Electrical muscle stimulation for osteoarthritis of the knee: biological basis and systematic review

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Authors' objectives
To examine the biological basis for, and efficacy of, electrical muscle stimulation (EMS) of quadriceps femoris (QF) for improving the clinical status of people with knee osteoarthritis (OA).

Searching
The following sources were searched for articles published in the English language: MEDLINE from 1966 to 1999, CINAHL from 1982 to 1999, and EMBASE from 1980 to 1999. The keywords were 'electrical stimulation', 'electrostimulation therapy', 'osteoarthritis', 'knee', 'physiotherapy', 'randomised clinical trials', 'randomised controlled trials' and 'muscle'. In addition, the Cochrane Database of Systematic Reviews was searched from 1991 to 1999, and Dissertation Abstracts from 1980 to 1999. A handsearch was conducted of relevant physiotherapy journals, citations from identified papers, and relevant citations from the Science Citation Index for 1999. The most recent literature search was conducted on October 23, 1999.

Study selection
Study designs of evaluations included in the review
The inclusion criteria were not defined in terms of study design. The actual studies included were randomised controlled trials, controlled trials, and trials of repeated measures design. The duration of follow-up ranged from one week to three months.

Specific interventions included in the review
Applications of EMS to either human or animal muscle, and therapeutic applications of EMS to the QF muscle were eligible. The studies compared EMS with either placebo EMS, other modalities including traditional physiotherapy, or no treatment. The studies all used different forms of EMS for different periods, and applied EMS at different sites and with different treatment parameters.

Participants included in the review
Patients with OA of the knee were eligible. The included participants were those with OA, severe OA, total knee arthroplasty, and those awaiting knee surgery. The majority of trials only included individuals with severe OA. The documented age ranged from 53 to 86 years; the mean age was 68.4 years. Details of disease severity and disability, gender, co-morbid conditions, disease duration and weight were either unclear or were not generally documented in the primary studies.

Outcomes assessed in the review
The outcomes had to be related to the anticipated benefits of applying EMS. The following fourteen different outcome measures were reported in the primary studies (in order of frequency of reporting): knee range of movement; level walking time; knee circumference; muscle histology; days to hospital discharge; duration of morning stiffness; knee swelling; muscle contractile properties; muscle torque or strength; muscle protein synthesis; visual analogue pain scale; patient estimate of function; physician global assessment; quality of life; stair walking time; and times sit-to-stand.

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were selected for the review, or how many of the reviewers performed the selection.

Assessment of study quality
Validity was assessed and scored according to criteria adapted from those described by Beckerman et al. (see Other Publications of Related Interest). The criteria were: randomisation procedure; the number of patients in the smallest
group after randomisation; percentage lost to follow-up; no selective loss to follow-up; restriction to homogeneous
group; relevant baseline characteristics described; cointerventions similar in all groups; comparability of prognosis
groups; correction for imbalance at baseline during analysis; the number of patients blinded and whether blinding was
successful; the number of therapists blinded and whether blinding was successful; the number of evaluators blinded; the
relevance of outcome measures and whether they were well-described, valid and reliable, according to the reviewer;
outcome measures at relevant points in the trial; outcomes measured at follow-up; analysis blinded; adverse effects
investigated; intention to treat analysis; frequencies of the most important outcomes presented for each group; therapy
standardised and explicitly described; other interventions standardised and described, or avoided; statistical analysis
incorrect (minus one point); and power calculations not performed, (minus one point). One point was awarded for each
criterion attained. Where reviewers were uncertain, no points were awarded. The maximum score attainable was 25
points. Three reviewers independently extracted the data relating to methodology, without reference to institution,
author or journal source. The results from the validity assessment, and the percentage of studies reporting specified
data, were presented in the review.

Data extraction
Three reviewers independently extracted the following data without reference to institution, author or journal source:
trial design, methodology, results, outcome measures, and the participants' characteristics.

Methods of synthesis
How were the studies combined?
The individual studies were described and evaluated in a narrative synthesis.

How were differences between studies investigated?
The differences between studies and their potential implications were discussed.

Results of the review
Seven studies (230 patients) were included, of which 4 were randomised controlled trials.

Efficacy of EMS.
Six of the seven studies demonstrated one or more physiological and/or clinical post-treatment improvements over and
above the control conditions. The benefits recorded included attenuation of muscle atrophy; normalisation of protein
turnover; increases in maximal force generating capacity; reduced knee extensor lag; decreased hospitalisation;
functional improvements; and pain.

Study quality.
Methodological quality was generally poor. The median quality score was 11 out of 25 (44% of maximum) with
individual scores ranging from 8 to 16 (32% to 64 of maximum). Flaws included: small sample size (only 4 studies had
a sample size greater than 25 patients); inadequate description of allocation procedures, patients' characteristics, and
intervention details; the use of measures of doubtful reliability and validity; variation in intervention; poor use of
blinding procedures; lack of evidence of sample comparability at baseline; and inappropriate statistical analysis,
including the use of multiple comparisons with no statistical adjustment for the significance level utilised.

Authors' conclusions
The studies generally showed strong support for the beneficial application of QF EMS to the muscles surrounding the
osteoarthritic knee. However, confidence in this conclusion is weakened by the small number of efficacy studies, their
small sample sizes, and their flawed allocation procedures. This line of research, which has a strong biological basis,
could benefit from physiotherapy-led studies, which examine the evidence base of QF EMS for treating knee OA using
more divergently impaired, larger samples and optimal randomisation procedures.
CRD commentary
The aim was stated and broad inclusion criteria were defined in terms of the intervention, participants, and outcomes. However, the inclusion criteria were not defined in terms of study design, and no criteria were specified for the diagnosis of OA, and eligible outcomes included non-clinical measures. The literature search included several relevant sources and attempts were made to locate unpublished material. The potential for publication bias, as a result of restricting included studies to those in the English language, was discussed. The methods used to select primary studies were not described. Validity was rigorously assessed using predefined criteria, and the results of this assessment were reported; these results were not used to exclude studies but were discussed alongside the individual study results. The methods used to extract data and assess validity were described, and relevant details on the individual studies were presented in tabular format and discussed in the text. Attention was drawn to the effect of various methodological flaws of the reported results. A narrative review was appropriate given the numerous sources of differences between the studies.

Given the small number of studies, the small sample sizes and the methodological flaws of the primary studies, the evidence-base was weak and any conclusions must be considered with caution.

Implications of the review for practice and research
Practice: The authors state that greater emphasis should be placed on examining the efficacy of any EMS protocol for knee OA in a rigidly controlled laboratory setting before advocating its use in the clinic or home. In particular, its long-term application should be investigated.

Research: The authors recommend that the application of EMS to the osteoarthritic knee be rigorously evaluated, particularly by physiotherapists. This should be conducted using either case studies in the clinical setting or, preferably, by large well-designed, robust clinical trials.

Bibliographic details

Other publications of related interest

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Subject indexing assigned by CRD

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on
the reliability of the review and the conclusions drawn.