should limit expansion and decrease the contribution to force production made by muscle fibers proximal to the band.[8,17] Despite their common use, the effectiveness of orthotic devices has yet to be proven.[15] To predict the effectiveness of this treatment in patients being evaluated in general practice, a simple test was applied. The extensor grip test was incorporated in a randomized clinical trial investigating different nonoperative treatment strategies for tennis elbow.[14] The aim of this study was to determine the predictive value of the test for effectiveness of bracing as treatment strategy in patients with subacute and chronic tennis elbow.

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PATIENTS AND METHODS

Between January 1999 and May 2000, patients were recruited by both general practitioners and primary care physical therapists 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 that was 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 6 weeks. Exclusion criteria were bilateral complaints, a definite decrease of pain in the latter 2 weeks, treatment for the tennis elbow episode in the past 6 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 (G.K.) before randomization and in a blinded setting. Assessments included patient demographics, comorbidity, and baseline values of the outcome measures. After retrieval of informed consent, patients were included in the trial by a researcher (P.S.). Patients were randomized using a computer program with minimization strategy for the duration of complaints (ie, <3months, 3-6 months, and >6 months). Patients were then allocated to 1 of 3 treatment groups: (1) brace only, (2) physical therapy, and (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 randomization. The brace used was the Epipoint (Bauerfeind, Zeulenroda, Germany), and patients were instructed in its use and application immediately, using a standardized protocol. Patients were directed to visit a physical therapist participating in the trial once during the first week of the intervention period for instruction, according to a standardized protocol. They were advised to wear the brace continuously, only during daytime.

The patients in the physical therapy group were treated according to a standardized protocol. During the 6-week intervention period, patients received a total of 9 physical therapy sessions, 3, 2, 1, 1, 1, and 1 consecutive session(s) per week, unless complaints had resolved before the end of these sessions. Every session consisted of 7.5 minutes of pulsed ultrasound treatment according to the protocol by Binder et al.[2] Ultrasound is thought to enhance blood flow, increase membrane permeability, and alter connective tissue extensibility and nerve conduction.[16,17]

In addition, patients were treated by friction massage for 5 to 10 minutes.[6,11,16] When pain subsided, patients were instructed by the physical therapist in a strengthening and stretching protocol to perform at home twice daily.[17] All patients were provided an exercise diary in which the therapist described the number and type of exercises they were to perform and in which they noted their compliance with this instructed program. The exercises were done in the physical therapy setting as well, to be sure they were performed in an adequate manner. The exercises were done in steps; when a patient was able to perform an exercise step he or she was allowed to perform the next step. Each exercise included 10 repetitions in 2 or 3 series. The exercise programs were performed 4 to 6 times daily at home. All participating physical therapists took part in a training session, received the protocol, and were visited by the researcher for a final question round.

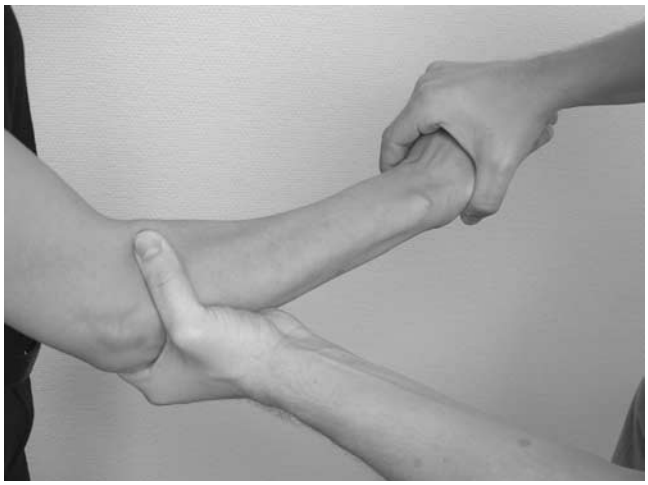

Figure 1. The extensor grip test.

