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Electroacupuncture as a complement to usual care for patients with non-acute pain after back surgery: a study protocol for a pilot pragmatic randomised controlled trial

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ABSTRACT

Introduction

Recurrent or persistent low back pain is common after back surgery but is typically not well controlled. Previous randomised controlled trials on non-acute pain after back surgery were flawed. In this article, the design and protocol of a randomised controlled trial to treat pain and improve function after back surgery are described.

Methods and analysis

This study is a pilot randomised, active-controlled, assessor-blinded trial. Patients with recurring or persistent low back pain after back surgery, defined as a Visual Analogue Scale value of ≥ 50 mm, with or without leg pain, will be randomly assigned to an electroacupuncture-plus-usual-care group or to a usual-care-only group. Patients assigned to both groups will have usual care management, including physical therapy and patient education, twice a week during a 4-week treatment period that would begin at randomisation. Patients assigned to the electroacupuncture-plus-usual-care group will also have electroacupuncture twice a week during the 4-week treatment period. The primary outcome will be measured with the 100 mm pain Visual Analogue Scale of low back pain by a blinded evaluator. Secondary outcomes will be measured with the EuroQol 5-Dimension and the Oswestry Disability Index. The primary and secondary outcomes will be measured at 4 and 8 weeks after treatment.

Ethics and dissemination

Written informed consent will be obtained from all participants. This study was approved by the institutional review board (IRB) of Pusan National University Korean Hospital in

September 2013 (IRB approval number 2013012). The study findings will be published in peer-reviewed journals and presented at national and international conferences.

Trial registration

This trial was registered with the United States National Institutes of Health Clinical Trials Registry: NCT01966250.

Strengths and limitations of this study

- This trial is designed to be a feasible, pragmatic, comparative effectiveness trial design that is similar to common clinical situations.
- Individualised acupuncture points according to patients' symptoms during the delivery of acupuncture treatment reflect the real clinical practice of acupuncture.
- We expect that this pilot study will provide the clinical basis and information that is required to assess the feasibility of a future large-scale trial.
- Blinding the practitioner will not be done in this trial because it is impossible to blind acupuncturists.
- The size of the study sample limits the power of the observations.

INTRODUCTION

Billions of dollars have been spent worldwide in the last few years on lumbar spine surgery to treat chronic low back pain (LBP), and thousands of studies have been devoted to

the subject.[1] Lumbar spine surgery is becoming more common, and there is a wide range of surgical procedures.[2] Complications can be acute or can occur later after surgery, and they can lead to worsening or to lack of resolution of the original symptoms.[3] Approximately 40% of patients who undergo lumbar spine surgery continue to report significant pain after the surgery.[4] Pain management is a very important element of patient care because pain is the most common complication of back surgery.[5,6] Various opioid analgesics, including morphine, hydromorphine, and meperidine, have been used for postoperative pain management.[7] However, opioids are frequently observed to have unwanted side effects, such as nausea and vomiting.[8] Therefore, there is a need for safe and effective pain management after back surgery.

Numerous studies have shown that acupuncture is generally safe[9,10] and cost-effective[11] compared with routine care.[12,13] Electroacupuncture (EA) is also commonly used for pain management.[14-16] The primary goal of EA treatment after back surgery is pain reduction. There has been a systematic review of current evidence concerning the effectiveness of acupuncture for relieving acute postoperative pain after back surgery.[17] However, there have been only a few clinical trials[18,19] that evaluated the effectiveness of EA for non-acute postoperative pain after back surgery, and the quality of these studies is too low to draw any meaningful conclusions.

In Korea, because of cultural influence, many potential study participants who are between 19 and 70 years old have already had experience with acupuncture. This makes it difficult to implement participant blinding and practitioner blinding given the nature of acupuncture.[20,21]

We therefore propose to conduct a pilot feasibility study to establish an appropriate sample size before conducting a confirmative, pragmatic, comparative randomised controlled

trial (RCT) to demonstrate the effectiveness of EA in combination with usual care (UC) compared with UC alone for controlling non-acute pain and function at ≥ 3 weeks[22] after the back surgery. The study will adhere to STRICTA[23] and CONSORT[24] guidelines.

Aims

The primary purpose of this study is to explore whether EA in combination with UC can provide benefits to patients with non-acute pain and dysfunction after back surgery. It is also a pilot feasibility study that is designed to estimate the appropriate sample size for a future confirmative, pragmatic, comparative RCT that would verify the effectiveness of EA in combination with UC (drug treatment and physical therapy) compared with UC alone in relieving non-acute pain and dysfunction after back surgery. The dependent variables are pain relief, enhancing disease-related functional status and improved quality of life. We also aim to conduct a cost-effectiveness analysis and a qualitative study with the pilot data, but these results will be reported separately.

METHODS AND ANALYSIS

Study design

This study is a randomised, active-controlled, assessor-blinded pilot trial with two parallel arms. The trial will be conducted in the Pusan National University Korean Medicine Hospital (PNUKH) in Yangsan, Korea. This study protocol was approved by the institutional review board (IRB) of PNUKH in September 2013 (IRB approval number 2013012) and is also registered with ClinicalTrials.gov (Identifier: NCT01966250).

Participants

Inclusion criteria

Patients whose LBP recurred or persisted after back surgery, with or without leg pain.

Patients whose pain persisted for at least 3 weeks (non-acute) after recent back surgery and who require intermittent medical treatment, such as medication, injection, or physical therapy.

Patients with LBP, defined as a Visual Analogue Scale (VAS) value of ≥ 50 mm.

Patients who are between 19 and 70 years of age.

Patients who agreed to participate voluntarily in this study and signed written informed consent forms.

Exclusion criteria

Patients who have been diagnosed with a serious disease that can cause LBP, including cancer, vertebral fracture, spinal infection, inflammatory spondylitis, and *cauda equina* compression.

Patients with a progressive neurological deficit or with severe neurological symptoms.

Patients whose pain is not caused by spinal or soft tissue diseases, such as ankylosing spondylitis, fibromyalgia, rheumatoid arthritis, or gout.

Patients with a chronic disease that could influence the treatment effects or results (e.g., severe cardiovascular disease, diabetic neuropathy, dementia, or epilepsy).

Patients for whom EA might be inappropriate or unsafe (e.g., because of haemorrhagic disease, clotting disorders, a history of having received anticoagulant therapy within the preceding 3 weeks, severe diabetes with a risk of infection, or severe cardiovascular disease).

Patients who are currently pregnant or planning to become pregnant.

Patients with psychiatric diseases.

Patients who are participating in another clinical trial.

Patients who are unable to sign a written informed consent form.

Patients who are judged to be inappropriate for the clinical study by the researchers, such as those who are unable to read and write Korean.

Recruitment

Patients will be recruited by advertisements on hospital websites, bulletin boards and in local newspapers. If hospital patients are interested in participating, they will be asked to answer screening questions to determine their eligibility. If they are eligible, they will be guided through the written informed consent process. After written consent is obtained, a study researcher will administer the baseline questionnaire. Patients who have been determined on the basis of the selection and exclusion criteria to be suitable for the clinical trial will be assigned randomly on a second visit to either the UC-plus-EA group or the UC-alone group, with a 1:1 ratio. After randomisation, a clinical research coordinator (CRC) will schedule the treatment procedure.

Randomisation

Before the first treatment session, a statistical expert will assign patients to one of the two groups by use of a central telephone randomisation process according to a computer-generated randomisation sequence that uses SPSS 19.0 (IBM Co., Armonk, NY, USA). Randomisation will be conducted by a trial coordinator who will have no contact with the patients. The CRC will obtain the codes for the trial (A or B) from a central telephone and inform the practitioner. The practitioner will then use these codes to assign patients to one of the two groups and to deliver the appropriate treatment.

The National Clinical Research Centre at the PNUKH will store the random number. The allocation sequence will be concealed from the researcher who is responsible for enrolling, treating or assessing patients (Figure 1).

Blinding

It is not possible to blind patients or practitioners in our trial because of the nature of EA and because there is no placebo. However, there is protection from detection bias because treatment and assessment will be conducted independently, and the practitioners will not be involved in outcome assessment.[26] The assessors will always perform outcome assessments in a separate room and will always be blinded to treatment assignment.

Education of practitioners for standardisation

The licensed KMDs who will be involved in this trial as practitioners or assessors have

all been certified by the Korean Ministry of Health and Welfare, have at least three years of clinical experience, and will have taken a course to ensure that they adhere strictly to the study protocol and are familiar with administering the study treatments. All participating KMDs underwent intensive and customised training for a full understanding of the EA procedure, including such details as acupuncture points, depth, and manipulation. All study protocols and details, including the recording method for the case report form (CRF) and outcome assessment methods, were additionally standardised among the assessors by means of 10 hours of training on the standard operating procedure.

Interventions

Patients who are randomised to both arms will have UC management during the 4-week treatment period, which begins at randomisation. It is assumed in this study that UC includes drug therapy, physiotherapy or an educational program about LBP.[22] Conventional medicinal drug treatment or therapies (e.g., pain medication, injection, or physiotherapy, but not surgical treatment) that are related to treating LBP after back surgery will be allowed, and they will be monitored. Physiotherapy and an educational program about back pain will be performed twice a week for 4 weeks by licensed KMDs. Interferential current therapy (ICT, OG Giken Co., Okayama, Japan) will last 15 minutes, and therapy with a hot (or ice) pack will last 10 minutes. The education program will be conducted through the brochure, including the physiology, pathology, and epidemiology of pain after back surgery. Additionally, KMDs will present suitable postures and exercises for LBP in 15-min face-to-face education sessions.

Patients who are randomised to the UC-plus-EA group will have EA treatment in

addition to the UC. In the UC-plus-EA group, the acupuncture point prescriptions used will be personalised to each patient and at the discretion of the practitioner. Differentiating the acupuncture point is an important part of traditional Korean medical theory and of creating the actual clinical situation, so it was used to select acupuncture points according to patients' symptoms. Detailed information on EA treatment is summarised in supplementary Appendix 1 and is based on the revised STRICTA statement.[23] EA treatment procedures were designed to reflect the feasibility afforded by the actual clinical setting by a consensus of 5 experts on acupuncture and the spine. EA treatment will be performed by licensed KMDs using disposable stainless steel needles that are 0.25 mm in diameter and 0.40 mm in length (Dong-bang Acupuncture Inc., Seoul, Korea). Electric stimulation will be applied with an ES-160 electronic stimulator (ITO co. LTD, Japan) twice a week for 4 weeks. Stimulation will be applied with biphasic waveform current, which is a compressional wave that combines an interrupted wave and a continuous wave, in triangular form, at a frequency of 50 Hz.[27] Acupuncture points will include Jia-ji (Ex-B2, L3-L5; bilateral) as required points and other reasonable points chosen by the practitioner as accessory points. Between 6 and 15 access points will be used by the physicians according to the individual clinical features of each patient. Each EA session will last 15 minutes. Patients in both groups will have had a total of 8 treatment sessions during 4 weeks.

The rationale of the lack of a placebo/sham intervention group

The primary purpose of this study is to explore whether EA combined with UC can provide benefits to patients with non-acute pain after back surgery. Currently, sham or placebo EA is used to assess the efficacy of the specific component of the EA while reducing any possible influence from clinical contexts and other treatment-related processes.[28,29]

However, with the pragmatic purpose of this trial, we decided not to employ a placebo/sham EA as a control group.

OUTCOME ASSESSMENT

At the initial screening visit, a CRC will ask patients to complete a questionnaire regarding their sociodemographic characteristics, including age, gender, height, weight and vital signs. A CRC or KMD with more than two years of clinical experience will record the outcomes in a separate room according to the standardised operating procedure without knowing to which group the patients have been assigned. Before the start of treatment at each visit, patients will be assessed to record the outcomes of the previous treatments. Any disease history or adverse events will be recorded and will be used to decide if a participant should continue in the trial. Follow-up assessments will be performed at 4 and 8 weeks after the 4-week treatment period (Table 1, Figure 1).

Table 1. Schedule for data collection and outcome measurement

Measures	Baseline	Active treatment								Follow-up	
	Week 0	1st week		2nd week		3rd week		4th week		8th week*	12th week*
Sociodemographic characteristics	√										
Back pain history	√										
Physical examination	√										
Visual analogue scale for back pain	√	√	√	√	√	√	√	√	√	√	√
Oswestry Disability Index		√			√				√	√	√
EuroQol-5Dimensions		√			√				√	√	√
Adverse events		√	√	√	√	√	√	√	√	√	√

*8, 12 week indicates 4 and 8 weeks, respectively, after 4 weeks of electroacupuncture treatment.

Primary outcome measurements

Back pain intensity will be assessed using the 100 mm pain VAS, on which 0 indicates the absence of pain and 100 indicates unbearable pain.[30,31] The VAS was selected as a primary outcome measurement of the clinical severity of patients' pain after back surgery. Using the 100 mm pain VAS, the participant will be asked to check his or her degree of back pain during recent days. Back pain will be measured at baseline (assessment 1), prior to each of the eight treatment sessions (assessments 2 through 9), and during the two follow-up visits (assessments 10 and 11). The primary end point is assessment 9, which marks the end of the 8 active treatment sessions.

Secondary outcome measurements

The Oswestry Disability Index (ODI) is one of two secondary outcome measurements that will be used. The ODI assesses back pain-related disability.[32] It contains 10 questions about daily life, including measures of pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life and travelling. Each question is rated on a scale of 0 to 5, with a higher score indicating a more severe pain-related disability. The validated Korean Version of the ODI[33] will be administered before treatment on the first, fourth and eighth treatment sessions (assessments 2, 5, and 9) and during each of the two follow-up sessions (assessments 10 and 11).

The EuroQol 5-Dimension (EQ-5D) will also be used as a secondary outcome measurement. The quality of life of patients with back pain will be assessed using the validated Korean version of the EQ-5D.[34,35] The EQ-5D includes generic questions about quality of life as it relates to personal health. The EQ-5D consists of five dimensions that pertain to mobility (mobility), self-care (self care), daily activities (usual activities), pain and

discomfort (pain), and anxiety and depression (anxiety/depression). Each dimension is scored on a scale of 1 to 3, with a lower score indicating a better state of participant health. The EQ-5D will be administered before treatment on the first, fourth and eighth treatment sessions (assessments 2, 5, and 9) and during each of the two follow-up sessions (assessments 10 and 11).

