Transcutaneous electric nerve stimulation (TENS) for cancer pain in adults (Review)

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[Intervention Review]

Transcutaneous electric nerve stimulation (TENS) for cancer pain in adults

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ABSTRACT

Background

Cancer-related pain is complex and multi-dimensional but the mainstay of cancer pain management has predominately used a biomedical approach. There is a need for non-pharmacological and innovative approaches. Transcutaneous Electric Nerve Stimulation (TENS) may have a role for a significant number of patients but the effectiveness of TENS is currently unknown.

Objectives

The aim of this systematic review was to determine the effectiveness of TENS for cancer-related pain in adults.

Search strategy

We searched *The Cochrane Library*, MEDLINE, EMBASE, CINAHL, PsychINFO, AMED and PEDRO databases (11/04/08).

Selection criteria

Only randomised controlled trials (RCTS) investigating the use of TENS for the management of cancer-related pain in adults were included.

Data collection and analysis

The search strategy identified 37 possible published studies which were divided between two pairs of review authors that decided on study selection. A study eligibility form was used to screen each abstract and where study eligibility could not be determined from the abstract, the full paper was obtained and assessed by one pair of review authors. A standardised data extraction sheet was used to collect information on the studies and the quality of the studies was assessed independently by two review authors using the validated five-point Oxford Quality Scale. Final scores were discussed and agreed between all four review authors. The small sample sizes and differences in patient study populations of the two included studies prevented meta-analysis.

Main results

Only two RCTs met the eligibility criteria (64 participants). These studies were heterogenous with respect to study population, sample size, study design, methodological quality, mode of TENS, treatment duration, method of administration and outcome measures used. In one RCT, there were no significant differences between TENS and placebo in women with chronic pain secondary to breast cancer treatment. In the other RCT, there were no significant differences between acupuncture-type TENS and sham in palliative care patients; this study was underpowered.

Authors' conclusions

The results of this systematic review are inconclusive due to a lack of suitable RCTs. Large multi-centre RCTs are required to assess the value of TENS in the management of cancer-related pain in adults.

PLAIN LANGUAGE SUMMARY

Transcutaneous electrical nerve stimulation (TENS) for cancer-related pain in adults

Cancer-related pain is complex and multidimensional but is mostly managed using drug therapy. There is increasing recognition of the need for non-drug approaches and TENS may have a significant role to play. Only two studies met eligibility criteria for this review. TENS was given to five participants in one study and 41 participants in the other. Consequently, there is insufficient evidence to judge whether TENS should be used in adults with cancer-related pain. Further research using well designed clinical trials is needed to improve knowledge in this field.

BACKGROUND

There are many reasons why a patient with cancer may experience pain and these include pain associated with the disease, pain associated with the cancer treatments and any associated co-morbid conditions. The mainstay of cancer pain management has predominantly used the biomedical approach including drug therapy, medical or surgical treatments (Turk 1998). However, it is clear that cancer-related pain is complex and multidimensional and there is a definite need for a multi-disciplinary team approach, utilising non-pharmacological and innovative approaches. Physical treatments such as electrical stimulation may have a role for a significant number of patients (Simpson 2000).

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive therapeutic intervention which has been widely used for many years to manage a range of acute and chronic pain problems (Johnson 2002; Walsh 1997). TENS is used in a variety of clinical settings and has gained popularity with both patients and healthcare professionals of different disciplines. TENS devices have many advantages in that they are portable, easy to use, have relatively few side-effects or contra-indications and allow the user autonomy over their pain control.

There are several types of TENS application which are used in clinical practice but the two most common are high frequency, low intensity (conventional) TENS (LF-TENS) and low frequency, high intensity (acupuncture-like) TENS (AL-TENS). More recent developments of TENS have evolved with the aim of improving the efficacy of TENS and these include 'burst' and 'modulated' modes of stimulation. The clinical use of conventional TENS is underpinned by the gate control theory of pain (Melzack 1965) which suggests that there is a 'gating' mechanism in the dorsal horn of the spinal cord which can control nociceptive signals and ultimately influence the pain experience. In summary, the stimulation of large diameter (A-beta) afferent fibres is thought to 'close the gate' and reduce the perception of pain. Acupuncture-like TENS mainly stimulates A-delta and C fibres and is therefore thought to achieve pain control mostly through the descending pain suppression system. In essence, acupuncture-like TENS is thought to help close the gateway of pain transmission and hence result in a reduction in pain.