Extensor Grip Test

The patient was asked to dorsiflex the wrist of the painful arm (Figure 1), after which the arm was gripped, simulating the effect of the brace. After 1 minute of rest, the patient was asked to perform the same test in reversed sequence. However, this time the researcher (P.S.) gripped the patient's arm just below the elbow with an estimated 10 to 13 N of pressure, thus simulating the effect of the brace before the dorsiflexion was performed. It was noted whether the test was less painful while simulating the brace (positive test) or not (negative test). The test was performed after the patient's inclusion in the study and before the randomization procedure.

Outcome Assessment

Outcomes were assessed by a blinded assessor (G.K.) at 6 weeks after randomization. Thus, the assessor was unaware of the result of the extensor grip test. The outcome measures were as follows: (1) global measure of improvement assessed on a 6-point scale (1, *completely recovered*; 2, *much improved*; 3, *a little improved*; 4, *not changed*; 5, *a little worse*; 6, *much worse*). This measure

TABLE 1
Baseline Characteristics Comparing Patients With a Positive and Negative Extensor Grip Test in a Trial Comparing Brace, Physical Therapy, or Both

	Brace		Physical Therapy		Combination	
	Positive Test (n = 46)	Negative Test (n = 22)	Positive Test (n = 34)	Negative Test (n = 20)	Positive Test (n = 30)	Negative Test (n = 25)
Mean age, y (SD)	48 (10)	44 (11)	45 (9)	41 (6)	48 (9)	45 (8)
Mean duration of complaints, wk (SD)	18 (15)	24 (24)	16 (15)	18 (19)	22 (45)	20 (25)
Sex, male (%)	22 (48)	10 (45)	19 (56)	10 (50)	16 (53)	12 (48)
Dominant arm affected, n (%)	36 (78)	14 (64)	26 (76)	16 (80)	25 (83)	15 (60)
Neck/shoulder complaints, n (%)	12 (26)	7 (32)	8 (24)	2 (10)	4 (13)	6 (24)
Outcome measures, mean (95% confidence interval)						
Severity of complaints[a]	48 (29-67)	46 (25-67)	46 (27-65)	41 (29-53)	49 (30-68)	46 (32-60)
Pain most important complaint[a]	77 (60-94)	70 (49-91)	72 (53-91)	74 (55-93)	72 (57-87)	73 (58-88)
Pain Free Function Questionnaire[b]	53 (37-69)	48 (31-65)	48 (33-63)	47 (28-65)	49 (33-65)	56 (40-72)
Inconvenience[c]	64 (42-86)	66 (46-86)	60 (37-83)	57 (31-83)	62 (40-84)	56 (40-72)

[a]Range 0 to 100; a score of 100 indicates severe pain.
[b]Pain Free Function Questionnaire, modified score (range 0-100); 100 indicates severe disability.
[c]Range 0 to 100; a score of 100 indicates severe inconvenience.

was dichotomized: patients reporting to be completely recovered or much improved were noted as a success. (2) Severity of the patient's complaints (11-point numeric scale; 0, *no complaints*; 10, *severe complaints*); (3) pain intensity of patients' most important complaint (11-point numeric scale; 0, *no pain*; 10, *severe pain*); (4) the Pain Free Function Questionnaire (PFFQ), a validated score describing 10 activities frequently affected in patients with lateral epicondylitis, in which each activity was rated from 0 to 4 (0, *no discomfort*; 4, *severe discomfort*) by the patient, for a total score ranging from 0 to 40[13]; (5) 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 those of patients with a positive test. This comparison was performed for all 3 intervention groups. Because randomization was not stratified for the extensor grip test result, baseline characteristics of all groups were compared. Continuous outcome measures were compared using independent *t* tests in cases of normal distribution. In cases in which the distribution was not normal, the Mann-Whitney test was applied. Dichotomous outcomes were analyzed using the Fisher exact test. 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 3 randomization groups.

