Effectiveness of electrical stimulation on rehabilitation after ligament and meniscal injuries:
a systematic review

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CRD summary
This review concluded that trials of limited quality found that electrical stimulation, combined with a conventional rehabilitation programme, might be more effective than conventional rehabilitation alone for improving muscle strength and function after anterior cruciate ligament reconstruction. The authors’ conclusions seem over optimistic and too generalised to represent the evidence available and should not be considered reliable.

Authors' objectives
To evaluate the effectiveness of electrical stimulation for rehabilitation after soft-tissue injuries of the knee that were treated surgically or conservatively.

Searching
MEDLINE, EMBASE, LILACS, CINAHL, PEDro, and Cochrane Central Register of Controlled Trials (CENTRAL) were searched to December 2010, without language restrictions; search terms were reported. The reference lists of identified studies were searched and study authors and experts were contacted to identify unpublished data.

Study selection
Randomised or quasi-randomised controlled trials that assessed electrical stimulation as a component of a rehabilitation programme, compared with no treatment, placebo, another physical intervention, or conventional rehabilitation, were eligible. Patients had to be 14 years old or older, with soft-tissue injuries of the knee (acute or chronic injury of the anterior or posterior cruciate ligament, medial or lateral collateral ligament, or menisci, alone or in combination), treated surgically or conservatively. The primary outcomes were muscle strength, functional outcomes and scales, and pain (measured on a visual analogue scale).

Participant ages ranged from 14 to 44 years, where reported, with most having undergone anterior cruciate ligament reconstruction. The parameters for electrical stimulation - such as frequency (in Hertz; Hz), intensity, and duration - varied across trials. Comparator treatments included conventional exercises without electrical stimulation or with different frequencies of stimulation, pulsed electromagnetic stimulation, transcutaneous electrical nerve stimulation (TENS), and biofeedback therapy.

Two reviewers independently selected studies for inclusion, with disagreements resolved by a third reviewer.

Assessment of study quality
Two authors independently assessed trial quality using the Delphi list. This consisted of nine questions on different aspects of quality, including randomisation and blinding.

Data extraction
Two authors independently extracted the data to calculate relative risks or mean differences, with 95% confidence intervals.

Methods of synthesis
Meta-analyses were performed to calculate pooled weighted mean differences and 95% confidence intervals, using a fixed-effect model. Heterogeneity was assessed using I². Where meta-analysis was not possible a narrative synthesis was presented, grouped by comparison, then by outcome.

Results of the review
Nineteen trials were eligible. Sample sizes ranged from eight to 110 patients; sizes were not presented for three trials. No trials described concealment of allocation and none reported using sample size calculations. One of the five trials with drop-outs reported an intention-to-treat analysis. Participant baseline characteristics were comparable in all but one
of the trials (where there were insufficient data to make an assessment). Blinded outcome assessment was reported in four trials. Follow-up ranged from one to 52 weeks after surgery.

**Anterior cruciate ligament patients:** Compared with conventional rehabilitation alone, there was a statistically significant improvement in isometric quadriceps strength with electrical stimulation at six weeks (WMD -33.0Nm, 95% CI -25.9 to -40.1; three trials; 76 patients; \( I^2 = 0 \)). Three other trials found no significant differences between groups; another reported significantly more strength at nine weeks; and another reported significant results at six, nine and 12 weeks, but not at four weeks. For isometric quadriceps peak torque, four trials found significant differences favouring electrical stimulation and two did not. Two trials found statistically significant differences favouring electrical stimulation for the isometric quadriceps index at six weeks, but not at 12 and 16 weeks.

Five trials assessed functional outcomes. One reported no significant differences for Lysholm score and Fastex test. One reported no significant differences in the number of participants using crutches and the number not progressing to treadmill running, but did report significant differences favouring electrical stimulation for the Activities of Daily Living questionnaire. One trial reported a significant difference for gait favouring electrical stimulation; another found a greater range of motion with electrical stimulation. One trial reported no significant differences for unilateral squat test, lateral step test and forward reach test.

One trial reported no significant differences at 12 weeks for knee pain. Further results were reported.

**Meniscectomy patients:** There were no significant differences between conventional rehabilitation with or without electrical stimulation at three weeks (one trial) and at six weeks (trial study) for isometric quadriceps peak torque.

**Authors’ conclusions**
Evidence from trials of limited quality showed that electrical stimulation, with a conventional rehabilitation programme, might be more effective for improving muscle strength and function for up to two months after anterior cruciate ligament reconstruction, compared with conventional rehabilitation alone.

**CRD commentary**
The review addressed a clear question and was supported by reproducible eligibility criteria. Relevant trials in any language were identified by searching electronic databases and attempts were made to identify unpublished trials. Suitable methods (two reviewers independently) were used to reduce the risk of reviewer error and bias throughout the review. Trial quality was assessed, and most of them appeared to be of poor quality. Basic trial details were provided.

Limited pooling of data was attempted, with most results presented in a narrative. The authors acknowledged the limitations of the primary trials, but the results from several individual trials indicated that the addition of electrical stimulation might not be more effective than conventional rehabilitation for muscle strength and function outcomes; this was not reflected in the authors’ conclusions. The reasons for heterogeneity in the results were not explored and were barely discussed.

The authors’ conclusions seem over optimistic and too generalised to represent the evidence available. They should not be considered to be reliable.

**Implications of the review for practice and research**

**Practice:** The authors recommended that electrical stimulation should be used for the first six weeks after surgery. They added that the ideal low frequency for increasing muscle strength ranged from 35 to 80 Hz. For medium frequency, the modulation should be at 2500 Hz for 50 to 75 Hz. The pulse should last around 200 to 350 microseconds and they recommended that the relationship between contraction and resting times should be about one to five during the early rehabilitation phase.

**Research:** The authors stated that randomised controlled trials with better methods, adequate sample sizes, and at least 12 months of follow-up were needed to ascertain the effectiveness of electrical stimulation to increase the muscle strength of patients with soft-tissue injuries of the knee.

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