There are currently five Cochrane Systematic Reviews addressing the use of TENS for benign pain (Brosseau 2003; Carroll 2001; Khadilkar 2005; Osiri 2000; Proctor 2005) as well as excellent

review articles (Bjordal 2003; Johnson 2001; Reeve 1996). There is some controversy over the use of TENS in chronic pain, with most review papers citing the need for further research using large multi-centre RCTs. The single available review in cancer pain addresses non-drug approaches for symptoms related to cancer and includes the evidence on TENS for pain management (Pan 2000). Although experts in the field suggest that TENS has an important role in the management of cancer-related pain (Filshie 2000) it is clear that there is currently no guidance for clinicians on the use of TENS for oncology and palliative care patients. The clinical benefit of TENS for cancer patients with pain remains controversial. A Cochrane review of TENS in acute pain is currently being undertaken (Walsh 2006).

The aim of this Cochrane review is to determine the effectiveness of TENS in the management of cancer-related pain and to provide guidance for healthcare professionals and patients on the optimal parameters of TENS for best pain relief.

OBJECTIVES

To establish the effectiveness of TENS in the management of cancer-related pain in adults.

METHODS

Criteria for considering studies for this review

Types of studies

Only randomised controlled trials (RCTs) (crossover and parallel design) were included; those investigating the use of TENS for the management of cancer-related pain in adults where the control (placebo) group was clearly defined and was either:
1. no active stimulation or,
2. no treatment.
Comparisons of TENS with active treatment were not included.

Types of participants

Participants were 18 years of age or older. They had experienced cancer-related pain, unspecified or persistent cancer treatment-related pain, or both, for a minimum of three months after any anti-cancer treatment had been completed. Pain was classified based on commonly used verbal rating scales or pain interference scales.

Types of interventions

Only studies that evaluated transcutaneous electrical stimulation administered using a standard TENS device that delivered monophasic or biphasic pulsed electrical currents in the mA range were included. Studies that used percutaneous electrical stimulation were not included. We considered Conventional TENS as administered using any TENS device which delivered a "strong but comfortable" electrical sensation either:
i. in an area of pain where sensation is present,
ii. over nerve bundles proximal to the site of pain.
Our definition of appropriate TENS delivery also included the use of Neuromuscular Electrical Stimulation devices (NMES) and Interferential current devices, providing that a "strong but comfortable" electrical sensation was produced. Any parameters of treatment which resulted in this were considered, as was any duration and frequency of treatment. TENS is typically delivered using at least two surface electrodes; however, studies involving single electrical probes (i.e. TENS pens) were also included providing that a "strong but comfortable" electrical sensation was produced. This included the placement of electrodes over an area of pain that co-incidentally included acupuncture points. Given the above physiological criteria, TENS delivered at intensities reported to be "barely perceptible" or "mild" were excluded.

Types of outcome measures

The primary outcome measure was patient reported pain using validated scales (e.g. visual analogue scales (VAS), numerical rating scales). Secondary outcome measures included any of the following:

- patient satisfaction,
- function,
- range of movement,
- quality of life,
- mood,
- pain coping,
- sleep,
- analgesic consumption,
- hospital attendance and other healthcare interventions e.g. physiotherapy visits, hospice admissions, and
- adverse events - major and minor.

Ideally, studies would take outcome measures before, during and after stimulation but studies which did not do this were not excluded. We wanted to perform subgroup analyses on outcomes of greater than or equal to 30% reduction in pain from baseline but this was not possible.

