**Soderberg J, Grooten WJ, and Ang BO. Effects of eccentric training on hand strength in subjects with lateral epicondylalgia: a randomized-controlled trial. *Scand J Med Sci Sports***

**2012; 22: 797–803.**

**PMID:** **21496112**

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**Date:** 4-21-16

**Design:** Randomized single-blinded controlled trial

**Objective:** To investigate the short-term effectiveness of daily home-based eccentric exercises on functional pain-free hand strength in subjects with long-term lateral epicondylalgia (LE).

**Population /sample size/setting:**

* A total of 42 participants including 24 females and 18 males, (mean age 49 years) with clinical signs of lateral epicondylitis were referred from a medical caregiver or recruited through information posters at health-care centers, universities and sports centers in Stockholm, Sweden.
* The 42 patients were randomly assigned to one of 2 groups. The exercise group (n = 20) performed eccentric training for the affected wrist extensors and wore a forearm band. The control group (n=22) wore only the forearm band without eccentric training.
* Inclusion criteria included positive diagnostic criteria such as a history of pain around the lateral epicondyle for at least 1 month, pain at palpation of the lateral epicondyle of the humerus and positive results in two of the following three pain-provocation tests: middle-finger test, resisted extension of the wrist and vigorimeter test.
* Exclusion criteria included those with known rheumatoid arthritis, fibromyalgia, previous surgery in the elbow region, neck dysfunction suggesting possible cervical rhizopathy, entrapment of n.radialis, or those with ongoing treatment or previous treatment less than 3 months before enrollment into the study.

**Methods/Interventions/Outcome Measures:**

* Study design was a randomized, single-blind study with 6 weeks of follow-up.
* Subjects were not informed (blinded) whether the allocated eccentric exercise training or the forearm band was under investigation.
* A randomized block design was used with stratification for duration of elbow pain for < 6 months or > 6 months, and whether the subject was referred from a medical caregiver or came on his/her own following advertising. Allocation after the baseline examination was randomized by each subject picking from a container one of two folded notes labeled “1” for the exercise group or a “2” for the control group.
* The subjects in both groups were instructed to wear the forearm band during all daily activities and to perform warm-up exercises for the wrist extensors including flexion, extension, abduction, adduction and circumduction for 1 minute twice a day. They were also instructed to avoid activities that increased their pain. Both groups kept a diary of their forearm band use.
* The subjects in the exercise group were instructed to perform daily eccentric contractions at home and keep a diary to record adherence. They were trained to flex the elbow at 700, and to sit on a chair with the affected forearm pronated and resting on a table with the wrist and hand over the edge, holding a bucket of water as a training weight. They were to place the non-affected hand over the one holding the bucket and slowly lift it with the non-affected hand, thus avoiding the concentric phase in the affected arm. With the affected hand extended, the subject removed the unaffected hand slowly and then, counting to three, lowered the hand to cause a flexion hand movement. This caused an eccentric contraction in the affected forearm extensors.
* Two sets of 8–12 repetitions of the exercises were to be performed once a day during the first week, twice a day during the following 2 weeks, and progress to 3 sets twice a day starting in the fourth week.
* Assessments were conducted before treatment (baseline) and 2 follow-up assessments were performed: the first at mid-intervention (week 3) and the second at the end of the intervention (week 6).
* The main outcome measures were pain-free hand-grip strength and pain-free isometric extensor strength comparing baseline measurements to the 3 and 6 week follow-ups. Grip strength was measured with the dynamometer and isometric extensor strength was measured with a myometer.
* Secondary outcomes included change in the proportion of cases with lateral epicondylalgia, and perceived pain during the previous week. Change in the proportion of cases was assessed at baseline and at the end of the 6-week intervention. Perceived average pain during the previous week was rated on a horizontal 100mm visual analogue scale (VAS) at both the 3 and the 6 week follow-ups.
* Since there was no follow-up data for the 5 drop-outs, the analysis was conducted as per protocol.
* A power calculation at 80% to detect a 50% reduction in lateral epicondylalgia cases in the exercise group, compared with a 10% reduction in controls, indicated that a sample size of 20 in each group was needed. A significance level of P < 0.05 was used for all analyses.