Sample size

Although our study is a pilot trial, we attempted to approximate a sample size that would be suitable for a future, large, pragmatic, multi-centred, comparative effectiveness RCT. We also attempted to estimate more exactly the power of a future trial. The sample size for the future clinical study was estimated by comparing the mean difference in the VAS for LBP between the experimental and control groups in the pilot study. The mean difference in the pain VAS for LBP between the experimental (65 mm in VAS) and control (86 mm in VAS) groups was 21 mm.[36] The standard deviation between the two groups was estimated to be 20, based on other published results.[36] When a two-tailed test with a test power of 80% and a significance level of 5% (α error) was applied to the following formula, the number of subjects required for each group was found to be 16. Considering a dropout rate of 20% and a 1:1 allocation ratio, the total sample size was calculated to be 40.

Sample size n: $\frac{2(Z_{\alpha/2}+Z_{1-\beta})^2\delta^2}{(\mu t-\mu c)^2}$

n = the number of subjects required in each group

$\mu_t - \mu_c = 21$

$\delta = 20$

$Z_{\alpha/2} = Z_{0.05/2} = 1.96$

$Z_{1-\beta} = Z_{0.8} = 0.84$

Statistical methods and analysis

The statistical analysis will be performed according to the principle of intention-to-treat (ITT) analysis and per-protocol (PP) analysis. In the case of ITT analysis, we will apply the last-observation-carried-forward (LOCF) rule for missing data. In parallel, PP analysis will be conducted without patients who dropped out of the clinical trials for any reason. Additionally, the subgroups of patients with pain after back surgery will be evaluated and analysed (subgroup analysis) for exploring potential future research. The significance of the differences in the various data in each group will be analysed with a paired T-test, and the significance of the differences between groups will be analysed with an independent T-test. An analysis of covariance (ANCOVA) will be used to analyse and adjust baseline characteristics if there are statistically significant differences and there is a possibility of covariance of baseline characteristics. Nonparametric statistical tests (a Wilcoxon signed-rank test or the Wilcoxon rank-sum test) will be used if the data are not normally distributed. A Chi-square test or a Fisher's exact test will be performed to analyse categorical data, such as responses that are recorded and described as frequencies (%). All statistical analyses will be conducted with SPSS statistical software (IBM Co., Armonk, NY, USA) for Windows, version 19.0, by a statistician. The significance level will be set at 5%.

Safety

All possible adverse events that could affect patients will be monitored and reported for every trial by the participating researchers. Every expected or unexpected adverse event

related to this study will be recorded and monitored until it is resolved. The research team will report any differences in the safety of the experimental and control groups. Data and safety monitoring will be conducted periodically during the study and at least once a year thereafter. Monitors will oversee study protocol compliance, informed consent documents, overall progress of the trial, participant recruitment, data quality and timeliness, performance of the intervention and all fields and processes of the trial.

Ethics and Dissemination

In conformity with the Declaration of Helsinki,[25] all participants will be recruited to participate voluntarily, and they will sign a written informed consent form. Participation can be ended at any time during the clinical trial if a participant refuses to continue or if there is significant clinical deterioration, as determined by the Korean medicine doctors (KMDs). The study findings will be disseminated in peer-reviewed journals and presented at national and international conferences.

DISCUSSION

EA is commonly used for pain management after surgery.[37-40] There has been a systematic review summarising the current evidence concerning the effectiveness of acupuncture for treating acute postoperative pain after back surgery,[17] but few clinical trials have evaluated the effectiveness of EA for treating non-acute postoperative pain after back surgery. We have therefore designed this pilot RCT to guide the design of a full-scale randomised trial. The results of our study will determine the appropriate sample size for a future feasible, pragmatic, comparative effectiveness RCT to evaluate the effectiveness and

cost effectiveness of EA with UC compared with UC alone in the treatment of non-acute pain after back surgery.

A strength of our study is that it is designed to be a feasible, pragmatic, comparative effectiveness trial design that is similar to common clinical situations. Additionally, this clinical trial protocol was conducted to conform strictly to the STRICTA statement[23] and the CONSORT statement.[24] We expect that this pilot study will provide the clinical basis and information that is required to assess the feasibility of a future large-scale trial.

TRIAL STATUS

The trial is currently in the recruitment phase. The results of this trial will be available in 2015.

List of abbreviations

RCT, randomised controlled trial; EA, electroacupuncture; UC, usual care; ODI, Oswestry Disability Index; VAS, Visual analogue scale; EQ-5D, The EuroQol 5-Dimension; ICT, Interferential Current Therapy; CRC, clinical research coordinator; KMD, Korean Medical Doctor; ITT, intention-to-treat; PP, per-protocol

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Contributors

MSH helped to conceive and design the trial and wrote the manuscript. KHH and HWC helped to conceive of and design the trial. BCS helped to conceive the trial and revised the manuscript. HYL and IH will recruit the patients and conduct the trial. NKK planned the statistical analysis. BKC and DWS will supervise the trial. EHH helped to conceive and design the study and critically revised the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Patients consent

Obtained.

Ethics approval

This study was approved by the institutional review board (IRB) of Pusan National University Korean Hospital in September 2013 (IRB approval number 2013012).

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

We will share the data after the trial is finished. Additional details of the study protocol can be requested from the corresponding author.

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REFERENCES

1. Don AS, Carragee E. A brief overview of evidence-informed management of chronic low back pain with surgery. *Spine J* 2008;8:258-65.
2. Sarrazin JL. [Imaging of postoperative lumbar spine]. *J Radiol* 2003;84:241-52.
3. Herrera Herrera I, Moreno de la Presa R, Gonzalez Gutierrez R, *et al.* Evaluation of the postoperative lumbar spine. *Radiologia* 2013;55:12-23.
4. Aghion D, Chopra P, Oyelese AA. Failed back syndrome. *Med Health R I* 2012;95:391-3.
5. Skolasky RL, Wegener ST, Maggard AM, *et al.* The impact of reduction of pain after lumbar spine surgery: the relationship between changes in pain and physical function and disability. *Spine (Phila Pa 1976)* 2014;39:1426-32.
6. Fleckenstein J, Baeumler PI, Gurschler C, *et al.* Acupuncture for post anaesthetic recovery and postoperative pain: study protocol for a randomised controlled trial. *Trials* 2014;15:292.
7. Hutchison RW, Chon EH, Tucker Jr. WF, *et al.* A comparison of a fentanyl, morphine, and hydromorphone patientcontrolled intravenous delivery for acute postoperative analgesia: a multicenter study of opioid-induced adverse reactions. *Hosp Pharm* 2006;41:659-63.
8. Benyamin R, Trescot AM, Datta S, *et al.* Opioid complications and side effects. *Pain Physician* 2008;11:S105-20.
9. White A, Hayhoe S, Hart A, *et al.* Survey of adverse events following acupuncture (SAFA): a prospective study of 32,000 consultations. *Acupunct Med* 2001;19:84-92.
10. Wheway J, Agbabiaka TB, Ernst E. Patient safety incidents from acupuncture treatments: a review of reports to the National Patient Safety Agency. *Int J Risk Saf Med* 2012;24:163-9.

11. Lin CW, Haas M, Maher CG, *et al.* Cost-effectiveness of guideline-endorsed treatments for low back pain: a systematic review. *Eur Spine J* 2011;20:1024-38.

12. Lee JH, Choi TY, Lee MS, *et al.* Acupuncture for acute low back pain: a systematic review. *Clin J Pain* 2013;29:172-85.

13. Shin JS, Ha IH, Lee J, *et al.* Effects of motion style acupuncture treatment in acute low back pain patients with severe disability: a multicenter, randomized, controlled, comparative effectiveness trial. *Pain* 2013;154:1030-7.

14. Casimiro L, Barnsley L, Brosseau L, *et al.* Acupuncture and electroacupuncture for the treatment of rheumatoid arthritis. *Cochrane Database Syst Rev* 2005:CD003788.

15. Zhao XB, Xing QZ, Han XC. Observation on electroacupuncture at neimadian (extra) and neiguan (PC 6) for analgesia after thoracic surgery. *Zhongguo Zhen Jiu* 2013;33:829-32.

16. Chia KL. Electroacupuncture treatment of acute low back pain: unlikely to be a placebo response. *Acupunct Med* 2014;32:354-5.

17. Cho YH, Kim CK, Heo KH, *et al.* Acupuncture for acute postoperative pain after back surgery: a systematic review and meta-analysis of randomized controlled trials. *Pain Pract* 2014:[Epub ahead of print].

18. Huang HT, Zheng SH, Feng J, *et al.* Thin's abdominal acupuncture for treatment of failed back surgery syndrome in 20 cases of clinical observation. *Guid J Trad Chin Med Pharm* 2012;18:63-5.

19. Zheng SH, Wu YT, Liao JR, *et al.* Abdominal acupuncture treatment of failed back surgery syndrome clinical observation [in Chinese]. *J Emerg Trad Chin Med* 2010;19:1497-8.

20. Kim SI, Lee KB, Lee HS, *et al.* Acupuncture experience in patients with chronic low back pain(2): a qualitative study - focused on participants in randomized controlled trial. *Korean J Acupunct* 2012;29:581-97.

21. Lee H, Bang H, Kim Y, *et al.* Non-penetrating sham needle, is it an adequate sham control in acupuncture research? *Complement Ther Med* 2011;19 Suppl 1:S41-8.

22. National Guideline Clearinghouse. Low Back Disorders. Secondary Low Back Disorders 2011. http://www.guideline.gov/content.aspx?id=38438.

23. MacPherson H, Altman DG, Hammerschlag R, *et al.* Revised STandards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA): Extending the CONSORT statement. *J Evid Based Med* 2010;3:140-55.

24. Moher D, Hopewell S, Schulz KF, *et al.* CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *Int J Surg* 2012;10:28-55.

25. Puri KS, Suresh KR, Gogtay NJ, *et al.* Declaration of Helsinki, 2008: implications for stakeholders in research. *J Postgrad Med* 2009;55:131-4.

26. Higgins J, Green S, Cochrane Collaboration. *Cochrane Handbook for Systematic Reviews of Interventions*. Chichester, England; Hoboken, NJ: Wiley-Blackwell, 2008.

27. Jung YP, Jung HK, Chiang SY, *et al.* The clinical study of electroacupuncture treatment at Hua-Tuo-Jia-Ji-Xue on spondylolisthesis. *The Journal of Korean Acupuncture & Moxibustion Society* 2008;25:221-32.

28. Dias M, Vellarde GC, Olej B, *et al.* Effects of electroacupuncture on stress-related symptoms in medical students: a randomised placebo-controlled study. *Acupunct Med* 2014;32:4-11.

29. Kim KH, Ryu JH, Park MR, *et al.* Acupuncture as analgesia for non-emergent acute non-specific neck pain, ankle sprain and primary headache in an emergency department

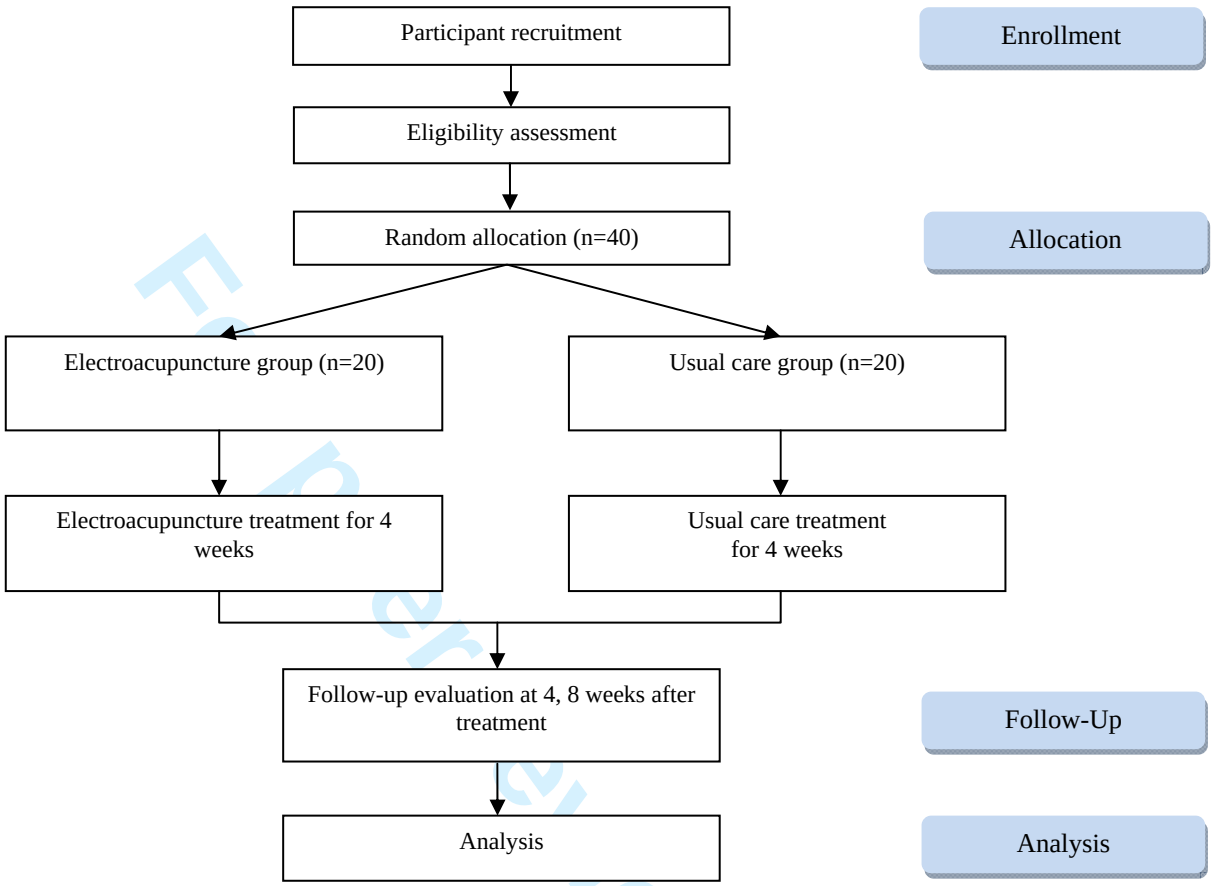
setting: a protocol for a parallel group, randomised, controlled pilot trial. *BMJ Open* 2014;4:e004994.

