The predictive value of extensor grip test for the effectiveness of treatment for tennis elbow

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ABSTRACT

الأهداف: مقارنة فعالية خمس نماذج مختلفة لعلاج ألم وتر المرفق، وتحديد الفائدة من اختبار القبضة الباسطة (EGT) في التنبؤ لاستجابة للعلاج.

الطريقة: أجريت دراسة سريرية عشوائية شملت 92 من 98 مريضاً، يعانون من ألم وتر المرفق بمستشفى سيناء – طهران – إيران، خلال الفترة ما بين عام 2006م وحتى عام 2007م. من بين هؤلاء المرضى 56 مريضاً (60.9%) يعانون من نتيجة ألم وتر المرفق (EGT). تم تقسيم المرضى عشوائياً إلى خمس مجموعات للعلاج: لبس الطوق (B)، العلاج الطبيعي (P)، لبس الطوق + العلاج الطبيعي (BP)، الحقن (I)، الحقن + العلاج الطبيعي (IP).

النتائج: كانت استجابة المرضى الذين لديهم ألم وتر المرفق (EGT) أفضل للمعالجة. كان من بينهم، مجموعة (IP) الأكثر نجاحاً، ثم المجموعة (BP)، ثم المجموعة (P)، بينما كانت المجموعة التي تلقت الحقن هي الأسوأ في العلاج. كما كانت الاستجابة للعلاج متقاربة لدى جميع المجموعات بين المرضى الذين لديهم نتيجة الم وتر المرفق (EGT) موجبة وسالبة ما عدا الطوق، حيث كانت نتيجة ألم وتر المرفق (EGT) الموجبة ذات صلة مع الاستجابة المفاجئة.

خاتمة: يوصى بارتداء الطوق لدى جميع المرضى في مجموعتي (IP) و (BP)، ولكن ليس للمرضى الذين لديهم نتيجة ألم وتر المرفق (EGT) سالبة، حيث يبدو الطوق غير مجدي. لا يوصى باستخدام الحقن لوحدها في أي من المجموعات.

Objective: To compare the effectiveness of 5 different modalities, and determine the usefulness of recently proposed extensor grip test (EGT) in predicting the response to treatment.

Method: In a randomized controlled clinical trial, 92 of 98 tennis elbow patients in Sina Hospital Tehran, Iran between 2006 and 2007 fulfilled the trial entry criteria. Among these patients 56 (60.9%) had positive EGT result. The stratified EGT result, were randomly allocated to 5 treatment groups: brace, physiotherapy, brace plus physiotherapy, injection, and injection plus physiotherapy.

Results: Patients with a positive EGT result had better response to treatments. Among them, injection plus physiotherapy was the most successful, then brace plus physiotherapy, physiotherapy, and brace injection was the worst treatment modality. Response to treatment was comparable in all groups between EGT positive and negative patients except bracing, in which positive EGT was correlated with a dramatic response to treatment.

Conclusion: In all patients, injection plus physiotherapy and then brace plus physiotherapy is recommended, but in EGT negatives, bracing seems to be of no use. Injection alone is not recommended in either group.

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Tennis elbow or lateral epicondylitis has an incidence of 4 new cases per thousand annually, although tennis causes only 5-10% of all cases,[1] 40-50% of tennis players experience this condition at some time of their life.[2] It is one of the most prevalent causes of disabilities up to 50 years old.[3] The prevalence range is from 1-3% in general population,[2] and peak incidence is at 40-50 years of age.[1] Tennis elbow disease was defined by Runge for the first time in 1873, and more than 30 different etiologies were suggested for it up to now.[3] This problem usually occurs in activities that need repetitive motion of pronation and supination of forearm in full extension elbow, and this condition is presented by pain at the lateral view of elbow with restricted wrist and finger extension.[4] Griping is also impaired so that holding a cup of coffee or giving a handshake is painful and difficult.[2]