Search methods for identification of studies

The Cochrane Library, MEDLINE, EMBASE, CINAHL, PsychINFO, AMED and PEDRO physiotherapy databases were

searched on the 11th of April 2008. Detailed search strategies were developed for each database searched, based on the strategy for MEDLINE but revised appropriately for each database. Various foreign language databases were also searched with the terms outlined below. Reference lists of eligible trials were reviewed to identify further studies. Relevant RCTs were identified using the following search strategy combined with the Cochrane Sensitive Search Strategy for RCTs {as published in Appendix 5b in the Cochrane Reviewers' Handbook for Systematic Reviews (Alderson 2004)}. Our MEDLINE search strategy for this review can be seen in Appendix 1 and all other search strategies can be seen in Appendix 2.

Data collection and analysis

Study selection

The search strategy identified 36 published studies which were divided between two pairs of review authors that decided on study selection. An additional seven published studies that were not identified by the search strategy were identified from reference lists and contact with authors. A study eligibility form was used to screen each abstract which identified whether the study was randomised, participants were adults with cancer related pain, the study compared TENS with another control group, and reported pain related outcomes. Where study eligibility could not be determined from the abstract, the full paper was obtained and assessed by one pair of review authors.

Data extraction

A standardised data extraction sheet was used to collect information on authors, participants, trial design, characteristics of interventions (TENS settings, application, treatment schedule, concurrent interventions), adverse effects and baseline and end of study outcomes. The quality of the studies was assessed independently by two review authors using the validated five-point Oxford Quality Scale (Jadad 1996) which considers the method of randomisation, blinding and the description of withdrawals or drop-outs. KR was not involved in this process as one of her publications was assessed. Final scores were discussed and agreed between all four review authors.

Analysis

The small sample sizes and differences in patient study populations of the two included studies prevented meta-analysis.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

In total 43 published studies were identified, of which only two met our eligibility criteria for review (Gadsby 1997; Robb 2007). The most common reasons for exclusion were non-randomised studies and the published source contained no clinical data (i.e. educational reviews). A full list of the 41 excluded studies and the reasons for exclusion is provided in the 'Characteristics of excluded studies' table.

The two RCTs included in our review were heterogenous with respect to study population, sample size, study design, methodological quality, mode of TENS, treatment duration, method of administration and outcome measures used (Gadsby 1997; Robb 2007). Participants who had previously used TENS were excluded in both studies. Robb 2007, who is also a member of this review team, compared conventional TENS with Transcutaneous Spinal Electroanalgesia (TSE) and sham TSE in 49 cancer survivors with chronic pain associated with breast cancer treatment. The investigators attempted to mimic clinical practice and used treatment for three weeks duration of each intervention with participants also self-treating at home as needed. They assessed outcome using measures for pain, anxiety and depression and physical functioning. Gadsby 1997 investigated acupuncture-like TENS for cancer pain or nausea and vomiting, or both, in 15 terminally ill participants. The investigators administered TENS for 30 minutes daily for five days and assessed the outcome using a quality of life questionnaire and a performance status score (*see* 'Characteristics of included studies' table for more details).

Risk of bias in included studies

Robb 2007 scored four points and Gadsby 1997 scored three points on the five-point Oxford Quality Scale (Jadad 1996).

Effects of interventions

Robb 2007 found no significant differences in pain relief scores between TENS or sham TSE. There were also no significant differences in any of the other outcome measures, except one dimension of a patient satisfaction questionnaire where TENS was considered significantly more effective than sham TSE. Twenty six of 41 women (63%) who completed the study decided to continue with a device on completion of the trial and of these, the majority (n = 13) decided to continue with TENS, as opposed to sham TSE (n = six). The majority of the women continuing with TENS were still using it to good effect at three months (n = 14) and 12 months (n = ten), with those using sham TSE to good effect at three months and 12 months, n = four and n = two respectively. Overall, TENS appeared to be well tolerated, women found TENS easy to use and few reported difficulties with electrode placement. Adverse effects were monitored and reported and were minimal in this study.

Gadsby 1997 did not detect any statistically significant differences between AL-TENS and sham AL-TENS. However, the study was

underpowered with only five participants randomised into each of the three treatment groups and only 13 participants completing the study.