30. Revill SI, Robinson JO, Rosen M, *et al.* The reliability of a linear analogue for evaluating pain. *Anaesthesia* 1976;31:1191-8.
31. Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. *Pain* 1983;16:87-101.
32. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine (Phila Pa 1976)* 2000;25:2940-52.
33. Jeon CH, Kim DJ, Kim SK, *et al.* Validation in the cross-cultural adaptation of the Korean version of the Oswestry Disability Index. *J Korean Med Sci* 2006;21:1092-7.
34. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. *Ann Med* 2001;33:337-43.
35. Kang EJ, Shin SH, Park HJ, *et al.* A validation of health status using EQ-5D. *The Korean Journal of Health Economics and Policy* 2006;12:19-43.
36. Tsukayama H, Yamashita H, Amagai H, *et al.* Randomised controlled trial comparing the effectiveness of electroacupuncture and TENS for low back pain: a preliminary study for a pragmatic trial. *Acupunct Med* 2002;20:175-80.
37. Chi H, Zhou WX, Wu YY, *et al.* Electroacupuncture intervention combined with general anesthesia for 80 cases of heart valve replacement surgery under cardiopulmonary bypass. *Zhen Ci Yan Jiu* 2014;39:1-6.
38. Wu J, Zhao Y, Yang CM, *et al.* Effects of electroacupuncture preemptive intervention on postoperative pain of mixed hemorrhoids. *Zhongguo Zhen Jiu* 2014;34:279-83.
39. Zhang H, Wang L, Zhang M, *et al.* Effects of electroacupuncture on postoperative functional recovery in patients with gynaecological laparoscopic surgery. *Zhongguo Zhen Jiu* 2014;34:273-8.

40. Zhang Z, Wang C, Li Q, *et al.* Electroacupuncture at ST36 accelerates the recovery of gastrointestinal motility after colorectal surgery: a randomised controlled trial. *Acupunct Med* 2014;32:223-6.

FIGURE LEGEND

Figure 1. Flowchart showing the steps in participant recruitment, treatment, and analysis.



Appendix 1. Acupuncture treatment details

	Item	Details
1. Acupuncture rationale	(a) Style of acupuncture	Traditional Korean medical theory
	(b) Reason for treatment provided (based on historical context, literature sources and consensus methods)	Textbook on acupuncture and moxibustion-related articles and references[1,2]
	(c) Extent to which treatment was varied	Partially individualised acupuncture treatment, i.e., fixed points plus optional points based on symptoms.
2. Details of needling	(a) Number of needle insertions per patient per session	From 6 to 15
	(b) Names (or location if no standard name) of points used (uni-/bilateral)	- Six fixed points: Ex-B2 (L3-L5; bilateral) - Optional points based on individual symptoms: GB30, GB34, ST36 and BL60 (bilateral), GV3 (unilateral)
	(c) Depth of insertion	10 to 20 mm
	(d) Response sought (for example, ‘de qi’ or muscle twitch response)	'De qi' sensation
	(e) Needle stimulation (for example, manual, electrical)	Electrical current biphasic wave form (Compressional wave that combines an interrupted wave and a continuous wave, in triangular form, at a frequency of 50 Hz.)
	(f) Needle-retention time	15 min
	(g) Needle type (diameter, length	A sterilised stainless steel needle (0.25 × 40

	and manufacturer or material)	mm, Dongbang Acupuncture Inc., Bundang, Sungnam, Korea).
3. Treatment regimen	(a) Number of treatment sessions	Eight
	(b) Frequency and duration of treatment sessions	Twice a week for four weeks
4. Other components of treatment	(a) Details of other interventions administered to the acupuncture group	Plus usual care (drug therapy, physiotherapy and participant education)
	(b) Setting and context of treatment, including instructions to practitioners and information and explanations to patients	Independent researcher counselling regarding treatment and lifestyle management of pain after back surgery.
5. Practitioner background	(a) Description of participating acupuncturists	Korean medical doctors who are specialists in oriental rehabilitation medicine, with more than 3 years of clinical experience under supervision by a specialist
6. Control or comparator interventions	(a) Rationale for the control or comparator in the context of the research question with sources that justify this choice	See reference[3]
	(b) Precise description of the control or comparator if sham acupuncture	Patients in the control group receive usual care, which includes drug therapy, physiotherapy and participant education. Frequency and duration: Twice a week for

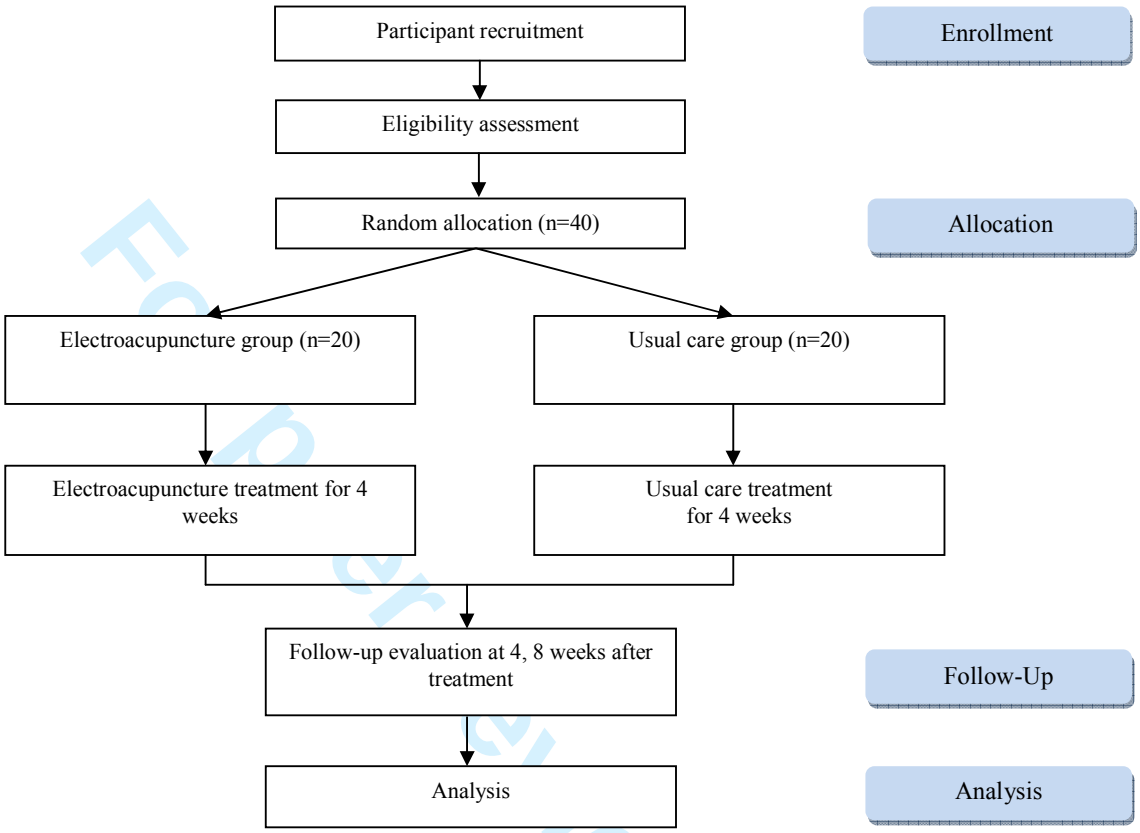
		four weeks

EX-B2, Extra acupoint of lumbar; GB, Gallbladder; CV, Conception Vessel; ST, Stomach; BL, Bladder.

1. Committee on Compilation of Textbook in Society for Acupuncture & Moxibustion. *Acupuncture and Moxibustion Medicine*. Paju: Jipmoondang Publishing Company, 2012.

2. Heo J, Ahn S, Kim N*, et al. Donguibogam*. Seoul: Ministry of Health & Welfare, 2012.

3. National Guideline Clearinghouse. Low Back Disorders. Secondary Low Back Disorders 2011. http://www.guideline.gov/content.aspx?id=38438.



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Electroacupuncture as a complement to usual care for patients with non-acute pain after back surgery: a study protocol for a pilot randomised controlled trial

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Electroacupuncture as a complement to usual care for patients with non-acute pain after back surgery: a study protocol for a pilot randomised controlled trial

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ABSTRACT

Introduction

Recurrent or persistent low back pain is common after back surgery but is typically not well controlled. Previous randomised controlled trials on non-acute pain after back surgery were flawed. In this article, the design and protocol of a randomised controlled trial to treat pain and improve function after back surgery are described.

Methods and analysis

This study is a pilot randomised, active-controlled, assessor-blinded trial. Patients with recurring or persistent low back pain after back surgery, defined as a Visual Analogue Scale value of ≥50 mm, with or without leg pain, will be randomly assigned to an electroacupuncture-plus-usual-care group or to a usual-care-only group. Patients assigned to both groups will have usual care management, including physical therapy and patient education, twice a week during a 4-week treatment period that would begin at randomisation. Patients assigned to the electroacupuncture-plus-usual-care group will also have electroacupuncture twice a week during the 4-week treatment period. The primary outcome will be measured with the 100 mm pain Visual Analogue Scale of low back pain by a blinded evaluator. Secondary outcomes will be measured with the EuroQol 5-Dimension and the Oswestry Disability Index. The primary and secondary outcomes will be measured at 4 and 8 weeks after treatment.

Ethics and dissemination

Written informed consent will be obtained from all participants. This study was approved by the institutional review board (IRB) of Pusan National University Korean Hospital in

September 2013 (IRB approval number 2013012). The study findings will be published in peer-reviewed journals and presented at national and international conferences.

Trial registration

This trial was registered with the United States National Institutes of Health Clinical Trials Registry: NCT01966250.

Strengths and limitations of this study

- This trial is designed to be a feasible, comparative effectiveness trial design that is similar to common clinical situations.
- Individualised acupuncture points according to patients' symptoms during the delivery of acupuncture treatment reflect the real clinical practice of acupuncture.
- We expect that this pilot study will provide the clinical basis and information that is required to assess the feasibility of a future large-scale trial.
- Blinding the practitioner will not be done in this trial because it is impossible to blind acupuncturists.
- The size of the study sample limits the power of the observations.

INTRODUCTION

Billions of dollars have been spent worldwide in the last few years on lumbar spine surgery to treat chronic low back pain (LBP), and thousands of studies have been devoted to the subject.[1] Lumbar spine surgery is becoming more common, and there is a wide range of surgical procedures.[2] Complications can be acute or can occur later after surgery, and they

can lead to worsening or to lack of resolution of the original symptoms.[3] Approximately 40% of patients who undergo lumbar spine surgery continue to report significant pain after the surgery.[4] Pain management is a very important element of patient care because pain is the most common complication of back surgery.[5 6]Various opioid analgesics, including morphine, hydromorphine, and meperidine, have been used for postoperative pain management.[7] However, opioids are frequently observed to have unwanted side effects, such as nausea and vomiting.[8] Therefore, there is a need for safe and effective pain management after back surgery.

Numerous studies have shown that acupuncture is generally safe[9 10]and cost-effective[11] compared with routine care.[12 13] Electroacupuncture (EA) is also commonly used for pain management.[14-16] The primary goal of EA treatment after back surgery is pain reduction. There has been a systematic review of current evidence concerning the effectiveness of acupuncture for relieving acute postoperative pain after back surgery.[17] However, there have been only a few clinical trials[18 19]that evaluated the effectiveness of EA for non-acute postoperative pain after back surgery, and the quality of these studies is too low to draw any meaningful conclusions.

In Korea, because of cultural influence, many potential study participants who are between 19 and 70 years old have already had experience with acupuncture. This makes it difficult to implement participant blinding and practitioner blinding given the nature of acupuncture.[20 21]

We therefore propose to conduct a pilot feasibility study to establish an appropriate sample size before conducting a confirmative, pragmatic, comparative randomised controlled trial (RCT) to demonstrate the effectiveness of EA in combination with usual care(UC)compared with UC alone for controlling non-acute pain and function at ≥ 3 weeks[22]

after the back surgery. The study will adhere to STRICTA[23] and CONSORT[24] guidelines.

Aims

The primary purpose of this study is to explore whether EA in combination with UC can provide benefits to patients with non-acute pain and dysfunction after back surgery. It is also a pilot feasibility study that is designed to estimate the appropriate sample size for a future confirmative, pragmatic, comparative RCT that would verify the effectiveness of EA in combination with UC (drug treatment and physical therapy) compared with UC alone in relieving non-acute pain and dysfunction after back surgery. The dependent variables are pain relief, enhancing disease-related functional status and improved quality of life. We also aim to conduct a cost-effectiveness analysis and a qualitative study with the pilot data, but these results will be reported separately.

METHODS AND ANALYSIS

Study design

This study is a randomised, active-controlled, assessor-blinded pilot trial with two parallel arms. The trial will be conducted in the Pusan National University Korean Medicine Hospital (PNUKH) in Yangsan, Korea. This study protocol was approved by the institutional review board(IRB) of PNUKH in September2013 (IRB approval number 2013012) and is also registered with ClinicalTrials.gov (Identifier: NCT01966250, 11-Oct-2013).

Participants

Inclusion criteria

Patients whose LBP recurred or persisted after back surgery, with or without leg pain.

Patients whose pain persisted for at least 3 weeks (non-acute) after back surgery and who require intermittent medical treatment, such as medication, injection, or physical therapy.

Patients with LBP, defined as a Visual Analogue Scale (VAS) value of ≥ 50 mm.

Patients who are between 19 and 70 years of age.

Patients who agreed to participate voluntarily in this study and signed written informed consent forms.