Up to now, more than 40 methods of treatment are suggested, but none of them has evidence-based superiority over the others;[5] some of these modalities are shockwave, ultrasound therapy,[6-10,11] botulinum toxin, bracing, physiotherapy, corticosteroid injection, friction massage,[12-15] and mobilization with movement.[4] Moreover, no predictive factor for the treatment effectiveness is also applicable. Recently, Struijs et al have proposed a simple test called extensor grip test (EGT),[16] with its negative result predictive of the non-response to brace use as solitary treatment. Herein, we have designed a randomized controlled clinical trial to compare the effectiveness of 5 different modalities of tennis elbow treatment, and determine the predictive value of EGT for each treatment response.

Methods. The study was performed at Sina Hospital of Tehran, Iran as a prospective randomized control trial between April 2006 and August 2007. Patients with tennis elbow diagnosis were included. The impression of tennis elbow defined with pain and tenderness in lateral epicondyle, especially in 5 mm anterior and distal of the condyle, and the pain increase during dorsiflexion of the wrist, forearm supination, and grasping. The patients complaints must be at least 6 weeks. Exclusion criteria were history of non-operative treatment for more than 6 months bilateral complaint, and not being able to cooperate for 8 weeks follow up. The review board and ethic committee of Sina Hospital approved the study, and all the patients gave informed consent before the participation. Participants were evaluated when they, entered the study. The first evaluating test was extensor weight strength (EWS).[1] The patients were asked to put the forearm on the table and do full extension from full flexion; the maximum weight that the patient could tolerate in this position without pain was documented. The second test was the pain free function questionnaire (PFFQ),[17] wherein the forearm and wrist function and probable disability were evaluated. A group of 10 daily activities that affected the tennis elbow were rated from 0-4 (0: without pain, 4: disable to do because of pain) scored by the patients. Then, scores were summed up to produce PFFQ score. The third parameter was the severity of complaint (SOC) reported by the patient that was rated from 0-10 (0 no complaints, 10 severe complaints).

After recording the baseline clinical characteristics, the EGT was performed on all of the patients to separate them into positive and negative groups. Patients were asked to performed dorsiflexion of the wrist when the elbow is near to extension. This action makes the common extensor origin region painful. After 5 minute of rest, the patient was asked to performed the same action while the clinician will gripped the superior part of the forearm, that clinician's thumb should completely protect the common extensor. If the pain was less than the first time, the test is positive (**Figure 1**). Patients in each group were then randomized, using a random number generator, to receive one of the 5 treatment modalities: bracing, physiotherapy, brace plus physiotherapy, corticosteroid injection, and injection plus physiotherapy. Eight weeks after treatment, patients were reevaluated for response to the treatment by above mention tests. The satisfaction of the patients with the assigned treatments were also evaluated by asking them to indicate score a based on a numeric scale from 0-10 (0 not satisfied; 10 very satisfied). The flow of participants through the study is illustrated in **Figure 2**.

Patients in bracing and brace plus physiotherapy groups need to wear the brace continuously during day time, the estimated time was 10-15 pressure on the elbow. Groups that received physiotherapy according to the standard protocol of the Physiotherapy Department of the hospital, the treatment period was 4 weeks with 4 sessions per week (45 minutes for each session). In the first 2 weeks hot pack and trans cutaneous nerve stimulation were used for 20 minutes that was decreased to 15 minutes in the 3rd and 4th weeks, then ultrasound and friction massage were carried out for 5 minutes. Based on the pain regression, strengthening and stretching activities were taught to the patients. In injection groups, the treatment protocol was to inject a single dose of 10 mg triamcinolone acetonide and one ml Lidocaine 2% in tender region of the common extensor origin. In calculating the sample size, we chose SOC as the main outcome measure. The SD in a pilot study of patients with tennis elbow was one, assuming a clinically significant difference of one on the scale, we calculated that a sample size of 80 (that is, 16 per group) that would result in a power of 0.80 at 5% significance based on comparisons of 2 groups at a time. Hence, the significant p-value is considered when $p<0.05$.