DISCUSSION

The results of this systematic review examining the effectiveness of TENS for cancer pain in adults are inconclusive due to a lack of suitable RCTs. Only two RCTs met the inclusion criteria for review and heterogeneity of these RCTs prevented meta-analysis. The studies were different with respect to study population, sample size, study design, methodological quality, mode of TENS, treatment duration, method of administration and outcome measures used. The larger study (Robb 2007) scored four out of five for the Oxford Quality Score and provided little evidence that TENS was superior to a placebo in treating women with chronic pain following breast cancer treatment. The smaller study (Gadsby 1997) scored three out of five and provided no evidence that TENS was significantly better than placebo in treating pain in palliative care patients. We are unable to comment on important clinical issues such as optimal treatment parameters as there was insufficient data for analysis.

There have been no previous systematic reviews on TENS in cancer pain and only one review paper has been published (Pan 2000). This paper reviewed the use of complementary and alternative medicine to manage pain and other symptoms associated with end of life. Four studies on TENS were discussed (Avellanosa 1982; Gadsby 1997; Ostrowski 1979 and Wen 1977), one of which was included in our review (Gadsby 1997). Pan 2000 concluded that TENS, along with a range of other interventions, may provide pain relief in palliative patients with pain but acknowledged that there is a paucity of data to support this. A major criticism of the majority of studies found in the literature search is that they were mostly case-series or non-randomised studies and the bulk of these studies were published in the 1970s and 1980s.

A major criticism of both RCTs found in the literature search is that they were undersized and lacked sufficient power to detect significant differences. Robb 2007 performed power calculations but failed to recruit a sufficient number of participants whereas Gadsby 1997 did not perform any power calculations. Adequate blinding was an issue in both studies with Robb 2007 failing to blind the assessor and Gadsby 1997 failing to provide sufficient information on how blinding was performed.

In summary, there is insufficient evidence to judge whether TENS should be used in adults with cancer-related pain. Further research is needed to improve knowledge in this field.

AUTHORS' CONCLUSIONS

Implications for practice

The evidence from two RCTs provides insufficient evidence to judge whether TENS should be used to manage cancer-related and cancer treatment-related pain.

Implications for research

Large multi-centre RCTs are required to assess the value of TENS in the management of cancer-related pain. Attention should be given to:

- power calculations to ensure adequate sample sizes;
- selection of participants to ensure homogeneity of pain conditions under study;
- optimal stimulation parameters and treatment schedules;
- use of valid, reliable outcome measures to assess all dimensions of pain;
- short and long-term follow-ups; and
- cost analysis in comparison to standard treatment i.e. medications.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Gadsby 1997

Methods	Double-blind RCT. Participants were allocated to active AL-TENS (Gp 1), placebo AL-TENS (Gp 2) or no treatment (Gp 3). Sample size: total 15 were randomised (Gp 1 n=5; Gp 2 n= 3; Gp 3 n=5). Follow-up: none. TENS administered by nurse practitioner (author). Outcome measures at baseline and on day 6. Retrospective analysis of analgesic and anti-emetic use on day 6. Daily biophysical measurements of body electrical resistance. No reporting of adverse effects.
Participants	Inclusions: admitted for symptom control; aged between 35-75; pain and/or nausea and vomiting symptoms; Caucasian origin. Exclusions: unwilling to provide informed consent; too ill to cope with 30 mins treatment; patients with an on-demand pacemaker, premenopausal women, patients with vomiting due to intestinal obstruction or raised intracranial pressure or iatrogenic causes, patients previously treated with TENS or AL-TENS. Gender: 14 females, 1 male. Age range 38-74 years. All terminal cancer; diagnoses: Breast (n=6), Colon (n=3), Pancreas (n=2), Stomach (n=1), Cervical (n=1). Dropouts: n=2; both in placebo group, due to a rapid deterioration in their condition.
Interventions	AL-TENS and placebo delivered via 2 gelled carbon electrodes, sealed with tape: one to acupuncture point Pe6 (Neiguan) and one to L14 (Hegu) of dominant hand. Leads attached to V-TENS stimulator. Electrical parameters: pulse rate: 2 Hz, symmetrical biphasic pulsewave in continuous mode; pulse width: 200 ms; amplitude: 2.5. Duration of treatment: 30 minutes; frequency: 5/day.
Outcomes	EORTC QOL-C30 at baseline and on Day 6. Includes dimensions on pain, nausea and vomiting and fatigue, global quality of life and 5 functional scales. Retrospective assessment of analgesic and anti-emetic use over study period at Day 6.
Notes	Quality: 3

