Low-level laser therapy for tinnitus (Protocol)

Peng Z, Chen XQ, Gong SS, Chen CF

This is a reprint of a Cochrane protocol, prepared and maintained by The Cochrane Collaboration and published in The Cochrane Library 2012, Issue 4

http://www.thecochranelibrary.com

WILEY
Publishers Since 1807
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEADER</td>
<td>1</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>1</td>
</tr>
<tr>
<td>BACKGROUND</td>
<td>2</td>
</tr>
<tr>
<td>OBJECTIVES</td>
<td>4</td>
</tr>
<tr>
<td>METHODS</td>
<td>4</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>6</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>7</td>
</tr>
<tr>
<td>ADDITIONAL TABLES</td>
<td>11</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>12</td>
</tr>
<tr>
<td>HISTORY</td>
<td>12</td>
</tr>
<tr>
<td>CONTRIBUTIONS OF AUTHORS</td>
<td>12</td>
</tr>
<tr>
<td>DECLARATIONS OF INTEREST</td>
<td>13</td>
</tr>
<tr>
<td>SOURCES OF SUPPORT</td>
<td>13</td>
</tr>
</tbody>
</table>
**[Intervention Protocol]**

**Low-level laser therapy for tinnitus**

Zhe Peng¹, Xiu-Qi Chen², Shu-Sheng Gong¹, Cheng-Fang Chen¹

¹Department of Otorhinolaryngology - Head and Neck Surgery, Beijing Tongren Hospital, Capital Medical University, Beijing, China.
²Department of Pediatrics, First Affiliated Hospital, Guangxi Medical University, Nanning, China

Contact address: Shu-Sheng Gong, Department of Otorhinolaryngology - Head and Neck Surgery, Beijing Tongren Hospital, Capital Medical University, Beijing, 100730, China. gongshusheng1962@sina.com.

**Editorial group:** Cochrane Ear, Nose and Throat Disorders Group.

**Publication status and date:** New, published in Issue 4, 2012.

**Citation:** Peng Z, Chen XQ, Gong SS, Chen CF. Low-level laser therapy for tinnitus. *Cochrane Database of Systematic Reviews* 2012, Issue 4. Art. No.: CD009811. DOI: 10.1002/14651858.CD009811.

Copyright © 2012 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

**ABSTRACT**

This is the protocol for a review and there is no abstract. The objectives are as follows:

To assess the effectiveness of low-level laser therapy for the treatment of subjective idiopathic tinnitus.
BACKGROUND

This is one of a number of tinnitus reviews produced by the Cochrane Ear, Nose & Throat Disorders Group, which use a standard background. The following paragraphs (‘Description of the condition’) are based on earlier work in the following reviews and reproduced with permission: Baldo 2006; Bennett 2007; Hilton 2004; Hobson 2010; Phillips 2010.

Description of the condition

Tinnitus can be described as the perception of sound in the absence of external acoustic stimulation. For the patient it may be trivial or it may be a debilitating condition (Luxon 1993). The quality of the perceived sound can vary enormously from simple sounds such as whistling or humming to complex sounds such as music. The patient may hear a single sound or multiple sounds. Tinnitus may be perceived in one or both ears, within the head or outside the body. The symptom may be continuous or intermittent. Tinnitus is described in most cases as subjective - meaning that it cannot be heard by anyone other than the patient. While, for the patient, this perception of noise is very real, because there is no corresponding external sound it can be considered a phantom, or false, perception. Objective tinnitus is a form of tinnitus which can be detected by an examiner, either unaided or using a listening aid such as a stethoscope or microphone in the ear canal. This is much less common and usually has a definable cause such as sound generated by blood flow in or around the ear or unusual activity of the tiny muscles within the middle ear. Tinnitus may be associated with normal hearing or any degree of hearing loss and can occur at any age. It is important to distinguish between clinically significant and non-significant tinnitus (Davis 2000) and several different classifications have been proposed (Daumann 1992; McCombe 2001; Stephens 1991). Daumann, for example, makes a distinction between ‘normal’ (lasting less than five minutes, occurring less than once a week and experienced by most people) and ‘pathological’ tinnitus (lasting more than five minutes, occurring more than once a week and usually experienced by people with hearing loss).