Statistical analysis were performed using SPSS version 16. Generalized linear models were used to compare outcome measures between the study groups, considering post-treatment measure as the dependent variable, result of EGT before treatment and treatment modality as fixed factors, and pre-treatment measure as covariate. All reported contrast estimates were adjusted for baseline measure and the treatment or EGT group.

Results. Out of 98 tennis elbow patients, 92 fulfilled the trial entry criteria and among these patients 56 (60.9%) had positive EGT results. When randomly allocated to treatment groups, 12 entered in bracing group, 9 in physiotherapy, 10 in brace plus physiotherapy, 11 in corticosteroid injection, and 10 in injection plus physiotherapy. The remaining 36 patients who had a negative EGT result were also allocated to these 5

Figure 1 - The extensor grip test: Schematic view.

groups as 7 in bracing, 8 in physiotherapy, 7 in brace plus physiotherapy, 6 in corticosteroid injection, and 6 in injection plus physiotherapy. Baseline characteristics were comparable for all groups and are summarized in **Table 1**. Mean differences between the test results before and after treatment in each study group are summarized in **Table 2**. Patients who had positive result of EGT in overall had better response to treatments. Extensor grip test positive patients had an average (0.41±0.2 SD) scores less severity of complaints after treatment compared to EGT negative ones adjusted for the pretreatment EWS and treatments received, which was marginally significant (p=0.06). This difference was more prominent in PFFQ (1.74±0.2) and patients' satisfaction scores (1.10±0.2), which were both statistically significant