**Results:**

* No significant differences or clinically meaningful differences were observed between the 2 groups at baseline for the background variables.
* Five participants, 2 from the exercise group and 3 from the control group, dropped out of the study between baseline and the 3 week follow-up leaving 37 total participants. Reasons for withdrawal were inconvenience, exaggerated pain when using the forearm band, time shortage and other health issues.
* At the end of the intervention at week 6, subjects in the exercise group had significantly higher pain-free hand-grip strength (P=0.025) and higher pain-free hand-extensor strength (P=0.0001) than subjects in the control group, but no significant difference was seen for either primary outcome at the 3 week follow-up.
* For the secondary outcome, the proportion of subjects in the exercise group with lateral epicondylalgia decreased from 100% to 44% (8/18), and in the control group the decrease was from 100% to 79% (15/19) at the end of the intervention. Subjects in the exercise group had an odds ratio of 4.7 (95% CI=1.1–19.9) compared with the control group for no longer meeting the diagnostic criteria of lateral epicondylalgia after the 6-week eccentric exercise regimen, P=0.035.
* For the secondary outcome of perceived average pain (VAS) during the previous week, both groups improved significantly showing decreased pain (exercise group, P<0.001; controls, P=0.005) from baseline to the end of the intervention. However, between-group testing showed no significant difference at the mid-intervention follow-up (P=0.869) or at the end of the intervention (P=0.916).
* No adverse effects of the exercise intervention were reported. All the subjects reported compliance of over 70% regarding both the exercise regimen and wearing the forearm band.

**Authors’ conclusions:**

* This study reported that a daily 6-week eccentric home exercise regimen was effective in increasing pain-free hand-grip and wrist-extensor strength in people with LE. In addition, a significant number of subjects with lateral epicondylalgia recovered according to the diagnostic criteria after 6 weeks of eccentric exercise. While global perceived pain as rated on VAS was reduced in both groups at the end of the intervention, no between-group differences emerged.
* The follow-up at week 3 revealed that the treatment effects were less evident compared with week 6 after treatment completion for pain-free hand-grip and wrist-extensor strength. This result at week 3 may indicate that more than 3 weeks of eccentric exercise is needed to produce an effect in the treatment of LE.
* This daily 6-week eccentric home exercise regimen can be used together with other treatment modalities to treat patients with LE.
* Since this exercise regimen is time-effective, no advanced equipment is required, and adherence is acceptable, this exercise protocol is a realistic treatment modality for LE.

**Comments:**

* This study supports the conclusion that a daily home eccentric-exercise intervention is effective in increasing pain-free hand strength and reducing cases suffering from lateral epicondylalgia over a period of 6 weeks. This study also shows that there is no improvement in pain-free hand-grip and wrist-extensor strength from just wearing a forearm band.
* Strengths of this study included subject blinding, a well described randomization method, the inclusion of a comparable control group, an adequate description of the exercise intervention, a mid-term follow-up time, and clearly designated primary outcomes.
* One limitation of this trial was that the outcome assessors were not blinded.
* The authors failed to provide means and confidence intervals and effect sizes for group differences. A between group effect size was given for the secondary outcome, but not for the primary outcome. Graphs and figures without numbers and no data presented in tables, disqualifies this study as a high quality RCT.
* This trial provided only a short-term follow-up. Since LE is a long-term condition, a longer follow-up would generally have been preferred. It is also possible that a longer follow-up may have diluted the found effect between groups, considering the positive natural course in subjects suffering from lateral epicondylalgia over a longer term.
* Recommendations during the study to not provoke pain during daily activities may have led to an overall reduction of such perceived pain seen in both groups, and thus differences in pain were not found between groups.
* It is interesting to note, that the primary outcome reported in clinicaltrials.gov is the secondary outcome reported in this study.

**Assessment*:***

This adequate study provides some evidence that a daily 6-week eccentric home exercise regimen is effective in increasing pain-free hand-grip and wrist-extensor strength in subjects with long-term lateral epicondylalgia and is also effective in reducing cases suffering from lateral epicondylalgia over a period of 6 weeks.