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Robb 2007

Methods	Randomised, placebo-controlled crossover trial design. Participants stratified according to level of average pain prior to randomisation. Randomised to 1 of 6 groups for TENS, TSE and placebo TSE. Sample size: total 49 were randomised (group 1: 9; group 2: 6; group 3: 9; group 4: 10; group 5: 7; group 6: 8). Treatment duration: 3 weeks of each treatment (12 weeks) with 3 x 1 week breaks in between treatments. Follow-up: 3, 6 and 12 months. TENS administered by researcher in clinic and taught to subjects to use at home. Self-report pain and mood questionnaires completed at baseline then weekly thereafter during intervention, then at 3, 6 and 12 months. Pain diaries completed daily during intervention. Objective measures of shoulder mobility completed by researcher at baseline and at the end of every arm of the trial. Self-report satisfaction questionnaire on completion of the trial.
Participants	Inclusions: history of breast cancer and chronic pain for at least 6 months due to cancer treatment. Exclusions: under 18 years of age, evidence of recurrent disease, cognitive deficits, pain due to a neurological deficit, absence of skin sensation in the painful area, previous experience of TENS. Gender: all female. 50% had pain secondary to surgery, 20% has pain secondary to radiotherapy, 30% had a combination. Mean age: 58 years (med: 59 range: 38-60). Mean duration of pain: 51 months (med: 31 range: 6-182). Majority were Caucasian (87%), married (61%) and in employment (44%). Dropouts: n=8 (pain increased: n=2; pain resolved: n=2; skin reaction: n=1; other: n=3).
Interventions	Concurrent treatment: subjects permitted to continue with all current medications but not permitted to start any new treatments during the trial. TENS: dual channel stimulator with self-adhesive pads (Spembly Medical Ltd). Amplitude adjusted to provide a "strong but comfortable" tingling sensation. Continuous mode. Pulse width: unknown. Pulse frequency: high (subject adjusted according to comfort). Electrode placement: in area of pain or adjacent dermatome. Two or four electrodes according to size of area. Treatment schedule: as determined by subject, advised on > 1 hour duration, frequency: as determined by pain. TSE: single channel stimulator with self-adhesive pads (Advanced Pain Management Ltd). Pulse frequency: 2000 Hz. Electrode placement: 2 pads para-vertebrally at C3-4 level for pain in the neck, arm or hand. Two pads over spinous processes of T1 and T10 for all pain below the neck. Treatment duration: 10-30 minutes, frequency: as determined by pain. Placebo: procedure as for TSE.
Outcomes	Brief Pain Inventory (BPI) short form: measured at baseline then weekly thereafter whilst receiving treatment. Post-treatment measurement at 3, 6 and 12 months. Hospital Anxiety and Depression Scale (HAD): measured as above. Range of movement at the ipsilateral shoulder joint (flexion and abduction): measured with a goniometer at baseline and at the end of each intervention. Pain diaries documented daily by the subjects: pain relief and analgesic consumption. Patient satisfaction questionnaire to evaluate satisfaction with each treatment: recorded on completion of the trial. Adverse effects like skin irritation and increased pain were monitored throughout.
Notes	Quality: 4

Robb 2007 (*Continued*)

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	No	C - Inadequate

RCT: Randomised Controlled Trial
Gp: group
n: number
TENS: Transcutaneous electrical nerve stimulation
AL-TENS: Acupuncture-like TENS
TSE: Transcutaneous spinal electroanalgesis
mins: minutes
Hz: hertz
ms: microseconds
C3-4: cervical spine level 3-4
T1: thoracic spine level 1
T10: thoracic spine level 10
EORTC QOL-C30: European organisation for research and treatment of cancer quality of life questionnaire