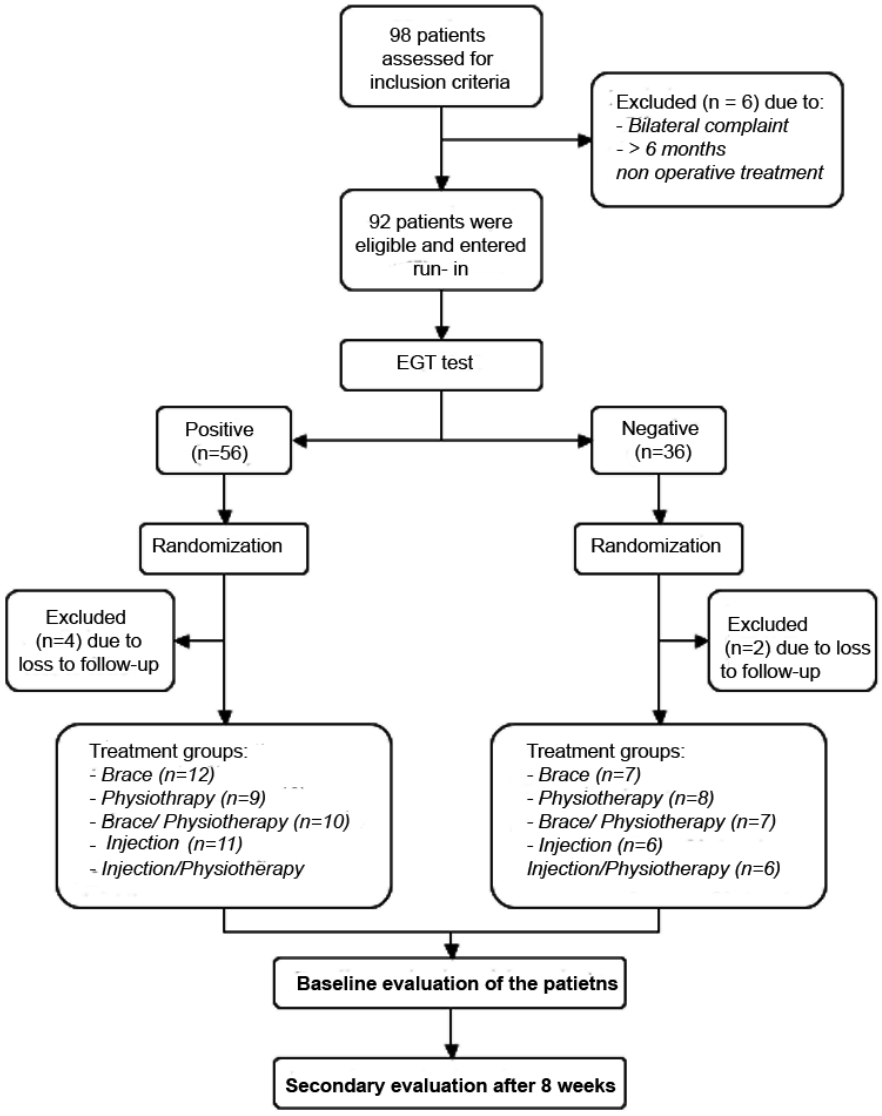

Figure 2 - Flow of the patients through the study.

Table 1 - Comparison of baseline characteristics of patients with positive and negative tests in each treatment group.

Characteristics	EGT	B		P		BP		I		IP	
		Positive n=12	Negative n=7	Positive n=9	Negative n=8	Positive n=10	Negative n=7	Positive n=11	Negative n=6	Positive n=10	Negative n=6
Age (year)	Mean	39.3	40.6	40.8	39.0	40.6	39.7	40.4	40.0	39.3	39.7
	SD	4.9	3.3	4.1	2.9	4.0	3.0	3.9	4.2	2.9	4.0
Male	n	4	3	3	2	3	2	4	2	4	3
	(%)	33	43	33	25	30	29	36	33	40	50
Severity of complaint (range 0-10)	Mean	5.0	4.9	5.4	4.8	5.2	4.9	4.5	4.3	5.3	4.7
	SD	1.4	1.3	1.3	1.5	1.5	1.2	1.1	1.0	1.3	0.8
EWS (kg)	Mean	1.9	2.0	1.5	1.8	1.7	2.0	2.2	2.2	1.8	2.3
	SD	0.9	0.9	0.8	1.0	0.7	0.8	0.8	0.7	0.6	0.4
PFFQ score (range 0-100)	Mean	24.4	23.0	25.1	22.0	24.8	23.7	22.4	21.5	25.4	23.3
	SD	5.6	4.0	4.9	6.7	5.3	4.8	3.6	3.7	4.3	2.9

B - bracing, P - physiotherapy, BP - bracing+physiotherapy, I - injection, IP - injection+physiotherapy, EGT - extensor grip test, EWS - extensor weight strength, PFFQ, pain-free function questionnaire, kg- kilogram

Table 2 - Summary measures of response to treatment in each study group.

Characteristics	EGT	B		P		BP		I		IP	
		Positive n=12	Negative n=7	Positive n=9	Negative n=8	Positive n=10	Negative n=7	Positive n=11	Negative n=6	Positive n=10	Negative n=6
Reduction in severity of complaint	Mean	3.0	1.1	3.3	2.9	3.9	3.0	1.4	0.8	4.0	3.8
	SD	2.5	1.3	2.0	1.4	1.7	1.9	1.7	1.3	2.0	1.7
Increase in EWS (kg)	Mean	1.1	0.3	0.7	1.0	1.2	0.8	0.4	0.0	1.4	1.1
	SD	1.1	0.7	0.8	1.0	0.8	0.7	0.7	0.5	0.7	0.5
Decrease in PFFQ score (range 0-100)	Mean	12.4	2.6	13.3	12.5	16.8	12.6	4.2	2.7	15.4	15.3
	SD	10.3	5.4	7.6	8.2	5.6	8.3	8.0	5.1	7.5	7.2
Patient satisfaction (range 0-10)	Mean	6.1	3.9	6.1	6.0	7.6	5.9	4.0	2.7	7.6	7.7
	SD	4.0	3.8	3.2	3.6	2.2	3.9	3.6	3.3	2.6	2.7