Exclusion criteria

Patients who have been diagnosed with a serious disease that can cause LBP, including cancer, vertebral fracture, spinal infection, inflammatory spondylitis, and *cauda equina* compression.

Patients with a progressive neurological deficit or with severe neurological symptoms.

Patients whose pain is not caused by spinal or soft tissue diseases, such as ankylosing spondylitis, fibromyalgia, rheumatoid arthritis, or gout.

Patients with a chronic disease that could influence the treatment effects or results (e.g., severe cardiovascular disease, diabetic neuropathy, dementia, or epilepsy).

Patients for whom EA might be inappropriate or unsafe (e.g., because of haemorrhagic

disease, clotting disorders, a history of having received anticoagulant therapy within the preceding 3weeks, severe diabetes with a risk of infection, or severe cardiovascular disease).

Patients who are currently pregnant or planning to become pregnant.

Patients with psychiatric diseases.

Patients who are participating in another clinical trial.

Patients who are unable to sign a written informed consent form.

Patients who are judged to be inappropriate for the clinical study by the researchers, such as those who are unable to read and write Korean.

Recruitment

Patients will be recruited by advertisements on hospital websites, bulletin boards and in local newspapers. If hospital patients are interested in participating, they will be asked to answer screening questions to determine their eligibility. If they are eligible, they will be guided through the written informed consent process. After written consent is obtained, a study researcher will administer the baseline questionnaire. Patients who have been determined on the basis of the selection and exclusion criteria to be suitable for the clinical trial will be assigned randomly on a second visit to either the UC-plus-EA group or the UC-alone group, with a 1:1 ratio. After randomisation, a clinical research coordinator (CRC) will schedule the treatment procedure. The first participant was enrolled in 29-Oct-2013.

Randomisation

Before the first treatment session, a statistical expert will assign patients to one of the two groups by use of a central telephone randomisation process according to a computer-generated randomisation sequence that uses SPSS 19.0 (IBM Co., Armonk, NY, USA).Randomisation will be conducted by a trial coordinator who will have no contact with the patients. The CRC will obtain the codes for the trial (A or B) from a central telephone and inform the practitioner. The practitioner will then use these codes to assign patients to one of the two groups and to deliver the appropriate treatment.

The National Clinical Research Centre at the PNUKH will store the random number. The allocation sequence will be concealed from the researcher who is responsible for enrolling, treating or assessing patients (Figure 1).

Blinding

It is not possible to blind patients or practitioners in our trial because of the nature of EA and because there is no placebo. However, there is protection from detection bias because treatment and assessment will be conducted independently, and the practitioners will not be involved in outcome assessment.[25] The assessors will always perform outcome assessments in a separate room and will always be blinded to treatment assignment. Unblinding of assessors should be performed only when exceptional circumstances occur as knowledge of the actual treatment is absolutely essential for further management of the patient (e.g., serious adverse event).

Education of practitioners for standardisation

The licensed KMDs who will be involved in this trial as practitioners or assessors have all been certified by the Korean Ministry of Health and Welfare, have at least three years of clinical experience, and will have taken a course to ensure that they adhere strictly to the study protocol and are familiar with administering the study treatments. All participating KMDs underwent intensive and customised training for a full understanding of the EA procedure, including such details as acupuncture points, depth, and manipulation. All study protocols and details, including the recording method for the case report form (CRF) and outcome assessment methods, were additionally standardised among the assessors by means of 10 hours of training on the standard operating procedure.

Interventions

Patients who are randomised to both arms will have UC management during the 4-week treatment period, which begins at randomisation. It is assumed in this study that UC includes drug therapy, physiotherapy or an educational program about LBP.[22] Conventional medicinal drug treatment or therapies (e.g., pain medication, injection, or physiotherapy, but not surgical treatment) that are related to treating LBP after back surgery will be allowed, and they will be monitored. Physiotherapy and an educational program about back pain will be performed twice a week for 4 weeks by licensed KMDs. Interferential current therapy (ICT,OG Giken Co., Okayama, Japan) will last 15 minutes, and therapy with a hot (or ice) pack will last 10 minutes. The education program will be conducted through the brochure, including the physiology, pathology, and epidemiology of pain after back surgery. Additionally, KMDs will present suitable postures and exercises for LBP in 15-min face-to-face education sessions.

Patients who are randomised to the UC-plus-EA group will have EA treatment in addition to the UC. In the UC-plus-EA group, the acupuncture point prescriptions used will be personalised to each patient and at the discretion of the practitioner. Differentiating the acupuncture point is an important part of traditional Korean medical theory and of creating the actual clinical situation, so it was used to select acupuncture points according to patients' symptoms. EA treatment procedures were designed to reflect the feasibility afforded by the actual clinical setting by a consensus of 5 experts on acupuncture and the spine. EA treatment will be performed by licensed KMDs using disposable stainless steel needles that are 0.25 mm in diameter and 0.40 mm in length (Dongbang Acupuncture Inc., Seongnam, Korea). Electric stimulation will be applied with an ES-160 electronic stimulator (ITO co. LTD, Japan) twice a week for 4 weeks. Stimulation will be applied with biphasic waveform current, which is a compressional wave that combines an interrupted wave and a continuous wave, in triangular form, at a frequency of 50 Hz.[26] Acupuncture points will include Jia-ji (Ex-B2, L3-L5; bilateral) as required points and other reasonable points can be chosen by the practitioner as accessory points. Between 6 and 15 access points will be used by the physicians according to the individual clinical features of each patient. Electric stimulation will be given through alligator clips, connected to Jia-ji (Ex-B2, L3/L5; bilateral). Each EA session will last 15 minutes. Patients in both groups will have had a total of 8 treatment sessions during 4 weeks.

The rationale of the lack of a placebo/sham intervention group

The primary purpose of this study is to explore whether EA combined with UC can provide benefits to patients with non-acute pain after back surgery. Currently, sham or placebo EA is used to assess the efficacy of the specific component of the EA while reducing any possible influence from clinical contexts and other treatment-related processes.[27 28]

However, with the purpose of pragmatic, comparative effectiveness RCT of future trial, we decided not to employ a placebo/sham EA as a control group.

OUTCOME ASSESSMENT

At the initial screening visit, a CRC will ask patients to complete a questionnaire regarding their sociodemographic characteristics, including age, gender, height, weight and vital signs. A CRC or KMD with more than two years of clinical experience will record the outcomes in a separate room according to the standardised operating procedure without knowing to which group the patients have been assigned. Before the start of treatment at each visit, patients will be assessed to record the outcomes of the previous treatments. Any disease history or adverse events will be recorded and will be used to decide if a participant should continue in the trial. Follow-up assessments will be performed at 4 and 8 weeks after the 4-week treatment period (Table 1, Figure 1).

Primary outcome measurements

Back pain intensity will be assessed using the 100 mm pain VAS, on which 0 indicates the absence of pain and 100 indicates unbearable pain.[29 30]The VAS was selected as a primary outcome measurement of the clinical severity of patients' pain after back surgery. Using the 100 mm pain VAS, the participant will be asked to check his or her degree of back pain for the previous 3days. Back pain will be measured at baseline (assessment 1), prior to each of the eight treatment sessions (assessments 2 through 9), and during the two follow-up visits (assessments 10 and 11). The primary endpoint is assessment 10, which marks the end of the 8active treatment sessions.

Secondary outcome measurements

The Oswestry Disability Index (ODI) is one of two secondary outcome measurements that will be used. The ODI assesses back pain-related disability.[31] It contains 10 questions about daily life, including measures of pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life and travelling. Each question is rated on a scale of 0 to 5, with a higher score indicating a more severe pain-related disability. The validated Korean Version of the ODI[32] will be administered before treatment on the first, fourth and eighth treatment sessions (assessments 2, 5, and 9) and during each of the two follow-up sessions (assessments 10 and 11).

Responder, is defined as a participant with 50% or more pain relief using a 100-mm VAS for pain intensity, versus non-responder (under 50% pain relief) will be assessed at eighth treatment session (assessments 9) and the two follow-up sessions (assessments 10 and 11). The EuroQol 5-Dimension (EQ-5D) will also be used as a secondary outcome measurement. The quality of life of patients with back pain will be assessed using the validated Korean version of the EQ-5D.[33 34] The EQ-5D includes generic questions about quality of life as it relates to personal health. The EQ-5D consists of five dimensions that pertain to mobility (mobility), self-care (self care), daily activities (usual activities), pain and discomfort (pain), and anxiety and depression (anxiety/depression). Each dimension is scored on a scale of 1 to 3, with a lower score indicating a better state of participant health. The EQ-5D will be administered before treatment on the first, fourth and eighth treatment sessions (assessments 2, 5, and 9) and during each of the two follow-up sessions (assessments 10 and 11).

Data management

Data and safety monitoring will be conducted periodically during the study and at least once a year thereafter. Only specific research assistants will have access to the final trial dataset. The research assistants will consist of two independent researchers (one in biomedical statistics, one in clinical expert of Korean medicine) who will not be involved in the trial. Monitors will oversee study protocol compliance, informed consent documents, overall progress of the trial, participant recruitment, data quality and timeliness, performance of the intervention and all fields and processes of the trial. If any important protocol modifications exist, we will resubmit amended protocol to IRB. Important protocol modifications will be announced to relevant parties (e.g., investigators, IRB, trial participants, trial registries, and sponsor). Audit will be carried out by the Korean Food & Drug Administration that adheres to its rule. Interim analysis will not be applied because we expect this small pilot trial to be a minimal risk of harm to be associated with EA and UC. All study-related information will be stored securely at the study site. All participant information will be stored for 10 years in locked file cabinets in areas with limited access.

Sample size

Although our study is a pilot trial, we attempted to approximate a sample size that would be suitable for a future, large, pragmatic, multi-centred, comparative effectiveness RCT. We also attempted to estimate more exactly the power of a future trial. The sample size for the future clinical study was estimated by comparing the mean difference in the VAS for LBP between the experimental and control groups in the pilot study. As there was no same trial

with our design of RCT, we estimated the sample size on the basis of other similar previous study.[35-37] The mean difference in the pain VAS for LBP between the experimental and control groups was 20 mm suggested as clinically important change.[38 39] The standard deviation between the two groups was estimated to be 19, based on other published results.[18 19 40] When a two-tailed test with a test power of 80% and a significance level of 5% (α error) was applied to the following formula, the number of subjects required for each group was found to be 16. Considering a dropout rate of 20% and a 1:1 allocation ratio, the total sample size was calculated to be 20. On the other hands, in previous pilot trials which were performed without calculating the number of sample size to enforce the number of samples of 20. [28 35-37 41 42]

Sample size n: $\frac{2(Z_{\alpha/2}+Z_{1-\beta})^2\delta^2}{(\mu t-\mu c)^2}$

n = the number of subjects required in each group

μ_t-μ_c = 20

δ= 19

$Z_{\alpha/2} = Z_{0.05/2} = 1.96$

$Z_{1-\beta} = Z_{0.8} = 0.84$

Statistical methods and analysis

The statistical analysis will be performed according to the principle of intention-to-treat (ITT) analysis and per-protocol (PP) analysis. In the case of ITT analysis, we will apply the last-observation-carried-forward (LOCF) rule for missing data. In parallel, PP analysis will be conducted without patients who dropped out of the clinical trials for any reason. Additionally, the subgroups of patients with pain after back surgery will be evaluated and analysed

(subgroup analysis) for exploring potential future research. Subgroup analysis will be conducted according to the type of surgery ((i.e. fusion, decompression or discectomy), surgically involved spine(s) (which level(s) was/were and how many levels were involved), and postoperative period (subacute: 3 weeks or more to 3 months versus chronic: more than 3 months) for exploring the feasibility of future trial. The significance of the differences in the various data in each group will be analysed with a paired T-test, and the significance of the differences between groups will be analysed with an independent T-test. An analysis of covariance (ANCOVA) will be used to analyse and adjust baseline characteristics if there are statistically significant differences and there is a possibility of covariance of baseline characteristics. Nonparametric statistical tests (a Wilcoxon signed-rank test or the Wilcoxon rank-sum test) will be used if the data are not normally distributed. A Chi-square test or a Fisher'sexact test will be performed to analyse categorical data, such as responses/ responders that are recorded and described as frequencies (%). All statistical analyses will be conducted with SPSS statistical software (IBM Co., Armonk, NY, USA) for Windows, version 19.0, by a statistician. The significance level will be set at 5%. Sample size estimation was conducted by the free program of G*Power Version 3.1.7 (Franz Faul, Uniesität Kiel, Germany).

Safety

All possible adverse events that could affect patients will be monitored and reported for every trial by the participating researchers. Every expected or unexpected adverse event related to this study will be recorded and monitored until it is resolved. And those who suffer harm from trial participation can be given medical treatment for compensation. The research team will report any differences in the safety of the experimental and control groups.

Ethics and Dissemination

In conformity with the Declaration of Helsinki,[43] all participants will be recruited to participate voluntarily, and they will sign a written informed consent form. Participation can be ended at any time during the clinical trial if a participant refuses to continue or if there is significant clinical deterioration, as determined by the Korean medicine doctors (KMDs). The study findings will be disseminated in peer-reviewed journals and presented at national and international conferences.

DISCUSSION

EA is commonly used for pain management after surgery.[44-47] There has been a systematic review summarising the current evidence concerning the effectiveness of acupuncture for treating acute postoperative pain after back surgery,[17] but few clinical trials have evaluated the effectiveness of EA for treating non-acute postoperative pain after back surgery. We have therefore designed this pilot RCT to guide the design of a full-scale randomised trial. The results of our study will determine the appropriate sample size for a future feasible, pragmatic, comparative effectiveness RCT to evaluate the effectiveness and cost effectiveness of EA with UC compared with UC alone in the treatment of non-acute pain after back surgery. From the subgroup analysis of the type of surgery and the surgically involved level of spine, we will explore the potential factor(s) related to the difference of effectiveness of EA on pain and function after back surgery.