Characteristics of excluded studies *[ordered by study ID]*

Avellanosa 1982	Non-randomised study
Bild 1990	Non-randomised study
Bonakdar 2004	No clinical data
Cata 2004	Non-randomised study
Cooperman 1975	Non-randomised study, not cancer-related pain
Crompton 1992	Non-randomised study, not cancer-related pain
De-Pinto 2006	No clinical data
Dil'Din 1985	Non-randomised study
Evtiukhin 1998	Non-randomised study
Hakl 1989	Non-randomised study

(*Continued*)

Hamza 1999	Not cancer-related pain
Hasun 1988	Non-randomised study
Hidderley 1997	Cancer patients were not randomised in the main clinical trial
Kim 2005	No clinical data
Kleinkort 2005	Non-randomised study, not cancer related pain
Lamer 1994	No clinical data
Lange 1995	No clinical data
Librach 1988	No clinical data
Long 1991	No clinical data
McCaffery 1992	No clinical data
Miguel 2000	No clinical data
Naveau 1992	Acute, not chronic treatment-related pain
Oosterwijk 1994	No clinical data
Ostrowski 1979	Non-randomised study
Pan 2000	No clinical data
Patt 1990	No clinical data
Patt 1992	No clinical data
Picaza 1975	Non-randomised study, not cancer related pain
Rafter 1986	Not an RCT
Reuss 1985	Non-randomised study
Robb 2003	No clinical data
Robb 2004	No clinical data
Rutkowski 1980	Non-randomised study
Sang 2003	Non-randomised study

(*Continued*)

Sharp 2003	No clinical data
Sloan 2004	No clinical data
Tonkin 1998	No clinical data
Urba 1996	No clinical data
Ventafridda 1979	Non-randomised study
Weinstein 1994	No clinical data
Wen 1977	Non-randomised study

DATA AND ANALYSES

This review has no analyses.

APPENDICES

Appendix 1. MEDLINE search strategy

MEDLINE search (1950 to present) (April 2008) - via Dialog Datastar:
1. TRANSCUTANEOUS ADJ ELECTRIC ADJ NERVE ADJ STIMULATION
2. TRANSCUTANEOUS-ELECTRIC-NERVE-STIMULATION.DE.
3. TNS
4. PERCUTANEOUS ADJ ELECTRIC ADJ NERVE ADJ STIMULATION
5. ELECTRIC ADJ STIMULATION ADJ THERAPY
6. ELECTRIC-STIMULATION-THERAPY.DE.
7. ELECTRIC ADJ STIMULATION
8. ELECTROSTIMULATION
9. ELECTROANALGESI$
10. ELECTROTHERA$
11. ELECTROMAGNETI$
12. INTERFERENTIAL
13. REBOX
14. CODETRON
15. LIKON
16. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15
17. CANCER$
18. NEOPLASMS#.W..DE.
19. TUMOUR$
20. TUMOR$
21. ONCOLO$
22. CARCINOMA$
23. MALIGNAN$
24. 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23
25. PAIN$
26. PAIN#.W..DE.
27. PAIN ADJ MEASUREMENT
28. PAIN-MEASUREMENT.DE.
29. PAIN ADJ SCALE
30. 25 OR 26 OR 27 OR 28 OR 29
31. 16 AND 24 AND 30

Appendix 2. Other search strategies

1 CINAHL search (1982 to 2008)

Search terms
1. TRANSCUTANEOUS ADJ ELECTRIC ADJ NERVE ADJ STIMULATION
2. TRANSCUTANEOUS-ELECTRIC-NERVE-STIMULATION.DE.
3. TNS
4. ELECTRIC-STIMULATION.DE.
5. ELECTRIC ADJ STIMULATION ADJ THERAPY
6. PERCUTANEOUS ADJ ELECTRIC ADJ NERVE ADJ STIMULATION
7. ELECTRIC ADJ STIMULATION
8. ELECTROSTIMULATION
9. ELECTROANALGESI$
10. ELECTROTHERA$
11. ELECTROMAGNETI$
12. ELECTROTHERAPY#.W..DE.
13. INTERFERENTIAL
14. REBOX
15. CODETRON
16. LIKON
17. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16
18. CANCER
19. CANCER-PATIENTS.DE.
20. CANCER ADJ PAIN
21. CANCER-PAIN.DE.
22. NEOPLASM