B - bracing, P - physiotherapy, BP - bracing+physiotherapy, I - injection, IP - injection+physiotherapy, EGT - extensor grip test, EWS - extensor weight strength, PFFQ - pain-free function questionnaire, kg - kilogram

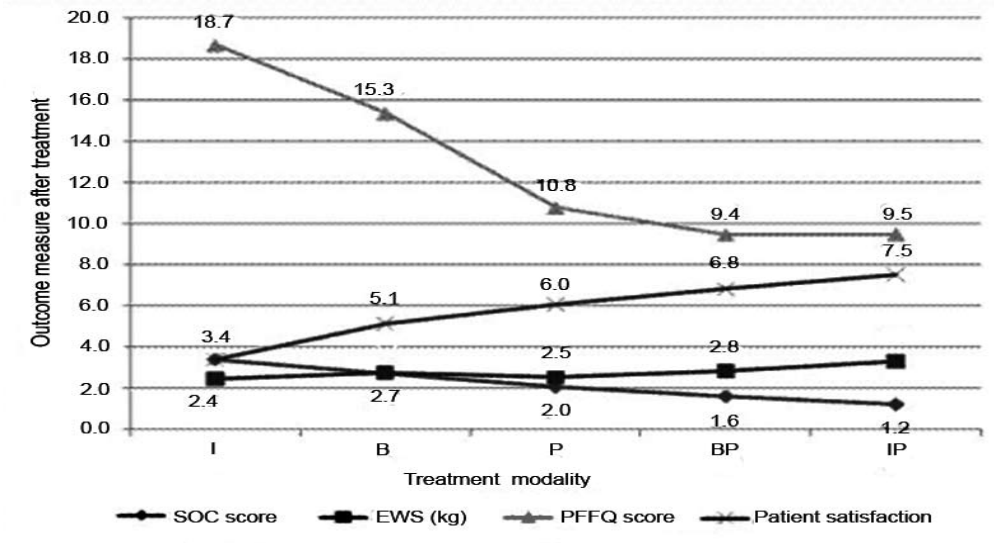

Figure 3 - Comparison of estimates of outcome measures among treatment modalities, after adjustment for the baseline measure and extensor grip test result. B - bracing, P - physiotherapy, BP - Bracing + physiotherapy, I - Injection, IP - injection + physiotherapy, EGT - extensor grip test, EWS - extensor weight strength, PFFQ - pain-free function questionnaire

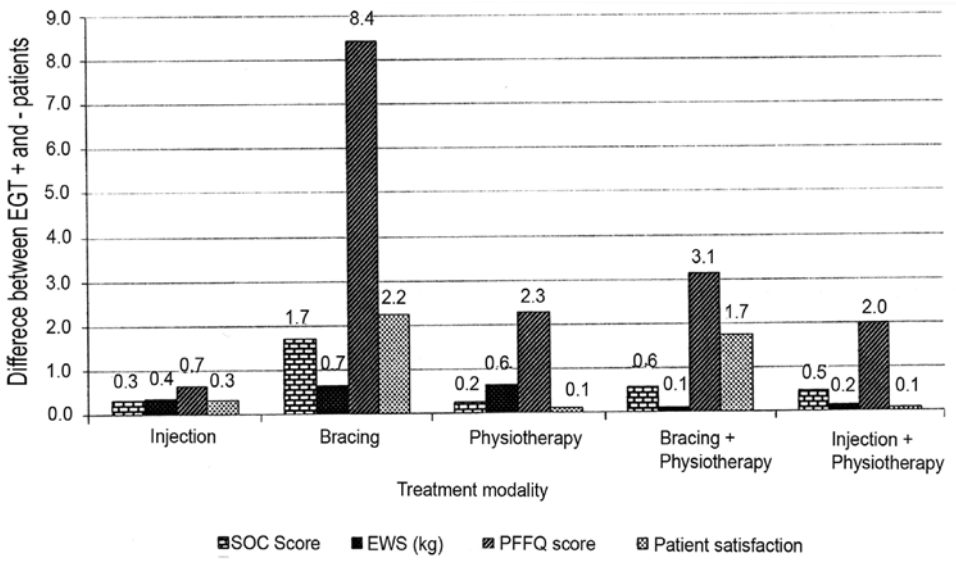

Figure 4 - Comparison of different of outcome measures between extensor grip test result (EGT) positive and negative patients, after adjustment for the baseline measure. EWS - extensor weight strength, PFFQ - pain-free function questionnaire, SOC - severity of complaint, kg - kilogram

(p=0.001). However, EWS showed the least difference between EGT positive and negative patients (0.07±0.2 kg: p=0.74). Regarding the superiority of treatment modalities, altogether, in a consistent pattern observed in all outcome measures, injection plus physiotherapy was the most successful treatment modality, then brace plus physiotherapy, physiotherapy, and bracing, respectively. Injection was the worst treatment modality (**Figure 3**). When comparing the response to each treatment modality between EGT positive and negative patients, it was comparable in all groups except the bracing (**Figure 4**), which showed that EGT can have a predictive value in patients with brace, and positive EGT result was correlated with a dramatic response to bracing, as illustrated in **Figure 4**, PFFQ was 8.4±0.5 scores lower in EGT negatives (p=0.04).

Discussion. The EGT seems valuable as a prognostic test for effectiveness of treatment in tennis elbow disease. The positives test patients had a better treatment outcomes than with the negative test. Aside from the EGT result, treatment responses were observed in injection plus physiotherapy groups that performs the best on success, and corticosteroid injection only produces the weakest treatment response. After injection plus physiotherapy, brace plus physiotherapy, physiotherapy, and bracing showed the best results, respectively. Performed other treatment modalities, this difference was statistically significant in comparing injection plus physiotherapy with corticosteroid injection, bracing and physiotherapy but not when compared with brace plus physiotherapy. Although the consistent superiority of injection plus physiotherapy over brace plus physiotherapy in all measures can be inferred as a clue to its real superiority, studies with more sample size is needed to detect this difference. Although EGT positive patients had an overall better response to treatment; the highest difference was observed in bracing group, which the EGT positives had a dramatically better response to treatment compared to injection plus physiotherapy and brace plus physiotherapy treated patients (**Table 2**). At the same time, bracing effectiveness in EGT negative patients was the least, and the same as patients receiving injection modality. It seems that this finding can be explained by the fact that EGT imitates brace therapy, and can be used partially in predicting the effectiveness of brace in the patient. During the course of follow up, injection modality, showed a short-term effect with reduction in patients' pain but over time the pain exacerbated again resulting in the weakest effectiveness after 8 weeks of treatment. Although some experiences suggested injection modality as an effective treatment option in the short-term, but they also mentioned that it is not satisfactory in the long-term follow up.[18] The main limitation of our study lies in lack of higher number of sample size, which subsequently decreases conclusiveness of our study. However, we proposed injection plus physiotherapy and then we recommended brace plus physiotherapy as a first line treatment for both EGT positive and EGT negative patients, and it seems that the combination modality along with physiotherapy has a satisfactory outcome in

both short-term and long-term period. The causality is not well defined, although we believe physiotherapy has the main role in reconstruction of damaged ligament in the long term, while both bracing and injection help to decrease the inflammation and pain in short time. Exacerbate bracing is only recommended for EGT positive patients and is no longer helpful for EGT negative. In EGT positive patients, bracing can be considered as a good modality due to its simple use and low cost, in line with its comparable outcome with injection plus physiotherapy and brace plus physiotherapy. Furthermore, is not recommended for any of the 2 groups. The EGT seems valuable as a predictive factor for effectiveness of any treatment strategy for tennis elbow disease. The test is simple and can be easily incorporated in daily practice.

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