**Music as an aid for postoperative recovery in adults: a systematic review**

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**Abstract**

**Background**

Music is a relatively non-invasive, safe and inexpensive intervention that can be delivered easily and successfully. This systematic review evaluated music to improve postoperative recovery after surgical procedures.

**Methods**

Randomised controlled trials (RCTs) in any language of adults undergoing surgical procedures excluding central nervous system or head and neck were included. Any form of music initiated before, during or after surgery was compared to standard care or other non-drug interventions. Medline (1946-Oct 2013), Embase (1947-Oct 2013), CINAHL (1960-Oct 2013), and Cochrane Central (1898-Oct 2013) were searched, using MESH and keyword terms: music, music therapy, surg\*, operat\*, recovery, recuperation, rehabilitation, convalescence, post-op\*. Inclusions, data-extraction and quality-assessment were in duplicate. Meta-analysis with RevMan (5.2), with standardised mean differences (SMD) and random-effects models, and STATA for meta-regression were used. (Prospero-CRD42013005220).

**Results**

Searches found 4261 titles and abstracts, 73 RCTs were included, with size varying between 20–458 participants. Choice of music, timing and duration varied. Comparators included routine care, headphones with no music, white noise and undisturbed bed-rest. Postoperatively music reduced pain (SMD -0.77 (95% confidence intervals (95%CI) -0.99 to -0.56), anxiety SMD -0.68 (95%CI -0.95 to -0.41), and analgesia use SMD -0.37 (95%CI -0.54 to -0.20) and increased patient satisfaction SMD 1.09 (95%CI 0.51 to 1.68) but there was no difference in length of stay (MD -0.11 (95%CI -0.35 to +0.12)). Music reduced 10cm scale pain scores by 2.3cm compared to placebo. Subgroup analyses on choice and timing made little difference. Meta-regression found no causes of heterogeneity in eight variables evaluated. Music was effective even when patients were under general anaesthetic.

**Conclusions**

There is now evidence to demonstrate that music should be available to all undergoing operative procedures. Patients should choose the type of music, from personal choice or playlists. Timing and delivery may be adapted to individual clinical settings and medical teams.

**Introduction**

Most people undergo a surgical procedure at some point in their lives, over 51 million operative procedures are performed annually in the United States of America (USA)1 and 4.6 million hospital admissions lead to surgical care in England.2 There is an emerging trend towards the conduct of surgical procedures without general anaesthesia, for example hysteroscopy and Caesarean section. Whether anaesthesia is used or not, the postoperative period is a difficult time for patients. The term ‘postoperative recovery’ has not been precisely defined. It is clinically based and includes the restoration of the patient’s cerebral and motor function. Current surgical recovery strategies, such as Enhanced Recovery3-5 recommend numerous successful perioperative interventions within this package.6 Some preoperative strategies, such as patient education and nutritional additives, have been seen to reduce postoperative pain requirements and improve satisfaction levels7-9 but not all potentially useful interventions have yet been evaluated or incorporated.

The use of music to improve patients’ hospital experience has a long foundation in medical care, including by Florence Nightingale.10 Music was first described being used to help patients during operations by Kane in 1914.11 There is abundant research investigating music’s impact on the emotions and neurophysiology.12-14 Pre-recorded music, used through headphones, musical pillows or background sound systems can be a non-invasive, safe and inexpensive intervention, compared to pharmaceuticals, that can be delivered easily and successfully in a medical setting.15 Music has frequently been investigated in the context of recovery from operative procedures and numerous RCTs have demonstrated positive effects on patients’ postoperative recovery.16,17 This use of music is different from music therapy, which is a cognitive rehabilitation method.18

Previous systematic reviews have investigated music and its role in specific surgical procedures such as colonoscopy19,20 or only one aspect of patient experience in isolation, such as preoperative anxiety21, or postoperative pain.22,23 Cepeda (2010) investigated music for pain relief in both surgical and non-surgical settings.24 Nilsson (2008) comprehensively reviewed 60 articles on music in the perioperative period but did not perform a meta-analysis.25 None have provided a comprehensive overview with meta-analyses and meta-regression.

Music is not currently being used routinely during episodes of surgery. General issues around lack of uptake include ignorance and scepticism of professionals as to clinical usefulness of music, and lack of: budget, research dissemination and integration of the intervention in daily practice.26

Despite the wealth of relevant studies the implementation of music as a therapeutic tool in everyday surgical practice is lacking because the information demonstrating effectiveness has not been synthesised and universally disseminated. This systematic review evaluates the effectiveness of music to improve postoperative recovery incorporating all available RCTs, reviewing the impact of music on common outcome measures for postoperative care: pain, analgesia requirements, anxiety and length of stay and exploring a number of relevant subgroups – patient choice of music, timing of the intervention and whether general anaesthesia was used.

**Methods**

We developed and registered a protocol for this systematic review (Prospero registration number CRD42013005220). The pre-defined inclusion criteria were RCTs in any language with adult patients undergoing any form of surgical procedure (with or without sedation or anaesthesia) to any part of the body excluding the central nervous system or head and neck (because of potential hearing impairment). Any form of music initiated before, during or after surgery was compared to standard care or any other non-drug interventions such as massage, undisturbed rest or relaxation. Outcomes of interest were: postoperative pain, analgesia requirement, anxiety, infection rates, wound healing, costs, length of stay, and satisfaction with care. Analgesia use included any opioids or non-steroidal anti-inflammatory drugs (NSAIDs). If both were reported, opioid use was used in the meta-analyses. The outcomes were measured up to six weeks postoperatively. We investigated subgroups of pain before and after four hours postoperatively, timing of the intervention pre, intra and postoperatively, general anaesthetic versus none and patient choice of music. We recorded if music given intraoperatively was started after induction of anaesthesia.

The following databases were searched: Medline (1946-Oct 2013), Embase (1947-Oct 2013), Cumulative Index to Nursing and Allied Health Literature (CINAHL) (1960-Oct 2013), and Cochrane Central (1898-Oct 2013). The following search terms were used; music, music therapy, surg\*, operat\*, recovery, recuperation, rehabilitation, convalescence, post-op\*. Both MESH terms and keywords were used. Reference lists of relevant reviews were checked for additional studies. All relevant titles and abstracts were transferred to Endnote Web for assessment.

Two reviewers (JH and MH) checked study eligibility. Both independently extracted data from studies using a standardised, pre-designed extraction form in Microsoft Excel 2007. Disagreements were resolved through discussion or referral to a senior reviewer (CM). Quality of included studies was assessed using criteria set by The York Centre for Reviews and Dissemination27; focussing on randomisation, allocation concealment, presence of blinding, explanation of withdrawals and presence or absence of intention-to-treat analysis.

We tabulated the characteristics and results of all the included studies; analysis was quantitative. Where standard errors or ranges were provided, standard deviations were calculated using standard formulae. Review Manager (version 5.2, The Cochrane Library) was used for meta-analyses. We used random effects models because of heterogeneity of participants and interventions. All outcomes were continuous measures and we used standardised mean differences (SMD) where the outcomes had differing measurement scales. Risk of publication bias was assessed using funnel plots. In addition to presenting SMD, which can be difficult to interpret clinically, we conducted back transformations of two outcomes used in the included RCTs. These were calculated using Excel and were performed on the pain outcome, using a mean of control group standard deviations from the RCTs measuring pain using a VAS, and for the anxiety outcome, using a mean of control group standard deviations from RCTs measuring anxiety with STAI. To further investigate heterogeneity, meta-regressions were conducted using STATA version 12.

**Role of the funding source**

There was no funding source for this study. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

**Results**

Searches found 4261 titles and abstracts. After removing duplicates 3876 remained for screening, of which 3616 were irrelevant. Full papers for 260 articles were assessed for inclusion (238 from database searches and 22 from reference lists) (see figure 1). There were 73 RCTs included in the qualitative synthesis and 72 RCTs in quantitative syntheses, including a Japanese study that was translated. It is unlikely that there will be much effect from publication bias (see figure 2).

Characteristics of included studies are in table 1. The size of the studies varied between 20 – 458 participants, and they underwent a variety of different surgical procedures ranging from minor endoscopic interventions to transplant surgery. Most studies only included elective procedures. Choice of music could be by patient or researcher. Patients chose a wide variety of styles. Researchers determined single types of music such as Chinese classical music, or gave patients’ choice from a list of six or more styles. Most were of a soothing quality. Delivery could be by headphones or music pillows for patients only to hear, or loudspeakers which could also be heard by the medical team. When music was delivered by headphones, it was often at a sufficiently low level that patients could still communicate easily. Timing could be pre, intra or postoperative, or a combination. The music could be played when patients were awake or anesthetised. Duration of music varied between a few minutes to repeated episodes over several days. Comparator descriptions varied, and included routine care, headphones with no music, white noise, and undisturbed bed rest. Duration and timing was normally similar to the interventions. Outcomes included postoperative pain, analgesia requirement, anxiety, length of stay, and satisfaction with care. None of the RCTs measured infection rates, wound healing or costs. Some outcomes were measured during or just after the procedure, others were measured at multiple times during the hospital stay.

A variety of outcomes were measured (see Table 2). Pain was usually measured with visual analogue scales (VAS) or numerical rating scales (NRS). An indirect measure of pain was the consumption of analgesia, which varied considerably between the studies including opioid-based drugs such as pethidine, fentanyl, and morphine, and non-steroidal anti-inflammatories such as diclofenac, ibuprofen, and paracetamol.

Quality of included studies varied (see table 3) but a number of the studies gave insufficient details to assess all aspects of quality. An intervention such as this cannot be blinded to the patient unless they are under general anaesthesia, but blinding of investigators and outcome assessment would be possible but was not stated in many of the studies. Where music was delivered when the patient was under anaesthesia it was unclear whether the patient knew beforehand to which group they were allocated.

The results showed that postoperatively music reduced pain (45 RCTS, SMD -0·77 (95%CI-0·99 to -0·56)), anxiety (43 RCTS, SMD -0·68 (95%CI -0·95 to -0·41)), and analgesia use (34 RCTS, SMD -0·37 (95%CI-0·54 to -0·20)) and increased patient satisfaction (16 RCTS, SMD 1·09 (95%CI 0·51 to 1·68)) but there was no difference in length of stay (7 RCTs, SMD -0·11 (95%CI-0·35 to +0·12)) (see figure 3). Pain and anxiety SMD outcomes were back-calculated into specific measurements most used in the RCTs. Pain results (using the 10cm VAS) suggested that music reduced pain scores by 2.3cm on average, compared to placebo. Anxiety results (measured by STAI) were reduced by 6.4 units on average, compared to placebo.

Heterogeneity was high for pain, anxiety and analgesia use, with I2 varying between 75-92%, for length of stay it was 0%. No RCTs reported wound healing rates, costs, wound infections or serious adverse events. A subgroup analysis by type of control (routine care vs control with attention) made little difference to the effectiveness of music. Univariate meta-regression analysis to explain heterogeneity did not show a significant impact of any of the eight variables on the main result (variables investigated were patient choice, timing of music, general anaesthetic, use of VAS to measure pain v other pain measures, routine care v other comparisons, endoscopy type procedures v surgery, allocation concealment, and blinding of outcome assessment). Because there were no significant outcomes found on univariate meta-regression, multivariate meta-regression was not conducted.

Postoperative pain was pragmatically categorised as being measured between zero and four hours and more than four hours. There was no difference between pain measured at the early versus later time categories (-0·79 (95%CI-1·06 to -0·52) and -0·76 (95%CI-1·19 to -0·33) respectively). For individual subgroup meta-analyses – see Web Appendix figures W2 – W12.

When patients were allowed to choose the music (from personal choice or from a playlist) there was a slightly greater but non-significant reduction in pain compared to when there was no choice (SMD -0·86 (95%CI-1·14 to -0·57) vs -0·70 (95%CI-1·01 to -0·39). Similarly, there was a slightly greater but non-significant reduction in analgesia use with patient choice (SMD -0·53 (95%CI-0·84 to -0·23) vs -0·15 (95%CI-0·29 to -0·02) but a slight but non-significant worsening in anxiety SMD -0·54 (95%CI-0·82 to -0·27) vs -0·89 (95%CI-1·42 to -0·36).

There was a trend for pain to be less if music was played preoperatively compared to postoperatively (preoperatively SMD -1·28 (95%CI-2·03 to -0·54), intraoperatively SMD -0·89 (95%CI-1·20 to -0·57) postoperatively SMD -0·71 (95%CI-1·03 to -0·39). A similar pattern was seen with analgesia use and anxiety. Results for analgesia use were preoperatively SMD -0·43 (95%CI-0·67 to -0·20), intra-operatively SMD -0·41 (95%CI-0·70 to -0·12), post-operatively SMD -0·27 (95%CI-0·45 to -0·09) and for anxiety were pre-operatively SMD -1·12 (95%CI-2·05 to -0·19), intra-operatively SMD -0·83 (95%CI-1·19 to -0·47) and postoperatively (SMD -0·50 (95%CI-0·96 to -0·04).

Even under general anaesthetic music still reduced pain, but a larger effect on pain was found intra-operatively where patients were conscious compared to where patients heard the music whilst under general anaesthetic (SMD -1·05 (95%CI-1·45 to -0·64) vs SMD -0·49 (95%CI-0·74 to -0·25). A similar effect was found with analgesia use (SMD -0·58 (95%CI -1·05 to -0·11) vs -0·26 (95%CI-0·44 to -0·07) and anxiety (SMD -0·91 (95%CI-1·33 to -0·48) vs -0·48 (95%CI-0·91 to -0·05).

None of the included studies reported side effects. However, some reported that they ensured that the low volume delivered permitted communication with medical teams.

**Discussion**

**Statement of principal findings**

The results of this systematic review suggest that playing music in the perioperative setting can reduce postoperative pain, anxiety and analgesia requirements, and improve patient satisfaction. Fewer studies measured length of stay and no difference was found. None of the studies investigated the effects of music on infections, wound healing rates, or costs.

**Strengths and weaknesses**

We used wide inclusion criteria in order to make the results more generalisable to clinical practice. It could be argued that we should not have combined very heterogeneous studies because of the clinical differences. For example, is it useful to meta-analyse studies reporting different analgesics used? Stronger pain tends to be alleviated with stronger analgesia whereas milder pain responds to weaker analgesia. