
Electrical stimulation for long-bone fracture-healing: a meta-analysis of randomized controlled trials

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CRD summary

This review concluded that no significant effect of electromagnetic stimulation on delayed unions or ununited long-bone fractures was found, but that methodological limitations and high levels of heterogeneity between studies made the impact of electromagnetic stimulation on fracture healing uncertain. This conclusion reflects the results of the review and is likely to be reliable.

Authors' objectives

To assess the effectiveness of electromagnetic stimulation on long-bone fracture healing.

Searching

MEDLINE, EMBASE, CINAHL, and all Evidence Based Medicine Reviews were searched from inception to April 2008. Search terms were reported. Seven relevant journals were also handsearched for dates ranging from 1980 to April 2008. Bibliographies of retrieved studies and other relevant publications were checked.

Study selection

Randomised controlled trials (RCTs) comparing electromagnetism of any waveform with no intervention, in patients presenting with long-bone lesions, were eligible for inclusion in the review. Eligible trials had to report the effect of the interventions on direct bone healing. Interim and subset analyses of trials published in full were excluded from the review.

Included trials assessed treatment of a range of long-bone lesions, including fracture non-unions, delayed fracture unions, tibial stress fractures, congenital pseudarthroses, fresh fractures, limb-lengthening procedures and osteotomies. Half of the included trials used electromagnetic stimulation following surgery, the other trials required full limb immobilisation. Outcomes reported related to bone union and clinical measures including pain. The majority of trials used dual external coils situated over the bone healing site for generation of an electromagnetic field, and most also used pulsed fields with frequency ranges of 15 to 75 Hz.

Two reviewers independently selected the studies for inclusion in the review; disagreements were resolved through discussion or consultation with a third reviewer.

Assessment of study quality

The trials were independently assessed for validity by two reviewers using the following criteria: randomisation, blinding, allocation concealment, management of withdrawals and extent of follow-up. Disagreements were resolved through consensus or consultation with a third reviewer. Authors were contacted for clarification where necessary. Trials were assigned to evidence levels within the GRADE (Grading of Recommendations Assessment, Development and Evaluation) protocol.

Data extraction

Two reviewers independently extracted the data using a standardised form to permit the calculation of relative risks (RR) with 95% confidence intervals (CIs). Authors were contacted for additional clarification and data.

Methods of synthesis

The trials were combined in a meta-analysis using a DerSimonian and Laird random-effects model to calculate pooled relative risks with 95% confidence intervals. A continuity correction factor of 0.25 used for cells with zero events. Statistical heterogeneity between trials was assessed using Cochran's Q and the I^2 statistic. Heterogeneity was explored using sensitivity analyses which excluded trials with potentially unique characteristics related to treatment methodology or duration, or to bone or bone lesion type. Where meta-analysis was not possible, a narrative synthesis was presented.

Results of the review

Eleven RCTs (n=347 patients) were included in the review. Study quality was variable. Nine RCTs blinded patients and outcome assessors and follow-up ranged from 84% to 100%, but none used an intention-to-treat analysis. Two trials reported substantial differences in participant characteristics between intervention and control groups, while three others had other methodological or reporting flaws.

Bone union (four RCTs): Meta-analysis found no statistically significant difference between the groups for bone union (RR 1.76, 95% CI: 0.8 to 3.8). There was significant statistical heterogeneity ($I^2=60\%$), which was not explained by sensitivity analyses.

Clinical outcomes: No trial found any statistically significant difference between the groups for a clinical outcome, with the exception of one trial which found significant reductions in pain measures in a small subgroup of patients.

Bone densitometry: There was evidence from single trials for a positive effect of treatment on callus formation in femoral intertrochanteric osteotomies, for conservatively managed Colles fracture and for lower limb strengthening.

Authors' conclusions

The pooled analysis showed no significant effect of electromagnetic stimulation on delayed unions or ununited long-bone fractures. However, methodological limitations and high levels of heterogeneity between trials meant that the impact of electromagnetic stimulation on fracture healing was uncertain.

CRD commentary

The review question and the inclusion criteria were clear. The authors searched several relevant databases and other sources without restrictions on language. No restrictions on publication status were noted. These factors made it less likely that relevant trials were excluded or that publication or language biases were introduced. The authors reported using rigorous methodology at all stages of the review process. An appropriate validity assessment was conducted. The use of meta-analysis or narrative synthesis was guided by clinical heterogeneity, and reasonable steps were taken to assess and explore statistical heterogeneity. The authors' conclusions are an accurate reflection of the results of the review and are likely to be reliable.

Implications of the review for practice and research

Practice: The authors stated that the current evidence justifies neither enthusiastic dissemination nor confident rejection of electromagnetic stimulation for bone fractures.

Research: The authors stated that appropriately sized and methodologically sound trials of electromagnetic stimulation for bone fractures were required.

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Other publications of related interest

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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.