RESULTS

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

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). Statistically significant differences were identified for 3 of 6 outcome measures. The success rate in the test-negative group was 23% (5/22), compared to 47% (21/45) in the test-positive group. The mean decrease in pain for the patient's main complaint was 23 (95% confidence interval [CI], –3 to 49) in the test-positive group compared to 11 (95% CI, –6 to 28) in the test-negative group. Mean satisfaction in the test-positive group was 71 (95% CI, 48 to 94) compared to 51 (95% CI, 24 to 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 to 29) in the test-positive group compared to 6 (95% CI, –10 to 26) in the test-negative group. The mean decrease in the PFFQ was 11 (95% CI, –7 to 29) in the test-positive group and 9 (95% CI, –11 to 29) in the test-negative group. For the outcome measure of inconvenience, the test-positive group showed a mean decrease of 24 (95% CI, –7 to 55) and the test-negative group showed a mean decrease of 18 (95% CI, –10 to 46).

No side effects were noted in either the brace or the physical therapy group.

For the physical therapy group and the combination group, no statistically significant differences between test-positive and test-negative patients were found. Therefore,

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[a]

	Brace		Physical Therapy		Combination	
Outcome Measure	Positive Test (n = 46)	Negative Test (n = 22)	Positive Test (n = 34)	Negative Test (n = 20)	Positive Test (n = 30)	Negative Test (n = 25)
Severity of complaints, mean decrease[b]	12 (–5 to 29)	6 (–10 to 26)	17 (0 to 34)	14 (1 to 27)	22 (3 to 41)	23 (5 to 41)
Pain most important complaint, mean decrease[b]	23 (–3 to 49)	11 (–6 to 28)	30 (5 to 55)	31 (6 to 56)	22 (–10 to 54)	26 (–3 to 55)
Pain Free Function Questionnaire, mean decrease[c]	11 (–7 to 29)	9 (–11 to 29)	18 (5 to 31)	16 (2 to 30)	16 (–2 to 34)	23 (7 to 39)
Inconvenience, mean decrease[d]	24 (–7 to 55)	18 (–10 to 46)	27 (–1 to 55)	24 (–9 to 57)	24 (0 to 48)	24 (–7 to 55)
Satisfaction, mean[e]	71 (48 to 94)	51 (24 to 78)	77 (57 to 97)	74 (52 to 96)	78 (61 to 95)	78 (60 to 96)

[a]Values in parentheses represent 95% confidence intervals.
[b]Range 0 to 100; a score of 100 indicates severe complaints.
[c]Pain Free Function Questionnaire, modified score (range 0-100); 100 indicates severe disability.
[d]Range 0 to 100; a score of 100 indicates severe inconvenience.
[e]Range 0 to 100; a score of 100 indicates very satisfied.

no predictive value of the test for success of these treatment strategies could be identified.

DISCUSSION

The extensor grip test seems valuable as a prognostic test for effectiveness of brace use when used as solitary 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 significantly different, although the results showed a similar trend. However, in the physical therapy group and the combination group, the test did not show any predictive value.

Braces are widely applied for treatment of tennis elbow.[3,8,9,12,16] However, their effectiveness has yet to be proven.[15] The brace supports the patient during daily activities and limits pain during these activities. The reason bracing seems effective in some patients and not others is unclear. In our study, 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 it 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 combination therapy. Thence, in case of a positive test, a brace could be started as initial treatment strategy for the patient with subacute and chronic tennis elbow complaints. Braces are relatively cheap, and about 47% of patients with a positive extensor grip test will be much improved or completely recovered at 6 weeks. This result 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 solitary 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.

Duration of complaints is known to be a prognostic factor in some injuries. In the whole study, prestratification for duration of complaints was performed.[14] Short-term, intermediate-term, and long-term results showed not to be different for prestratified groups, implying no prognostic value of duration of complaints in our study. We chose not to perform subgroup analysis for duration of complaints in the test-positive and test-negative brace-only groups, since numbers of patients would become very small.

Separate subgroup analysis for light/heavy labor showed no differences between treatment strategies for all of the 177 patients who were seen at 6-week follow-up. No separate subdivision for grip-test positive and negative patients was performed because of the resulting very small groups.

CONCLUSION

The extensor grip test seems valuable as a predictive factor for effectiveness of bracing as a treatment strategy for tennis elbow over the short term. The test can easily be incorporated in daily practice. Another way to perform the test might be by simply applying the brace to the patient's elbow to see if this provides an immediate reduction of complaints. The correct pressure to be applied is given by an indicator on the brace, which provides between 10 N and 13 N of pressure.

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