Aetiology

Almost any form of disorder involving the outer, middle or inner ear or the auditory nerve may be associated with tinnitus (Brummett 1980; Shea 1981). However, it is possible to have severe tinnitus with no evidence of any aural pathology. Conversely, tinnitus can even exist without a peripheral auditory system: unilateral tinnitus is a common presenting symptom of vestibular schwannomas (acoustic neuromas), which are rare benign tumours of the vestibulo-cochlear nerve. When these neuromas are removed by a translabyrinthine route, the cochlear nerve can be severed. Despite the effective removal of their peripheral auditory mechanisms, 60% of these patients retain their tinnitus postoperatively (Baguley 1992). This suggests the fundamental importance of the central auditory pathways in the maintenance of the symptom, irrespective of trigger. Many environmental factors can also cause tinnitus. The most relevant and frequently reported are:

- acute acoustic trauma (AAAT) (for example, explosions or gunfire) (Christianson 1993; Chung 1980; Melinek 1976; Mrena 2002; Temmel 1999);
- airbag inflation (Saunders 1998); toy-pistols (Fleischer 1999);
- exposure to occupational noise; ‘urban noise pollution’ (Alberti 1987; Axelsson 1985; Chouard 2001; Daniell 1998; Griest 1998; Kowalska 2001; McShane 1988; Neuberger 1992; Phoon 1993); and
- exposure to recreational and amplified music (Becher 1996; Chouard 2001; Lee 1999; Metternich 1999)

Pathophysiology

Over 50 years ago, Heller and Bergman demonstrated that if ‘normal’ people (with no known cochlear disease) were placed in a quiet enough environment, the vast majority of them would experience sounds inside their head. They concluded that tinnitus-like activity is a natural phenomenon perceived by many in a quiet enough environment (Heller 1953). Mazurek has shown that pathologic changes in the cochlear neurotransmission, e.g. as a result of intensive noise exposure or ototoxic drugs, can be a factor in the development of tinnitus (Mazurek 2007).

In the ‘neurophysiological model’ of tinnitus (Jastreboff 1990; Jastreboff 2004) it is proposed that tinnitus results from the abnormal processing of a signal generated in the auditory system. This abnormal processing occurs before the signal is perceived centrally. This may result in ‘feedback’, whereby the annoyance created by the tinnitus causes the individual to focus increasingly on the noise, which in turn exacerbates the annoyance and so a ‘vicious cycle’ develops. In this model tinnitus could therefore result from continuous firing of cochlear fibres to the brain, from hyperactivity of cochlear hair cells or from permanent damage to these cells being translated neurally into a ‘phantom’ sound-like signal that the brain ‘believes’ it is hearing. For this reason tinnitus may be compared to chronic pain of central origin - a sort of ‘auditory pain’ (Briner 1995; Sullivan 1994).

The relationship between the symptom of tinnitus and the activity of the prefrontal cortex and limbic system has been emphasised. The limbic system mediates emotions. It can be of great importance in understanding why the sensation of tinnitus is in many cases so distressing for the patient. It also suggests why, when symptoms are severe, tinnitus can be associated with major depression, anxiety and other psychosomatic and/or psychological disturbances, leading to a progressive deterioration of quality of life (Lockwood 1999; Sullivan 1989; Sullivan 1992; Sullivan 1993).
Prevalence

Epidemiological data reports are few. The largest single study was undertaken in the UK by the Medical Research Council Institute of Hearing Research and was published in 2000 (Davis 2000). This longitudinal study of hearing questioned 48,313 people; 10.1% described tinnitus arising spontaneously and lasting for five or more minutes at a time and 5% described it as moderately or severely annoying. However, only 0.5% reported tinnitus having a severe effect on their life. This is another of the paradoxes of tinnitus: the symptom is very common but the majority of people who experience it are not particularly concerned by it. These figures from the UK are broadly consistent with data collected by the American Tinnitus Association (ATA) which suggests that tinnitus may be experienced by around 50 million Americans, or 17% of the US population (ATA 2004). Data also exist for Japan, Europe and Australia (Sindhuske 2003), and estimates suggest that tinnitus affects a similar percentage of these populations, with 1% to 2% experiencing debilitating tinnitus (Seidman 1998). The Oregon Tinnitus Data Archive (Oregon 1995) contains data on the characteristics of tinnitus drawn from a sample of 1630 tinnitus patients. The age groups with the greatest prevalence are those between 40 and 49 years (23.9%) and between 50 and 59 years (25.6%).

Olszewski showed in his study that the risk of tinnitus increases in patients over 55 years old who suffer from metabolic conditions and cervical spondylosis (Olszewski 2008).