(*Continued*)

23. NEOPLASMS#.W..DE.
24. TUMOUR
25. CARCINOMA#.W..DE.
26. CARCINOMA
27. ONCOLO$
28. MALIGNAN$
29. TUMOR
30. 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29
31. PAIN
32. PAIN#.W..DE.
33. PAIN ADJ MEASUREMENT
34. PAIN-MEASUREMENT.DE.
35. PAIN ADJ SCALE
36. 31 OR 32 OR 33 OR 34 OR 35
37. ADULT.DE. OR MIDDLE-AGE OR AGED.W..DE. OR AGED-80-AND-OVER
38. CLINICAL ADJ TRIAL
39. CONTROLLED ADJ CLINICAL ADJ TRIAL
40. EVALUATION
41. PROSPECTIVE
42. META-ANALYSIS
43. RANDOMISED ADJ CONTROLLED ADJ TRIAL
44. VALIDATION
45. RANDOM ADJ ALLOCATION
46. EXPERIMENTAL-STUDIES#.DE. OR CLINICAL-TRIALS#.DE.
47. CLINICAL ADJ RESEARCH

(*Continued*)

48. CLINICAL-RESEARCH#.DE.
49. 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44 OR 45 OR 46 OR 47 OR 48
50. 17 AND 30 AND 36
51. 17 AND 30 AND 36 AND 49
52. 51 AND 37

2 EMBASE Search (1974 to 2008)

Search terms
1. TRANSCUTANEOUS ADJ ELECTRIC ADJ NERVE ADJ STIMULATION
2. TRANSCUTANEOUS-NERVE-STIMULATION.DE.
3. TNS
4. PERCUTANEOUS ADJ ELECTRIC ADJ NERVE ADJ STIMULATION
5. ELECTROSTIMULATION.W..DE.
6. ELECTRIC ADJ STIMULATION ADJ THERAPY
7. ELECTROSTIMULATION-THERAPY.DE. OR NERVE-STIMULATION#.DE.
8. ELECTRIC ADJ STIMULATION
9. ELECTROANALGESI$
10. ELECTROANALGESIA.W..DE.
11. ELECTROTHERA$
12. ELECTROMAGNETI$
13. INTERFERENTIAL
14. REBOX
15. CODETRON
16. LIKON

(*Continued*)

17. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16
18. CANCER
19. NEOPLASM#.W..DE.
20. TUMOUR
21. TUMOR
22. ONCOLO$
23. CANCER-PAIN.DE.
24. CARCINOMA
25. MALIGNANT
26. MALIGNANCY
27. MALIGNANT-NEOPLASTIC-DISEASE#.DE.
28. 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27
29. PAIN
30. PAIN#.W..DE.
31. PAIN ADJ MEASUREMENT
32. PAIN-ASSESSMENT#.DE.
33. PAIN ADJ SCALE
34. 29 OR 30 OR 31 OR 32 OR 33
35. CLINICAL-TRIAL#
36. META-ANALYSIS.DE.
37. CLINICAL ADJ TRIAL
38. CONTROLLED ADJ CLINICAL ADJ TRIAL
39. RANDOMISED ADJ CONTROLLED ADJ TRIAL
40. META-ANALYSIS
41. EVIDENCE-BASED-PRACTICE#.DE.