A strength of our study is that it is designed to be a feasible, comparative effectiveness trial design that is similar to common clinical situations. Additionally, this clinical trial

protocol was conducted to conform strictly to the STRICTA statement[23] and the CONSORT statement.[24] We expect that this pilot study will provide the clinical basis and information that is required to assess the feasibility of a future large-scale trial.

TRIAL STATUS

The trial is currently in the recruitment phase. The results of this trial will be available in 2015.

List of abbreviations

RCT, randomised controlled trial; EA, electroacupuncture; UC, usual care; ODI, Oswestry Disability Index; VAS, Visual analogue scale; EQ-5D, The EuroQol 5-Dimension; ICT, Interferential Current Therapy; CRC, clinical research coordinator; KMD, Korean Medical Doctor; ITT, intention-to-treat; PP, per-protocol

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Contributors

MSH helped to conceive and design the trial and wrote the manuscript. KHH and HWC helped to conceive of and design the trial. BCS helped to conceive the trial and revised the manuscript. HYL and IH will recruit the patients and conduct the trial. NKK planned the statistical analysis. BKC and DWS will supervise the trial. EHH helped to conceive and design the study and critically revised the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Patients consent

Obtained.

Ethics approval

This study was approved by the institutional review board (IRB) of Pusan National University Korean Hospital in September 2013 (IRB approval number 2013012).

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

We will share the data after the trial is finished. Additional details of the study protocol can be requested from the corresponding author.

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REFERENCES

1. Don AS, Carragee E. A brief overview of evidence-informed management of chronic low back pain with surgery. The spine journal : official journal of the North American Spine Society 2008;**8**(1):258-65.

2. Sarrazin JL. [Imaging of postoperative lumbar spine]. Journal de radiologie 2003;**84**(2 Pt 2):241-52.

3. Herrera Herrera I, Moreno de la Presa R, Gonzalez Gutierrez R, et al. Evaluation of the postoperative lumbar spine. Radiologia 2013;**55**(1):12-23.

4. Aghion D, Chopra P, Oyelese AA. Failed back syndrome. Medicine and health, Rhode Island 2012;**95**(12):391-3.

5. Skolasky RL, Wegener ST, Maggard AM, et al. The impact of reduction of pain after lumbar spine surgery: the relationship between changes in pain and physical function and disability. Spine 2014;**39**(17):1426-32.

6. Fleckenstein J, Baeumler PI, Gurschler C, et al. Acupuncture for post anaesthetic recovery and postoperative pain: study protocol for a randomised controlled trial. Trials 2014;**15**:292.

7. Hutchison RW, Chon EH, Tucker Jr. WF, et al. A comparison of a fentanyl, morphine, and hydromorphone patientcontrolled intravenous delivery for acute postoperative analgesia: a multicenter study of opioid-induced adverse reactions. Hosp Pharm 2006;**41**:659-63.

8. Benyamin R, Trescot AM, Datta S, et al. Opioid complications and side effects. Pain physician 2008;**11**(2 Suppl):S105-20.

9. White A, Hayhoe S, Hart A, et al. Survey of adverse events following acupuncture (SAFA): a prospective study of 32,000 consultations. Acupuncture in medicine : journal of the

British Medical Acupuncture Society 2001;**19**(2):84-92.

10. Wheway J, Agbabiaka TB, Ernst E. Patient safety incidents from acupuncture treatments: a review of reports to the National Patient Safety Agency. The International journal of risk & safety in medicine 2012;**24**(3):163-9.
11. Lin CW, Haas M, Maher CG, et al. Cost-effectiveness of guideline-endorsed treatments for low back pain: a systematic review. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society 2011;**20**(7):1024-38.
12. Lee JH, Choi TY, Lee MS, et al. Acupuncture for acute low back pain: a systematic review. The Clinical journal of pain 2013;**29**(2):172-85.
13. Shin JS, Ha IH, Lee J, et al. Effects of motion style acupuncture treatment in acute low back pain patients with severe disability: a multicenter, randomized, controlled, comparative effectiveness trial. Pain 2013;**154**(7):1030-7.
14. Casimiro L, Barnsley L, Brosseau L, et al. Acupuncture and electroacupuncture for the treatment of rheumatoid arthritis. The Cochrane database of systematic reviews 2005(4):CD003788.
15. Zhao XB, Xing QZ, Han XC. Observation on electroacupuncture at neimadian (extra) and neiguan (PC 6) for analgesia after thoracic surgery. Zhongguo zhen jiu = Chinese acupuncture & moxibustion 2013;**33**(9):829-32.
16. Chia KL. Electroacupuncture treatment of acute low back pain: unlikely to be a placebo response. Acupuncture in medicine : journal of the British Medical Acupuncture Society 2014;**32**(4):354-5.
17. Cho YH, Kim CK, Heo KH, et al. Acupuncture for acute postoperative pain after back surgery: a systematic review and meta-analysis of randomized controlled trials. Pain practice : the official journal of World Institute of Pain 2014:[Epub ahead of print].

18. Huang HT, Zheng SH, Feng J, et al. Thin's abdominal acupuncture for treatment of failed back surgery syndrome in 20 cases of clinical observation. Guid J Trad Chin Med Pharm 2012;**18**:63-65.

19. Zheng SH, Wu YT, Liao JR, et al. Abdominal acupuncture treatment of failed back surgery syndrome clinical observation [in Chinese]. J Emerg Trad Chin Med 2010;**19**:1497-98.

20. Kim SI, Lee KB, Lee HS, et al. Acupuncture experience in patients with chronic low back pain(2): a qualitative study - focused on participants in randomized controlled trial. Korean J Acupunct 2012;**29**(4):581-97.

21. Lee H, Bang H, Kim Y, et al. Non-penetrating sham needle, is it an adequate sham control in acupuncture research? Complementary therapies in medicine 2011;**19 Suppl 1**:S41-8.

22. National Guideline Clearinghouse. Low Back Disorders. Secondary Low Back Disorders 2011. http://www.guideline.gov/content.aspx?id=38438.

23. MacPherson H, Altman DG, Hammerschlag R, et al. Revised STandards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA): Extending the CONSORT statement. Journal of evidence-based medicine 2010;**3**(3):140-55.

24. Moher D, Hopewell S, Schulz KF, et al. CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. International journal of surgery (London, England) 2012;**10**(1):28-55.

25. Higgins J, Green S, Cochrane Collaboration. *Cochrane Handbook for Systematic Reviews of Interventions*. Chichester, England; Hoboken, NJ: Wiley-Blackwell, 2008.

26. Jung YP, Jung HK, Chiang SY, et al. The clinical study of electroacupuncture treatment at Hua-Tuo-Jia-Ji-Xue on spondylolisthesis. The Journal of Korean Acupuncture & Moxibustion Society 2008;**25**(1):221-32.

27. Dias M, Vellarde GC, Olej B, et al. Effects of electroacupuncture on stress-related symptoms in medical students: a randomised placebo-controlled study. Acupuncture in medicine : journal of the British Medical Acupuncture Society 2014;**32**(1):4-11.

28. Kim KH, Ryu JH, Park MR, et al. Acupuncture as analgesia for non-emergent acute non-specific neck pain, ankle sprain and primary headache in an emergency department setting: a protocol for a parallel group, randomised, controlled pilot trial. BMJ open 2014;**4**(6):e004994.

29. Revill SI, Robinson JO, Rosen M, et al. The reliability of a linear analogue for evaluating pain. Anaesthesia 1976;**31**(9):1191-8.

30. Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. Pain 1983;**16**(1):87-101.

31. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine 2000;**25**(22):2940-52.

32. Jeon CH, Kim DJ, Kim SK, et al. Validation in the cross-cultural adaptation of the Korean version of the Oswestry Disability Index. Journal of Korean medical science 2006;**21**(6):1092-7.

33. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Annals of medicine 2001;**33**(5):337-43.

34. Kang EJ, Shin SH, Park HJ, et al. A validation of health status using EQ-5D. The Korean Journal of Health Economics and Policy 2006;**12**(2):19-43.

35. Markowski A, Sanford S, Pikowski J, et al. A pilot study analyzing the effects of Chinese cupping as an adjunct treatment for patients with subacute low back pain on relieving pain, improving range of motion, and improving function. Journal of alternative and complementary medicine (New York, NY) 2014;**20**(2):113-7.

36. Ryan CG, Gray HG, Newton M, et al. Pain biology education and exercise classes compared to pain biology education alone for individuals with chronic low back pain:

a pilot randomised controlled trial. Manual therapy 2010;**15**(4):382-7.

37. Harden RN, Remble TA, Houle TT, et al. Prospective, randomized, single-blind, sham treatment-controlled study of the safety and efficacy of an electromagnetic field device for the treatment of chronic low back pain: a pilot study. Pain practice : the official journal of World Institute of Pain 2007;**7**(3):248-55.
38. Hagg O, Fritzell P, Nordwall A. The clinical importance of changes in outcome scores after treatment for chronic low back pain. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society 2003;**12**(1):12-20.
39. Ostelo RW, de Vet HC. Clinically important outcomes in low back pain. Best practice & research Clinical rheumatology 2005;**19**(4):593-607.
40. Molsberger AF, Mau J, Pawelec DB, et al. Does acupuncture improve the orthopedic management of chronic low back pain--a randomized, blinded, controlled trial with 3 months follow up. Pain 2002;**99**(3):579-87.
41. Kim JH, Kim EJ, Seo BK, et al. Electroacupuncture for chemotherapy-induced peripheral neuropathy: study protocol for a pilot multicentre randomized, patient-assessor-blinded, controlled trial. Trials 2013;**14**:254.
42. Man SC, Hung BH, Ng RM, et al. A pilot controlled trial of a combination of dense cranial electroacupuncture stimulation and body acupuncture for post-stroke depression. BMC complementary and alternative medicine 2014;**14**:255.
43. Puri KS, Suresh KR, Gogtay NJ, et al. Declaration of Helsinki, 2008: implications for stakeholders in research. Journal of postgraduate medicine 2009;**55**(2):131-4.
44. Chi H, Zhou WX, Wu YY, et al. Electroacupuncture intervention combined with general anesthesia for 80 cases of heart valve replacement surgery under cardiopulmonary bypass. Zhen ci yan jiu = Acupuncture research / [Zhongguo yi xue ke xue yuan Yi

xue qing bao yan jiu suo bian ji] 2014;**39**(1):1-6.

45. Wu J, Zhao Y, Yang CM, et al. Effects of electroacupuncture preemptive intervention on postoperative pain of mixed hemorrhoids. Zhongguo zhen jiu = Chinese acupuncture & moxibustion 2014;**34**(3):279-83.

46. Zhang H, Wang L, Zhang M, et al. Effects of electroacupuncture on postoperative functional recovery in patients with gynaecological laparoscopic surgery. Zhongguo zhen jiu = Chinese acupuncture & moxibustion 2014;**34**(3):273-8.

47. Zhang Z, Wang C, Li Q, et al. Electroacupuncture at ST36 accelerates the recovery of gastrointestinal motility after colorectal surgery: a randomised controlled trial. Acupuncture in medicine : journal of the British Medical Acupuncture Society 2014;**32**(3):223-6.

FIGURE LEGEND

Figure 1.Flowchart showing the steps in participant recruitment, treatment, and analysis.

Table 1. Schedule for data collection and outcome measurement

Measures	Baseline	Active treatment								Follow-up	
	Week 0	1st week		2nd week		3rd week		4th week		8th week*	12th week*
Sociodemographic characteristics	√										
Back pain history	√										
Physical examination	√										
Visual analogue scale for back pain	√	√	√	√	√	√	√	√	√	√	√
Oswestry Disability Index		√			√				√	√	√
EuroQol-5Dimensions		√			√				√	√	√
Adverse events		√	√	√	√	√	√	√	√	√	√

*8, 12 week indicates 4 and 8 weeks, respectively, after 4 weeks of electroacupuncture treatment.

Electroacupuncture as a complement to usual care for patients with non-acute pain after back surgery: a study protocol for a pilot randomised controlled trial

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ABSTRACT

Introduction

Recurrent or persistent low back pain is common after back surgery but is typically not well controlled. Previous randomised controlled trials on non-acute pain after back surgery were flawed. In this article, the design and protocol of a randomised controlled trial to treat pain and improve function after back surgery are described.

Methods and analysis

This study is a pilot randomised, active-controlled, assessor-blinded trial. Patients with recurring or persistent low back pain after back surgery, defined as a Visual Analogue Scale value of ≥50 mm, with or without leg pain, will be randomly assigned to an electroacupuncture-plus-usual-care group or to a usual-care-only group. Patients assigned to both groups will have usual care management, including physical therapy and patient education, twice a week during a 4-week treatment period that would begin at randomisation. Patients assigned to the electroacupuncture-plus-usual-care group will also have electroacupuncture twice a week during the 4-week treatment period. The primary outcome will be measured with the 100 mm pain Visual Analogue Scale of low back pain by a blinded evaluator. Secondary outcomes will be measured with the EuroQol 5-Dimension and the Oswestry Disability Index. The primary and secondary outcomes will be measured at 4 and 8 weeks after treatment.

Ethics and dissemination

Written informed consent will be obtained from all participants. This study was approved by the institutional review board (IRB) of Pusan National University Korean Hospital in

September 2013 (IRB approval number 2013012). The study findings will be published in peer-reviewed journals and presented at national and international conferences.

Trial registration

This trial was registered with the United States National Institutes of Health Clinical Trials Registry: NCT01966250.

Strengths and limitations of this study

- This trial is designed to be a feasible, comparative effectiveness trial design that is similar to common clinical situations.
- Individualised acupuncture points according to patients' symptoms during the delivery of acupuncture treatment reflect the real clinical practice of acupuncture.
- We expect that this pilot study will provide the clinical basis and information that is required to assess the feasibility of a future large-scale trial.
- Blinding the practitioner will not be done in this trial because it is impossible to blind acupuncturists.
- The size of the study sample limits the power of the observations.

INTRODUCTION

Billions of dollars have been spent worldwide in the last few years on lumbar spine surgery to treat chronic low back pain (LBP), and thousands of studies have been devoted to the subject.[1] Lumbar spine surgery is becoming more common, and there is a wide range of surgical procedures.[2] Complications can be acute or can occur later after surgery, and they

can lead to worsening or to lack of resolution of the original symptoms.[3] Approximately 40% of patients who undergo lumbar spine surgery continue to report significant pain after the surgery.[4] Pain management is a very important element of patient care because pain is the most common complication of back surgery.[5 6]Various opioid analgesics, including morphine, hydromorphine, and meperidine, have been used for postoperative pain management.[7] However, opioids are frequently observed to have unwanted side effects, such as nausea and vomiting.[8] Therefore, there is a need for safe and effective pain management after back surgery.

Numerous studies have shown that acupuncture is generally safe[9 10]and cost-effective[11] compared with routine care.[12 13] Electroacupuncture (EA) is also commonly used for pain management.[14-16] The primary goal of EA treatment after back surgery is pain reduction. There has been a systematic review of current evidence concerning the effectiveness of acupuncture for relieving acute postoperative pain after back surgery.[17] However, there have been only a few clinical trials[18 19]that evaluated the effectiveness of EA for non-acute postoperative pain after back surgery, and the quality of these studies is too low to draw any meaningful conclusions.

In Korea, because of cultural influence, many potential study participants who are between 19 and 70 years old have already had experience with acupuncture. This makes it difficult to implement participant blinding and practitioner blinding given the nature of acupuncture.[20 21]

We therefore propose to conduct a pilot feasibility study to establish an appropriate sample size before conducting a confirmative, pragmatic, comparative randomised controlled trial (RCT) to demonstrate the effectiveness of EA in combination with usual care(UC)compared with UC alone for controlling non-acute pain and function at ≥ 3 weeks[22]

after the back surgery. The study will adhere to STRICTA[23] and CONSORT[24] guidelines.

Aims

The primary purpose of this study is to explore whether EA in combination with UC can provide benefits to patients with non-acute pain and dysfunction after back surgery. It is also a pilot feasibility study that is designed to estimate the appropriate sample size for a future confirmative, pragmatic, comparative RCT that would verify the effectiveness of EA in combination with UC (drug treatment and physical therapy) compared with UC alone in relieving non-acute pain and dysfunction after back surgery. The dependent variables are pain relief, enhancing disease-related functional status and improved quality of life. We also aim to conduct a cost-effectiveness analysis and a qualitative study with the pilot data, but these results will be reported separately.

METHODS AND ANALYSIS

Study design

This study is a randomised, active-controlled, assessor-blinded pilot trial with two parallel arms. The trial will be conducted in the Pusan National University Korean Medicine Hospital (PNUKH) in Yangsan, Korea. This study protocol was approved by the institutional review board(IRB) of PNUKH in September2013 (IRB approval number 2013012) and is also registered with ClinicalTrials.gov (Identifier: NCT01966250, 11-Oct-2013).

Participants

Inclusion criteria

Patients whose LBP recurred or persisted after back surgery, with or without leg pain.

Patients whose pain persisted for at least 3 weeks (non-acute) after back surgery and who require intermittent medical treatment, such as medication, injection, or physical therapy.

Patients with LBP, defined as a Visual Analogue Scale (VAS) value of ≥ 50 mm.

Patients who are between 19 and 70 years of age.

Patients who agreed to participate voluntarily in this study and signed written informed consent forms.

Exclusion criteria

Patients who have been diagnosed with a serious disease that can cause LBP, including cancer, vertebral fracture, spinal infection, inflammatory spondylitis, and *cauda equina* compression.

Patients with a progressive neurological deficit or with severe neurological symptoms.

Patients whose pain is not caused by spinal or soft tissue diseases, such as ankylosing spondylitis, fibromyalgia, rheumatoid arthritis, or gout.

Patients with a chronic disease that could influence the treatment effects or results (e.g., severe cardiovascular disease, diabetic neuropathy, dementia, or epilepsy).

Patients for whom EA might be inappropriate or unsafe (e.g., because of haemorrhagic

disease, clotting disorders, a history of having received anticoagulant therapy within the preceding 3weeks, severe diabetes with a risk of infection, or severe cardiovascular disease).

Patients who are currently pregnant or planning to become pregnant.

Patients with psychiatric diseases.

Patients who are participating in another clinical trial.

Patients who are unable to sign a written informed consent form.

Patients who are judged to be inappropriate for the clinical study by the researchers, such as those who are unable to read and write Korean.

Recruitment

Patients will be recruited by advertisements on hospital websites, bulletin boards and in local newspapers. If hospital patients are interested in participating, they will be asked to answer screening questions to determine their eligibility. If they are eligible, they will be guided through the written informed consent process. After written consent is obtained, a study researcher will administer the baseline questionnaire. Patients who have been determined on the basis of the selection and exclusion criteria to be suitable for the clinical trial will be assigned randomly on a second visit to either the UC-plus-EA group or the UC-alone group, with a 1:1 ratio. After randomisation, a clinical research coordinator (CRC) will schedule the treatment procedure. The first participant was enrolled in 29-Oct-2013.

Randomisation

Before the first treatment session, a statistical expert will assign patients to one of the two groups by use of a central telephone randomisation process according to a computer-generated randomisation sequence that uses SPSS 19.0 (IBM Co., Armonk, NY, USA).Randomisation will be conducted by a trial coordinator who will have no contact with the patients. The CRC will obtain the codes for the trial (A or B) from a central telephone and inform the practitioner. The practitioner will then use these codes to assign patients to one of the two groups and to deliver the appropriate treatment.

The National Clinical Research Centre at the PNUKH will store the random number. The allocation sequence will be concealed from the researcher who is responsible for enrolling, treating or assessing patients (Figure 1).

Blinding

It is not possible to blind patients or practitioners in our trial because of the nature of EA and because there is no placebo. However, there is protection from detection bias because treatment and assessment will be conducted independently, and the practitioners will not be involved in outcome assessment.[25] The assessors will always perform outcome assessments in a separate room and will always be blinded to treatment assignment. Unblinding of assessors should be performed only when exceptional circumstances occur as knowledge of the actual treatment is absolutely essential for further management of the patient (e.g., serious adverse event).

Education of practitioners for standardisation

The licensed KMDs who will be involved in this trial as practitioners or assessors have all been certified by the Korean Ministry of Health and Welfare, have at least three years of clinical experience, and will have taken a course to ensure that they adhere strictly to the study protocol and are familiar with administering the study treatments. All participating KMDs underwent intensive and customised training for a full understanding of the EA procedure, including such details as acupuncture points, depth, and manipulation. All study protocols and details, including the recording method for the case report form (CRF) and outcome assessment methods, were additionally standardised among the assessors by means of 10 hours of training on the standard operating procedure.

Interventions

Patients who are randomised to both arms will have UC management during the 4-week treatment period, which begins at randomisation. It is assumed in this study that UC includes drug therapy, physiotherapy or an educational program about LBP.[22] Conventional medicinal drug treatment or therapies (e.g., pain medication, injection, or physiotherapy, but not surgical treatment) that are related to treating LBP after back surgery will be allowed, and they will be monitored. Physiotherapy and an educational program about back pain will be performed twice a week for 4 weeks by licensed KMDs. Interferential current therapy (ICT,OG Giken Co., Okayama, Japan) will last 15 minutes, and therapy with a hot (or ice) pack will last 10 minutes. The education program will be conducted through the brochure, including the physiology, pathology, and epidemiology of pain after back surgery. Additionally, KMDs will present suitable postures and exercises for LBP in 15-min face-to-face education sessions.

Patients who are randomised to the UC-plus-EA group will have EA treatment in addition to the UC. In the UC-plus-EA group, the acupuncture point prescriptions used will be personalised to each patient and at the discretion of the practitioner. Differentiating the acupuncture point is an important part of traditional Korean medical theory and of creating the actual clinical situation, so it was used to select acupuncture points according to patients' symptoms. EA treatment procedures were designed to reflect the feasibility afforded by the actual clinical setting by a consensus of 5 experts on acupuncture and the spine. EA treatment will be performed by licensed KMDs using disposable stainless steel needles that are 0.25 mm in diameter and 0.40 mm in length (Dongbang Acupuncture Inc., Seongnam, Korea). Electric stimulation will be applied with an ES-160 electronic stimulator (ITO co. LTD, Japan) twice a week for 4 weeks. Stimulation will be applied with biphasic waveform current, which is a compressional wave that combines an interrupted wave and a continuous wave, in triangular form, at a frequency of 50 Hz.[26] Acupuncture points will include Jia-ji (Ex-B2, L3-L5; bilateral) as required points and other reasonable points can be chosen by the practitioner as accessory points. Between 6 and 15 access points will be used by the physicians according to the individual clinical features of each patient. Electric stimulation will be given through alligator clips, connected to Jia-ji (Ex-B2, L3/L5; bilateral). Each EA session will last 15 minutes. Patients in both groups will have had a total of 8 treatment sessions during 4 weeks.

The rationale of the lack of a placebo/sham intervention group

The primary purpose of this study is to explore whether EA combined with UC can provide benefits to patients with non-acute pain after back surgery. Currently, sham or placebo EA is used to assess the efficacy of the specific component of the EA while reducing any possible influence from clinical contexts and other treatment-related processes.[27 28]

However, with the purpose of pragmatic, comparative effectiveness RCT of future trial, we decided not to employ a placebo/sham EA as a control group.

OUTCOME ASSESSMENT

At the initial screening visit, a CRC will ask patients to complete a questionnaire regarding their sociodemographic characteristics, including age, gender, height, weight and vital signs. A CRC or KMD with more than two years of clinical experience will record the outcomes in a separate room according to the standardised operating procedure without knowing to which group the patients have been assigned. Before the start of treatment at each visit, patients will be assessed to record the outcomes of the previous treatments. Any disease history or adverse events will be recorded and will be used to decide if a participant should continue in the trial. Follow-up assessments will be performed at 4 and 8 weeks after the 4-week treatment period (Table 1, Figure 1).

Primary outcome measurements

Back pain intensity will be assessed using the 100 mm pain VAS, on which 0 indicates the absence of pain and 100 indicates unbearable pain.[29 30]The VAS was selected as a primary outcome measurement of the clinical severity of patients' pain after back surgery. Using the 100 mm pain VAS, the participant will be asked to check his or her degree of back pain for the previous 3days. Back pain will be measured at baseline (assessment 1), prior to each of the eight treatment sessions (assessments 2 through 9), and during the two follow-up visits (assessments 10 and 11). The primary endpoint is assessment 10, which marks the end of the 8active treatment sessions.

Secondary outcome measurements

The Oswestry Disability Index (ODI) is one of two secondary outcome measurements that will be used. The ODI assesses back pain-related disability.[31] It contains 10 questions about daily life, including measures of pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life and travelling. Each question is rated on a scale of 0 to 5, with a higher score indicating a more severe pain-related disability. The validated Korean Version of the ODI[32] will be administered before treatment on the first, fourth and eighth treatment sessions (assessments 2, 5, and 9) and during each of the two follow-up sessions (assessments 10 and 11).

Responder, is defined as a participant with 50% or more pain relief using a 100-mm VAS for pain intensity, versus non-responder (under 50% pain relief) will be assessed at eighth treatment session (assessments 9) and the two follow-up sessions (assessments 10 and 11). The EuroQol 5-Dimension (EQ-5D) will also be used as a secondary outcome measurement. The quality of life of patients with back pain will be assessed using the validated Korean version of the EQ-5D.[33 34] The EQ-5D includes generic questions about quality of life as it relates to personal health. The EQ-5D consists of five dimensions that pertain to mobility (mobility), self-care (self care), daily activities (usual activities), pain and discomfort (pain), and anxiety and depression (anxiety/depression). Each dimension is scored on a scale of 1 to 3, with a lower score indicating a better state of participant health. The EQ-5D will be administered before treatment on the first, fourth and eighth treatment sessions (assessments 2, 5, and 9) and during each of the two follow-up sessions (assessments 10 and 11).

Data management

Data and safety monitoring will be conducted periodically during the study and at least once a year thereafter. Only specific research assistants will have access to the final trial dataset. The research assistants will consist of two independent researchers (one in biomedical statistics, one in clinical expert of Korean medicine) who will not be involved in the trial. Monitors will oversee study protocol compliance, informed consent documents, overall progress of the trial, participant recruitment, data quality and timeliness, performance of the intervention and all fields and processes of the trial. If any important protocol modifications exist, we will resubmit amended protocol to IRB. Important protocol modifications will be announced to relevant parties (e.g., investigators, IRB, trial participants, trial registries, and sponsor). Audit will be carried out by the Korean Food & Drug Administration that adheres to its rule. Interim analysis will not be applied because we expect this small pilot trial to be a minimal risk of harm to be associated with EA and UC. All study-related information will be stored securely at the study site. All participant information will be stored for 10 years in locked file cabinets in areas with limited access.