Diagnosis

Firstly a patient with tinnitus may undergo a basic clinical assessment. This will include the relevant otological, general and family history, and an examination focusing on the ears, teeth and neck and scalp musculature. Referral to a specialist is likely to involve a variety of other investigations including audiological tests and radiology. Persistent, unilateral tinnitus may be due to a specific disorder of the auditory pathway and imaging of the cerebello-pontine angle is important to exclude, for example, a vestibular schwannoma (acoustic neuroma) - a rare benign tumour of the cochleo-vestibular nerve. Other lesions, such as glomus tumours, meningiomas, adenomas, vascular lesions or neuro-vascular conflicts may also be detected by imaging (Marx 1999; Weissman 2000).

Treatment

At present no specific therapy for tinnitus is acknowledged to be satisfactory in all patients. Many patients who complain of tinnitus, and also have a significant hearing impairment, will benefit from a hearing aid. Not only will this help their hearing disability but the severity of their tinnitus may be reduced. A wide range of therapies have been proposed for the treatment of tinnitus symptoms. Pharmacological interventions used include cortisone (Koester 2004), vasodilators, benzodiazepines, lidocaine and spasmolytic drugs. The use of anticonvulsants is not beneficial in treating tinnitus.

Description of the intervention

Laser was discovered in the 1960s. Laser is light that is generated by high-intensity electrical stimulation of a medium, which can be a gas, liquid, crystal, dye or semiconductor (Jünger 1999). The light produced consists of coherent beams of single wavelengths in the visible to infrared spectrum, which can be emitted in a continuous wave or pulsed mode (Bjorjdal 2007; Bjorjdal 2008). Mester first reported the earliest clinical application of the low-level laser in 1972 (Mester 1972). Since then, low-level laser therapy (LLLT) has come to the forefront of clinical research. Hundreds of randomised, double-blind, placebo-controlled phase III clinical trials have been published from over a dozen countries (Kaviani 2011; Saayman 2011; Silva 2011). Low-level laser therapy (LLLT) uses low-powered laser light in the range of 1 to 1000 mW, at wavelengths from 632 to 1064 nm, to stimulate a biological response. LLLT uses laser to aid tissue repair (Woodruff 2004), relieve pain (Enwemeka 2004) and stimulate acupuncture points (Siendentopf 2002). Surgical applications of laser ablate tissue by intense heat and are different from LLLT, which uses light energy to modulate cell and tissue physiology to achieve therapeutic benefit without a macroscopic thermal effect (sometimes termed cold laser). LLLT is non-invasive, painless and can be easily administered in primary care settings. LLLT acts by inducing a photochemical reaction in the cell, a process referred to as biostimulation or photobiomodulation (Hashmi 2011).
It is an irradiation technique that has the ability to induce biological processes using photon energy. There are studies showing proliferation and angiogenesis after irradiation in skeletal muscle tissue cells post-myocardial infarction. Most evidence of efficacy is based on the increase in energy state and the activation of mitochondrial pathways. It has been reasonably well established that mitochondria are a principal intracellular target of red and near infrared light (Karu 1989). Cytochrome C oxidase (unit IV of the mitochondrial respiratory chain) is a chromophore that absorbs light as far into the infrared as 1000 nm (Szundi 2001).

In recent years, LLLT has been widely used in the treatment of tinnitus. The laser emits dual wavelength beams which are red and near infrared. These laser beams are cool to the touch and do not cause discomfort. They are aimed into the auditory canal and through the mastoid bone behind the ear. The patients are awake during the period of therapy. The wavelength nature of these lasers allows them to penetrate tissue. Although the laser beams lose intensity rapidly, they can have an effect on tissues 2 to 5 cm inside the body. The mechanism of action of low-level laser on the inner ear and on tinnitus is not well understood. Previous studies evaluating low-level laser for the treatment of tinnitus have been equivocal, with both positive (Hahn 2001; Plath 1995; Shiomi 1997; Wilden 1996) and negative effects (Mirz 1999; Nakashima 2002; Tauber 2003; Teggi 2009) reported. The incidence of adverse effects of LLLT is low and similar to that of placebo, with no reports of serious events (Nakashima 2002).

**How the intervention might work**

Several hypotheses have been proposed for the mechanism of action of LLLT. The prevailing opinion is that the respiratory chain plays a central role in the effect induced by laser therapy (Rhee 2011). Laser energy in the red and near infrared light spectrum is capable of penetrating tissue. It stimulates mitochondria in the cells to produce energy through the production of adenosine triphosphate (ATP) (Karu 1995). Mitochondria are the power supplies of all cells; they metabolise fuel and produce energy for the cell in the form of ATP. It has been reported that LLLT irradiation increases the production of ATP (Oron 2007). Increased ATP production may lead to enhanced cell metabolism, promoting the damage recovery process, returning cells to a healthy state and reversing many degenerative conditions.

For ear disorders, low-level laser has been reported to alter the collagen organisation within the cochlea, especially within the basilar membrane. This should increase the stiffness of the basilar membrane (Wenzel 2004; Wenzel 2007). Also, LLLT has a beneficial effect on the recovery of cochlear hair cells after acute hair cell loss (Rhee 2011), increases cell proliferation (van Breugel 1992), synthesis of ATP (Passarella 1984) and collagen (Reddy 1998), release of growth factors (including nerve growth factor (NGF), brain-derived neurotrophic factor (BDNF), glial cell line-derived neurotrophic factor (GDNF) and ciliary neurotrophic factor (CNTF)) (Kipshidze 2001; Yu 1994; Yazdani 2012), promotes local blood flow in the inner ear associated with suppression of the sympathetic nerve action potential, and activates repair mechanisms in the inner ear through photochemical and photophysical stimulation of the hair cell mitochondria (Karu 1986).

Additionally, studies have shown that laser leads to activation of related cortical areas in healthy subjects. The mechanism leading to the observed activated neuronal network by means of trans-veal cochlear laser (TCL) is vague (Siedentopf 2007). It cannot be explained by a supra-sensory stimulation of the tympanic membrane, since subjects are not able to differentiate between real and placebo stimulation.

Different low-level laser therapy studies have focused on the determination and the modulation of irradiation parameters that seem to play a pivotal role in its effectiveness (Amaral 2001; Basford 1995; Belkin 1994; Gungor 2008; Rochkind 1987; Rochkind 1992; Tauber 2003). The biological effects of low-level laser therapy are supposed to depend largely on well-controlled parameters, e.g. wavelength, waveform, power, dosage per site, duration of irradiation, type of irradiated cell and time interval between injury and irradiation.

**Why it is important to do this review**

The effects of low-level laser directed at the auditory canal or the mastoid bone behind the ear are not known (Hahn 2001; Mirz 1999; Nakashima 2002; Plath 1995; Shiomi 1997; Tauber 2003; Teggi 2009; Wilden 1996). Therefore this Cochrane review will provide an up-to-date, detailed analysis of the current evidence available.

**OBJECTIVES**

To assess the effectiveness of low-level laser therapy for the treatment of subjective idiopathic tinnitus.

**METHODS**

**Criteria for considering studies for this review**

**Types of studies**

Randomised controlled trials.

**Types of participants**

Adults in whom there is a complaint of persistent, distressing, subjective tinnitus of any aetiology.
Types of interventions

Studies where the patients received low-level laser therapy. Comparisons will include the following.

- Low-level laser therapy versus placebo
- Low-level laser therapy versus drug/other therapy

Types of outcome measures

Primary outcomes

- Improvement in tinnitus severity and disability, measured by a validated tinnitus-specific questionnaire. Commonly used tinnitus questionnaires are listed in Table 1 (Budd 1995; Erlandsson 1992).

Secondary outcomes

- Improvement of quality of life
- Change in socio-economic impact associated with work
- Change in anxiety and depression disorders
- Change in psychoacoustic parameters
- Change in tinnitus loudness
- Change in overall severity of tinnitus
- Change in thresholds on pure-tone audiometry
- Adverse effects of treatment

Searching other resources

We will scan the reference lists of identified publications for additional trials and contact trial authors if necessary. In addition, we will search PubMed, Tripdatabase, The Cochrane Library and Google to retrieve existing systematic reviews relevant to this systematic review, so that we can scan their reference lists for additional trials. We will search for conference abstracts using the Cochrane Ear, Nose and Throat Disorders Group Trials Register.

Data collection and analysis

Selection of studies

Two authors (Zhe Peng, Xiu Qi Chen) will independently review the titles, abstracts and keywords of all records retrieved to identify studies which meet the inclusion criteria outlined above. We will resolve disagreements by consensus.

Data extraction and management

The same two review authors will carry out data extraction independently. Each review author will review approximately the same number of studies. We will use a standardised extraction form for data collection. Unresolved disagreement on inclusion, ‘Risk of bias’ assessment and data collection will be referred to the other two authors (Shusheng Gong, Chengfang Chen). Extracted data will include the following.

1. Study details: first author; year of publication; country of publication; publication type.
2. Study eligibility: type of study; participants; types of intervention; types of outcomes/measures.
3. Methods: study inclusion criteria; study exclusion criteria; detail of participants (age, sex, aetiology, hearing level, duration of tinnitus, severity of tinnitus); setting; study intervention (wave, session, frequency); study control; matching of interventions; compliance; similarity between groups; duration of follow-up.
5. Outcome: primary outcomes, secondary outcomes and other outcomes at the end of treatment and/or the end of follow-up. We will also extract the number and type of adverse events.
6. Conclusions.

We will contact authors for clarification and missing data information.

Assessment of risk of bias in included studies

Zhe Peng and Xiu Qi Chen will independently undertake assessment of the risk of bias of the included trials, with the following taken into consideration, as guided by the Cochrane Handbook for Systematic Reviews of Interventions (Handbook 2011):
• sequence generation;
• allocation concealment;
• blinding;
• incomplete outcome data;
• selective outcome reporting; and
• other sources of bias.

We will use the Cochrane ‘Risk of bias’ tool in Review Manager (RevMan) 5 (RevMan 2011), which involves describing each of these domains as reported in the trial and then assigning a judgement about the adequacy of each entry: ‘low’, ‘high’ or ‘unclear’ risk of bias.

Measures of treatment effect
We will analyse the data using Review Manager 5. We will assess the treatment effect for dichotomous data outcome measures using the risk ratio (RR) and for continuous data we will use the mean difference (MD), with 95% confidence intervals. We will combine data statistically if they are available and of sufficient quality and in the absence of significant heterogeneity.

Unit of analysis issues
To protect the accuracy of the results, we will only include randomised controlled trials. We will not include other non-standard designs such as cross-over trials and cluster-randomised trials.

Dealing with missing data
We will contact authors for missing data information. If the data are missing at random, analyses based on the available data will tend to be unbiased; if the data are said to be ‘not missing at random’, publication bias and selective reporting bias may exist. The principal options for dealing with missing data are based on the recommendations in the Cochrane Handbook for Systematic Reviews of Interventions, Chapter 16 (Handbook 2011).

Assessment of heterogeneity
We will assess clinical heterogeneity by examining types of participants (e.g. cause of tinnitus), interventions and outcomes in each study. We will assess statistical heterogeneity among trials by inspecting the forest plots and using the Chi² test and the I² statistic. When interpreting the I² statistic, we will use the following thresholds:

- 0% to 40%: might not be important;
- 30% to 60%: may represent moderate heterogeneity;
- 50% to 90%: may represent substantial heterogeneity;
- 75% to 100%: considerable heterogeneity.

The importance of the observed value of the I² statistic depends on (i) the magnitude and direction of effects and (ii) the strength of evidence for heterogeneity (e.g. P value from the Chi² test or a confidence interval for I²) (Handbook 2011).

Assessment of reporting biases
We will test for potential publication bias using a funnel plot or other corrective analytical methods, depending on the number of clinical trials included in the systematic review. We will attempt to reduce any effects of reporting bias by obtaining and including missing trial data and data from unpublished trials where possible.

Data synthesis
A pooled statistical analysis of treatment effects will proceed only in the absence of significant clinical or statistical heterogeneity. Where it is appropriate to pool data and heterogeneity is detected, we will use the random-effects model. We will analyse the clinical heterogeneity of the included trials to determine whether it is appropriate to carry out the meta-analysis. If the trial data cannot be pooled, we will describe the outcomes in the text of the review.

Subgroup analysis and investigation of heterogeneity
No subgroup analyses are planned.

Sensitivity analysis
We will perform sensitivity analyses by repeating the analysis excluding internal reports and conference abstracts. We will use study quality in a sensitivity analysis.

ACKNOWLEDGEMENTS
We are grateful to Paolo Baldo, John Phillips, Malcolm Hilton, Jonathan Hobson and Michael Bennett for their previous Cochrane reviews on which the Background to this protocol is based.
REFERENCES

Additional references

Alberti 1987

Amaral 2001

Andersson 1999

Argstatter 2008

ATA 2004

Axelsson 1985

Baguley 1992

Baldo 2006

Basford 1995

Becher 1996

Belkin 1994

Bennett 2007

Bjordal 2007

Bjordal 2008

Briner 1995

Brumnett 1980

Budd 1995

Chouard 2001

Christiansson 1993

Chung 1980

Daniell 1998

Dauman 1992

Davis 2000

Enwemeka 2004


Kowalska 2001

Kuk 1990

Lee 1999

Li 2009

Lockwood 1999

Luxon 1993

Martinez-Devesa 2010

Marx 1999

Mazurek 2007

McCombe 2001

McShane 1988

Melinck 1976

Meng 2011

Mester 1972

Metternich 1999

Mirz 1999

Mrena 2002

Nakashima 2002

Neuberger 1992

Newman 1996

Olszewski 2008

Oregon 1995

Oron 2007

Passarella 1984

Phillips 2010
Low-level laser therapy for tinnitus (Protocol)

Copyright © 2012 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

Phoon 1993

Plath 1995

Reddy 1998

Rejali 2004

RevMan 2011

Rhee 2011

Robinson 2007

Rochkind 1987

Rochkind 1992

Saayman 2011

Saunders 1998

Seidman 1998

Shea 1981

Shiomi 1997

Siendentopf 2007

Siendentopf 2002

Silva 2011

Sindhusake 2003

Stephens 1991

Sullivan 1989

Sullivan 1992

Sullivan 1993

Sullivan 1994
Sweetow 1990

Szundi 2001

Tauber 2003

Teggi 2009

Temmel 1999

Tunér 1999

van Breugel 1992

Weissman 2000

Wenzel 2004

Wenzel 2007

Wilden 1996

Wilson 1998

Woodruff 2004

Yazdani 2012

Yu 1994

* Indicates the major publication for the study

**ADDITIONAL TABLES**

Table 1. Tinnitus questionnaires

<table>
<thead>
<tr>
<th>Title</th>
<th>No. of items/factors</th>
<th>Psychometrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinnitus Questionnaire (Hallam 1996)</td>
<td>52 items, 5 factors</td>
<td>α = 0.91 for total scale; for subscales α = 0.76 to α = 0.94</td>
</tr>
<tr>
<td>Tinnitus Handicap Questionnaire (Kuk 1990)</td>
<td>27 items, 3 factors</td>
<td>α = 0.93 for total scale</td>
</tr>
<tr>
<td>Tinnitus Severity Scale (Sweetow 1990)</td>
<td>15 items</td>
<td>Alpha not reported</td>
</tr>
<tr>
<td>Subjective Tinnitus Severity Scale (Halford 1991)</td>
<td>16 items</td>
<td>α = 0.84</td>
</tr>
</tbody>
</table>
Table 1. Tinnitus questionnaires (Continued)

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Scale</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinnitus Handicap/Support Scale (Erlandsson 1992)</td>
<td>28 items, 3 factors</td>
<td>Alpha not reported</td>
</tr>
<tr>
<td>Tinnitus Handicap Inventory (Newman 1996)</td>
<td>25 items, 3 scales</td>
<td>a = 0.93 for total scale</td>
</tr>
<tr>
<td>Tinnitus coping strategy questionnaire (Henry 1995)</td>
<td>33</td>
<td>a = 0.88</td>
</tr>
<tr>
<td>Tinnitus coping style questionnaire (Budd 1995)</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>Tinnitus cognitions questionnaire (Wilson 1998)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

APPENDICES

Appendix 1. CENTRAL search strategy

#1 MeSH descriptor Tinnitus explode all trees
#2 tinnitus
#3 (#1 OR #2)
#4 MeSH descriptor Laser Therapy explode all trees
#5 MeSH descriptor Lasers explode all trees
#6 laser* OR lllt
#7 #4 OR #5 OR #6
#8 #3 AND #7

HISTORY

CONTRIBUTIONS OF AUTHORS

Zhe Peng: lead author, searching, selection of studies, data extraction, drafting and co-drafting of the protocol/review, assistance with statistics, data analysis and data presentation, update of the review.

Xiu-Qi Chen: selection of studies, data extraction, assistance with statistics, data analysis, update of the review.

Shu-Sheng Gong: selection of studies, assistance with statistics.

Cheng-Fang Chen: searching, assistance with data extraction.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

• None, Not specified.

External sources

• None, Not specified.