(*Continued*)

42. EVALUATION
43. PROSPECTIVE
44. RANDOM ADJ ALLOCATION
45. MEDICAL-RESEARCH#.DE.
46. CLINICAL ADJ RESEARCH
47. CLINICAL-RESEARCH.DE.
48. 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44 OR 45 OR 46 OR 47
49. 17 AND 28 AND 34
50. 48 AND 49
51. ADULT# OR AGED.DE.
52. 50 AND 51

3 AMED Search (1985 to 2008)

search terms
1. TRANSCUTANEOUS ADJ ELECTRIC ADJ NERVE ADJ STIMULATION
2. TRANSCUTANEOUS-NERVE-STIMULATION.DE.
3. TNS
4. PERCUTANEOUS ADJ ELECTRIC ADJ NERVE ADJ STIMULATION
5. ELECTROSTIMULATION.W..DE.
6. ELECTRIC ADJ STIMULATION ADJ THERAPY
7. ELECTROSTIMULATION-THERAPY.DE. OR NERVE-STIMULATION#.DE.
8. ELECTRIC ADJ STIMULATION
9. ELECTROANALGESI$

(*Continued*)

10. ELECTROANALGESIA.W..DE.
11. ELECTROTHERA$
12. ELECTROMAGNETI$
13. INTERFERENTIAL
14. REBOX
15. CODETRON
16. LIKON
17. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16
18. CANCER
19. NEOPLASM#.W..DE.
20. TUMOUR
21. TUMOR
22. ONCOLO$
23. CANCER-PAIN.DE.
24. CARCINOMA
25. MALIGNANT
26. MALIGNANCY
27. MALIGNANT-NEOPLASTIC-DISEASE#.DE.
28. 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27
29. PAIN
30. PAIN#.W..DE.
31. PAIN ADJ MEASUREMENT
32. PAIN-ASSESSMENT#.DE.
33. PAIN ADJ SCALE
34. 29 OR 30 OR 31 OR 32 OR 33

(*Continued*)

35. CLINICAL-TRIAL#
36. META-ANALYSIS.DE.
37. CLINICAL ADJ TRIAL
38. CONTROLLED ADJ CLINICAL ADJ TRIAL
39. RANDOMISED ADJ CONTROLLED ADJ TRIAL
40. META-ANALYSIS
41. EVIDENCE-BASED-PRACTICE#.DE.
42. EVALUATION
43. PROSPECTIVE
44. RANDOM ADJ ALLOCATION
45. MEDICAL-RESEARCH#.DE.
46. CLINICAL ADJ RESEARCH
47. CLINICAL-RESEARCH.DE.
48. 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44 OR 45 OR 46 OR 47
49. 17 AND 28 AND 34
50. 48 AND 49
51. ADULT# OR AGED.DE.
52. 50 AND 51

4 Search of The Cochrane Library

Search terms
In addition, Cochrane search history (Reviews / CENTRAL / DARE):
1.Transcutaneous electric nerve stimulation (All fields & products)

(*Continued*)

2.MeSH descriptor TENS, this term only in MeSH products
3.Cancer (All fields & products)
4.MeSH descriptor Neoplasms (explode all trees)
5.Pain (All fields & products)
6.MeSH descriptor Pain (explode all trees)
7.(#1 or #2) and (#3 or #4) and (#5 or #6)

WHAT'S NEW

Last assessed as up-to-date: 20 April 2008.

21 April 2008	Amended	Converted to new review format.

HISTORY

Protocol first published: Issue 4, 2006

Review first published: Issue 3, 2008

18 March 2008	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Background: KR, MJ

Protocol: SO

Methods: SO, KR

Search strategy: SO, KR

Paper collection: HR

Review of studies (appraisal/quality/data extraction): KS, MB, MJ, SO

Statistical analysis: SO, KR, MB, MJ, KS

Discussion: All

Final production: KR

Contact for Cochrane: KR

Group co-ordinator: SO, KR

DECLARATIONS OF INTEREST

Karen Robb is lead author of one of the included studies in this review.

SOURCES OF SUPPORT

Internal sources

- Barts and the London NHS Trust and Tower Hamlets PCT, UK.

External sources

- No sources of support supplied

INDEX TERMS

Medical Subject Headings (MeSH)

Neoplasms [*complications]; Pain [etiology; *therapy]; Randomized Controlled Trials as Topic; Transcutaneous Electric Nerve Stimulation [*methods]

MeSH check words

Adult; Humans