Sample size

Although our study is a pilot trial, we attempted to approximate a sample size that would be suitable for a future, large, pragmatic, multi-centred, comparative effectiveness RCT. We also attempted to estimate more exactly the power of a future trial. The sample size for the future clinical study was estimated by comparing the mean difference in the VAS for LBP between the experimental and control groups in the pilot study. As there was no same trial

with our design of RCT, we estimated the sample size on the basis of other similar previous study.[35-37] The mean difference in the pain VAS for LBP between the experimental and control groups was 20 mm suggested as clinically important change.[38 39] The standard deviation between the two groups was estimated to be 19, based on other published results.[18 19 40] When a two-tailed test with a test power of 80% and a significance level of 5% (α error) was applied to the following formula, the number of subjects required for each group was found to be 16. Considering a dropout rate of 20% and a 1:1 allocation ratio, the total sample size was calculated to be 20. On the other hands, in previous pilot trials which were performed without calculating the number of sample size to enforce the number of samples of 20. [28 35-37 41 42]

Sample size n: $\frac{2(Z_{\alpha/2}+Z_{1-\beta})^2\delta^2}{(\mu t-\mu c)^2}$

n = the number of subjects required in each group

μ_t-μ_c = 20

δ= 19

$Z_{\alpha/2} = Z_{0.05/2} = 1.96$

$Z_{1-\beta} = Z_{0.8} = 0.84$

Statistical methods and analysis

The statistical analysis will be performed according to the principle of intention-to-treat (ITT) analysis and per-protocol (PP) analysis. In the case of ITT analysis, we will apply the last-observation-carried-forward (LOCF) rule for missing data. In parallel, PP analysis will be conducted without patients who dropped out of the clinical trials for any reason. Additionally, the subgroups of patients with pain after back surgery will be evaluated and analysed

(subgroup analysis) for exploring potential future research. Subgroup analysis will be conducted according to the type of surgery ((i.e. fusion, decompression or discectomy), surgically involved spine(s) (which level(s) was/were and how many levels were involved), and postoperative period (subacute: 3 weeks or more to 3 months versus chronic: more than 3 months) for exploring the feasibility of future trial. The significance of the differences in the various data in each group will be analysed with a paired T-test, and the significance of the differences between groups will be analysed with an independent T-test. An analysis of covariance (ANCOVA) will be used to analyse and adjust baseline characteristics if there are statistically significant differences and there is a possibility of covariance of baseline characteristics. Nonparametric statistical tests (a Wilcoxon signed-rank test or the Wilcoxon rank-sum test) will be used if the data are not normally distributed. A Chi-square test or a Fisher'sexact test will be performed to analyse categorical data, such as responses/ responders that are recorded and described as frequencies (%). All statistical analyses will be conducted with SPSS statistical software (IBM Co., Armonk, NY, USA) for Windows, version 19.0, by a statistician. The significance level will be set at 5%. Sample size estimation was conducted by the free program of G*Power Version 3.1.7 (Franz Faul, Uniesität Kiel, Germany).

Safety

All possible adverse events that could affect patients will be monitored and reported for every trial by the participating researchers. Every expected or unexpected adverse event related to this study will be recorded and monitored until it is resolved. And those who suffer harm from trial participation can be given medical treatment for compensation. The research team will report any differences in the safety of the experimental and control groups.

Ethics and Dissemination

In conformity with the Declaration of Helsinki,[43] all participants will be recruited to participate voluntarily, and they will sign a written informed consent form. Participation can be ended at any time during the clinical trial if a participant refuses to continue or if there is significant clinical deterioration, as determined by the Korean medicine doctors (KMDs). The study findings will be disseminated in peer-reviewed journals and presented at national and international conferences.

DISCUSSION

EA is commonly used for pain management after surgery.[44-47] There has been a systematic review summarising the current evidence concerning the effectiveness of acupuncture for treating acute postoperative pain after back surgery,[17] but few clinical trials have evaluated the effectiveness of EA for treating non-acute postoperative pain after back surgery. We have therefore designed this pilot RCT to guide the design of a full-scale randomised trial. The results of our study will determine the appropriate sample size for a future feasible, pragmatic, comparative effectiveness RCT to evaluate the effectiveness and cost effectiveness of EA with UC compared with UC alone in the treatment of non-acute pain after back surgery. From the subgroup analysis of the type of surgery and the surgically involved level of spine, we will explore the potential factor(s) related to the difference of effectiveness of EA on pain and function after back surgery.

A strength of our study is that it is designed to be a feasible, comparative effectiveness trial design that is similar to common clinical situations. Additionally, this clinical trial

protocol was conducted to conform strictly to the STRICTA statement[23] and the CONSORT statement.[24] We expect that this pilot study will provide the clinical basis and information that is required to assess the feasibility of a future large-scale trial.

TRIAL STATUS

The trial is currently in the recruitment phase. The results of this trial will be available in 2015.

List of abbreviations

RCT, randomised controlled trial; EA, electroacupuncture; UC, usual care; ODI, Oswestry Disability Index; VAS, Visual analogue scale; EQ-5D, The EuroQol 5-Dimension; ICT, Interferential Current Therapy; CRC, clinical research coordinator; KMD, Korean Medical Doctor; ITT, intention-to-treat; PP, per-protocol

Acknowledgements

The authors would like to thank Dr SeungHoon Choi for providing helpful advice for the trial implementation. The authors would also like to express appreciation for the contributions from patients with pain after back surgery who will participate in this trial.

Contributors

MSH helped to conceive and design the trial and wrote the manuscript. KHH and HWC helped to conceive of and design the trial. BCS helped to conceive the trial and revised the manuscript. HYL and IH will recruit the patients and conduct the trial. NKK planned the statistical analysis. BKC and DWS will supervise the trial. EHH helped to conceive and design the study and critically revised the manuscript. All authors read and approved the final manuscript.

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2013(K14273).This funding source had no role in the design of this study and will not have any role during its execution, analyses, interpretation of the data, or decision to submit results.

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Competing interests

The authors declare that they have no competing interests.

Patients consent

Obtained.

Ethics approval

This study was approved by the institutional review board (IRB) of Pusan National University Korean Hospital in September 2013 (IRB approval number 2013012).

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

We will share the data after the trial is finished. Additional details of the study protocol can be requested from the corresponding author.

Open Access

REFERENCES

1. Don AS, Carragee E. A brief overview of evidence-informed management of chronic low back pain with surgery. The spine journal : official journal of the North American Spine Society 2008;**8**(1):258-65.
2. Sarrazin JL. [Imaging of postoperative lumbar spine]. Journal de radiologie 2003;**84**(2 Pt 2):241-52.
3. Herrera Herrera I, Moreno de la Presa R, Gonzalez Gutierrez R, et al. Evaluation of the postoperative lumbar spine. Radiologia 2013;**55**(1):12-23.
4. Aghion D, Chopra P, Oyelese AA. Failed back syndrome. Medicine and health, Rhode Island 2012;**95**(12):391-3.
5. Skolasky RL, Wegener ST, Maggard AM, et al. The impact of reduction of pain after lumbar spine surgery: the relationship between changes in pain and physical function and disability. Spine 2014;**39**(17):1426-32.
6. Fleckenstein J, Baeumler PI, Gurschler C, et al. Acupuncture for post anaesthetic recovery and postoperative pain: study protocol for a randomised controlled trial. Trials 2014;**15**:292.
7. Hutchison RW, Chon EH, Tucker Jr. WF, et al. A comparison of a fentanyl, morphine, and hydromorphone patientcontrolled intravenous delivery for acute postoperative analgesia: a multicenter study of opioid-induced adverse reactions. Hosp Pharm 2006;**41**:659-63.
8. Benyamin R, Trescot AM, Datta S, et al. Opioid complications and side effects. Pain physician 2008;**11**(2 Suppl):S105-20.
9. White A, Hayhoe S, Hart A, et al. Survey of adverse events following acupuncture (SAFA): a prospective study of 32,000 consultations. Acupuncture in medicine : journal of the

British Medical Acupuncture Society 2001;**19**(2):84-92.

10. Wheway J, Agbabiaka TB, Ernst E. Patient safety incidents from acupuncture treatments: a review of reports to the National Patient Safety Agency. The International journal of risk & safety in medicine 2012;**24**(3):163-9.
11. Lin CW, Haas M, Maher CG, et al. Cost-effectiveness of guideline-endorsed treatments for low back pain: a systematic review. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society 2011;**20**(7):1024-38.
12. Lee JH, Choi TY, Lee MS, et al. Acupuncture for acute low back pain: a systematic review. The Clinical journal of pain 2013;**29**(2):172-85.
13. Shin JS, Ha IH, Lee J, et al. Effects of motion style acupuncture treatment in acute low back pain patients with severe disability: a multicenter, randomized, controlled, comparative effectiveness trial. Pain 2013;**154**(7):1030-7.
14. Casimiro L, Barnsley L, Brosseau L, et al. Acupuncture and electroacupuncture for the treatment of rheumatoid arthritis. The Cochrane database of systematic reviews 2005(4):CD003788.
15. Zhao XB, Xing QZ, Han XC. Observation on electroacupuncture at neimadian (extra) and neiguan (PC 6) for analgesia after thoracic surgery. Zhongguo zhen jiu = Chinese acupuncture & moxibustion 2013;**33**(9):829-32.
16. Chia KL. Electroacupuncture treatment of acute low back pain: unlikely to be a placebo response. Acupuncture in medicine : journal of the British Medical Acupuncture Society 2014;**32**(4):354-5.
17. Cho YH, Kim CK, Heo KH, et al. Acupuncture for acute postoperative pain after back surgery: a systematic review and meta-analysis of randomized controlled trials. Pain practice : the official journal of World Institute of Pain 2014:[Epub ahead of print].

18. Huang HT, Zheng SH, Feng J, et al. Thin's abdominal acupuncture for treatment of failed back surgery syndrome in 20 cases of clinical observation. Guid J Trad Chin Med Pharm 2012;**18**:63-65.

19. Zheng SH, Wu YT, Liao JR, et al. Abdominal acupuncture treatment of failed back surgery syndrome clinical observation [in Chinese]. J Emerg Trad Chin Med 2010;**19**:1497-98.

20. Kim SI, Lee KB, Lee HS, et al. Acupuncture experience in patients with chronic low back pain(2): a qualitative study - focused on participants in randomized controlled trial. Korean J Acupunct 2012;**29**(4):581-97.

21. Lee H, Bang H, Kim Y, et al. Non-penetrating sham needle, is it an adequate sham control in acupuncture research? Complementary therapies in medicine 2011;**19 Suppl 1**:S41-8.

22. National Guideline Clearinghouse. Low Back Disorders. Secondary Low Back Disorders 2011. http://www.guideline.gov/content.aspx?id=38438.

23. MacPherson H, Altman DG, Hammerschlag R, et al. Revised STandards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA): Extending the CONSORT statement. Journal of evidence-based medicine 2010;**3**(3):140-55.

24. Moher D, Hopewell S, Schulz KF, et al. CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. International journal of surgery (London, England) 2012;**10**(1):28-55.

25. Higgins J, Green S, Cochrane Collaboration. *Cochrane Handbook for Systematic Reviews of Interventions*. Chichester, England; Hoboken, NJ: Wiley-Blackwell, 2008.

26. Jung YP, Jung HK, Chiang SY, et al. The clinical study of electroacupuncture treatment at Hua-Tuo-Jia-Ji-Xue on spondylolisthesis. The Journal of Korean Acupuncture & Moxibustion Society 2008;**25**(1):221-32.

27. Dias M, Vellarde GC, Olej B, et al. Effects of electroacupuncture on stress-related symptoms in medical students: a randomised placebo-controlled study. Acupuncture in medicine : journal of the British Medical Acupuncture Society 2014;**32**(1):4-11.

28. Kim KH, Ryu JH, Park MR, et al. Acupuncture as analgesia for non-emergent acute non-specific neck pain, ankle sprain and primary headache in an emergency department setting: a protocol for a parallel group, randomised, controlled pilot trial. BMJ open 2014;**4**(6):e004994.

29. Revill SI, Robinson JO, Rosen M, et al. The reliability of a linear analogue for evaluating pain. Anaesthesia 1976;**31**(9):1191-8.

30. Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. Pain 1983;**16**(1):87-101.

31. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine 2000;**25**(22):2940-52.

32. Jeon CH, Kim DJ, Kim SK, et al. Validation in the cross-cultural adaptation of the Korean version of the Oswestry Disability Index. Journal of Korean medical science 2006;**21**(6):1092-7.

33. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Annals of medicine 2001;**33**(5):337-43.

34. Kang EJ, Shin SH, Park HJ, et al. A validation of health status using EQ-5D. The Korean Journal of Health Economics and Policy 2006;**12**(2):19-43.

35. Markowski A, Sanford S, Pikowski J, et al. A pilot study analyzing the effects of Chinese cupping as an adjunct treatment for patients with subacute low back pain on relieving pain, improving range of motion, and improving function. Journal of alternative and complementary medicine (New York, NY) 2014;**20**(2):113-7.

36. Ryan CG, Gray HG, Newton M, et al. Pain biology education and exercise classes compared to pain biology education alone for individuals with chronic low back pain:

a pilot randomised controlled trial. Manual therapy 2010;**15**(4):382-7.

37. Harden RN, Remble TA, Houle TT, et al. Prospective, randomized, single-blind, sham treatment-controlled study of the safety and efficacy of an electromagnetic field device for the treatment of chronic low back pain: a pilot study. Pain practice : the official journal of World Institute of Pain 2007;**7**(3):248-55.
38. Hagg O, Fritzell P, Nordwall A. The clinical importance of changes in outcome scores after treatment for chronic low back pain. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society 2003;**12**(1):12-20.
39. Ostelo RW, de Vet HC. Clinically important outcomes in low back pain. Best practice & research Clinical rheumatology 2005;**19**(4):593-607.
40. Molsberger AF, Mau J, Pawelec DB, et al. Does acupuncture improve the orthopedic management of chronic low back pain--a randomized, blinded, controlled trial with 3 months follow up. Pain 2002;**99**(3):579-87.
41. Kim JH, Kim EJ, Seo BK, et al. Electroacupuncture for chemotherapy-induced peripheral neuropathy: study protocol for a pilot multicentre randomized, patient-assessor-blinded, controlled trial. Trials 2013;**14**:254.
42. Man SC, Hung BH, Ng RM, et al. A pilot controlled trial of a combination of dense cranial electroacupuncture stimulation and body acupuncture for post-stroke depression. BMC complementary and alternative medicine 2014;**14**:255.
43. Puri KS, Suresh KR, Gogtay NJ, et al. Declaration of Helsinki, 2008: implications for stakeholders in research. Journal of postgraduate medicine 2009;**55**(2):131-4.
44. Chi H, Zhou WX, Wu YY, et al. Electroacupuncture intervention combined with general anesthesia for 80 cases of heart valve replacement surgery under cardiopulmonary bypass. Zhen ci yan jiu = Acupuncture research / [Zhongguo yi xue ke xue yuan Yi

xue qing bao yan jiu suo bian ji] 2014;**39**(1):1-6.

45. Wu J, Zhao Y, Yang CM, et al. Effects of electroacupuncture preemptive intervention on postoperative pain of mixed hemorrhoids. Zhongguo zhen jiu = Chinese acupuncture & moxibustion 2014;**34**(3):279-83.

46. Zhang H, Wang L, Zhang M, et al. Effects of electroacupuncture on postoperative functional recovery in patients with gynaecological laparoscopic surgery. Zhongguo zhen jiu = Chinese acupuncture & moxibustion 2014;**34**(3):273-8.

47. Zhang Z, Wang C, Li Q, et al. Electroacupuncture at ST36 accelerates the recovery of gastrointestinal motility after colorectal surgery: a randomised controlled trial. Acupuncture in medicine : journal of the British Medical Acupuncture Society 2014;**32**(3):223-6.

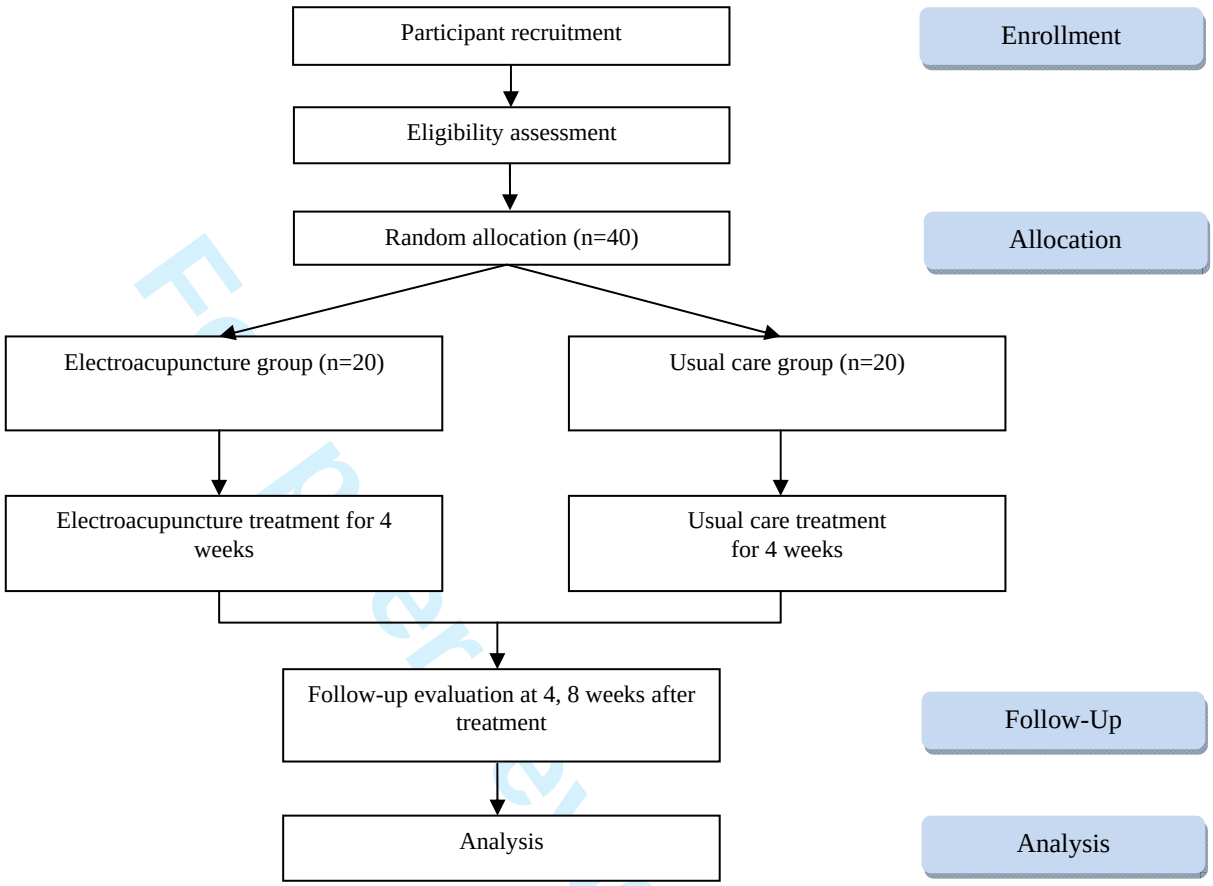
FIGURE LEGEND

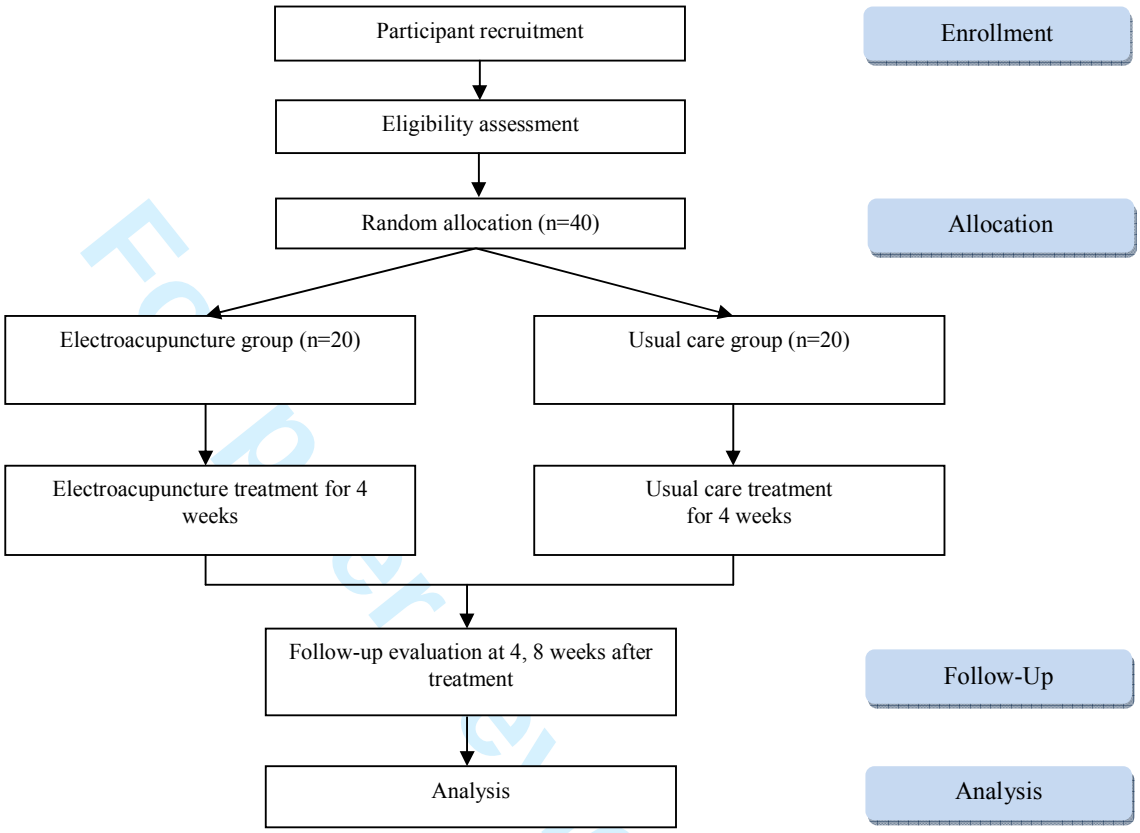
Figure 1.Flowchart showing the steps in participant recruitment, treatment, and analysis.

Table 1. Schedule for data collection and outcome measurement

Measures	Baseline	Active treatment								Follow-up	
	Week 0	1st week		2nd week		3rd week		4th week		8th week*	12th week*
Sociodemographic characteristics	√										
Back pain history	√										
Physical examination	√										
Visual analogue scale for back pain	√	√	√	√	√	√	√	√	√	√	√
Oswestry Disability Index		√			√				√	√	√
EuroQol-5Dimensions		√			√				√	√	√
Adverse events		√	√	√	√	√	√	√	√	√	√

*8, 12 week indicates 4 and 8 weeks, respectively, after 4 weeks of electroacupuncture treatment.





Appendix 1. Acupuncture treatment details as recommended by STRICTA

	Item	Details
1. Acupuncture rationale	(a) Style of acupuncture	Traditional Korean medical theory
	(b) Reason for treatment provided (based on historical context, literature sources and consensus methods)	Textbook on acupuncture and moxibustion-related articles and references[1,2]
	(c) Extent to which treatment was varied	Partially individualised acupuncture treatment, i.e., fixed points plus optional points based on symptoms.
2. Details of needling	(a) Number of needle insertions per patient per session	From 6 to 15
	(b) Names (or location if no standard name) of points used (uni-/bilateral)	- Six fixed points: Ex-B2 (L3-L5; bilateral) - Optional points based on individual symptoms: GB30, GB34, ST36 and BL60 (bilateral), GV3 (unilateral)
	(c) Depth of insertion	10 to 20 mm
	(d) Response sought (for example, 'de qi' or muscle twitch response)	'De qi' sensation
	(e) Needle stimulation (for example, manual, electrical)	Electrical current biphasic wave form to six fixed points of Ex-B2 (L3-L5; bilateral) (Compressional wave that combines an interrupted wave and a continuous wave, in triangular form, at a frequency of 50 Hz.)

	(f) Needle-retention time	15 min
	(g) Needle type (diameter, length and manufacturer or material)	A sterilised stainless steel needle (0.25 × 40 mm, Dongbang Acupuncture Inc., Sungnam, Korea).
3. Treatment regimen	(a) Number of treatment sessions	Eight
	(b) Frequency and duration of treatment sessions	Twice a week for four weeks
4. Other components of treatment	(a) Details of other interventions administered to the acupuncture group	Plus usual care (drug therapy, physiotherapy and participant education)
	(b) Setting and context of treatment, including instructions to practitioners and information and explanations to patients	Independent researcher counselling regarding treatment and lifestyle management of pain after back surgery.
5. Practitioner background	(a) Description of participating acupuncturists	Korean medical doctors who are specialists in oriental rehabilitation medicine, with more than 3 years of clinical experience under supervision by a specialist
6. Control or comparator interventions	(a) Rationale for the control or comparator in the context of the research question with sources that justify this choice	See reference[3]
	(b) Precise description of the control or comparator if sham acupuncture	Patients in the control group receive usual care, which includes drug therapy,

		physiotherapy and participant education. Frequency and duration: Twice a week for four weeks

EX-B2, Extra acupoint of lumbar; GB, Gallbladder; CV, Conception Vessel; ST, Stomach; BL, Bladder.

1. Committee on Compilation of Textbook in Society for Acupuncture & Moxibustion. *Acupuncture and Moxibustion Medicine*. Paju: Jipmoondang Publishing Company, 2012.

2. Heo J, Ahn S, Kim N*, et al.Donguibogam*. Seoul: Ministry of Health & Welfare, 2012.

3. National Guideline Clearinghouse. Low Back Disorders. Secondary Low Back Disorders 2011. http://www.guideline.gov/content.aspx?id=38438.

SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description	Addressed on page number
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	4
	2b	All items from the World Health Organization Trial Registration Data Set	End of this file.
Protocol version	3	Date and version identifier	6
Funding	4	Sources and types of financial, material, and other support	20
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	19
	5b	Name and contact information for the trial sponsor	20
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	20
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	14
Introduction			

Background and rationale	6a	Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention	4
	6b	Explanation for choice of comparators	5
Objectives	7	Specific objectives or hypotheses	6
Trial design	8	Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory)	5
Methods: Participants, interventions, and outcomes			
Study setting	9	Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained	6
Eligibility criteria	10	Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists)	7
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	10
	11b	Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease)	17
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)	10
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	10
Outcomes	12	Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended	12
Participant timeline	13	Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure)	29

Sample size	14	Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations	14
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	8
Methods: Assignment of interventions (for controlled trials)			
Allocation:			
Sequence generation	16a	Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions	9
Allocation concealment mechanism	16b	Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned	9
Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	9
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	9
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	9
Methods: Data collection, management, and analysis			
Data collection methods	18a	Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol	10
	18b	Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols	10

Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	14
Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	15
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	15
	20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	15
Methods: Monitoring			
Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	14
	21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial.	14
Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	12
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor.	14
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	20
Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	14

Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	17
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	Not planned
Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	14
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	20
Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	14
Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	16
Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	17
	31b	Authorship eligibility guidelines and any intended use of professional writers	19
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	Not planned
Appendices			
Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	Appendices
Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	Not planned

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.

Data category	Information
Primary registry and trial identifying number	NCT01966250
Date of Registration in Primary Registry	11-Oct- 2013
Secondary Identifying Numbers	K14273
Source(s) of Monetary or Material Support	Korea Institute of Oriental Medicine
Primary Sponsor	Korea Institute of Oriental Medicine
Secondary Sponsor(s)	National Clinical Research Center
Contact for Public Queries	MD [hwangmansuk@gmail.com]
Contact for Scientific Queries	MD [drshinbc@gmail.com]
Public Title	Electroacupuncture as a complement to usual care for patients with non-acute pain after back surgery
Scientific Title	Electroacupuncture as a complement to usual care for patients with non-acute pain after back surgery: a study protocol for a pilot pragmatic randomised controlled trial
Countries of Recruitment	Korea, Republic of
Health Condition(s) or Problem(s) Studied	non-acute pain after back surgery
Intervention(s)	Treatment : electroacupuncture-plus-usual-care
	Control : usual-care alone (drug treatment and physical therapy)
Key Inclusion and Exclusion Criteria	Ages eligible for study: between 19 and 70 years, Sexes eligible for study: both; Accepts healthy volunteers: no
	Inclusion criteria : Patients whose LBP recurred or persisted after back surgery, with or without leg pain
	Exclusion criteria : Patients who have been diagnosed with a serious disease that can cause LBP, including cancer, vertebral fracture, spinal infection, inflammatory spondylitis, and cauda equina compression.
Study Type	Interventional
	Allocation: randomized; Intervention model: parallel assignment; Masking: single blind (assessor-blind) . . .
	Primary purpose: pain alleviation
Date of First Enrollment	29-Oct-2013
Target Sample Size	40 (20 per each group)
Recruitment Status	Recruiting
Primary Outcome(s)	100 mm pain VAS (time frame: $ years; not designated as safety issue)
Key Secondary Outcomes	The Oswestry Disability Index (ODI) (time frame: $ years; not designated as safety issue)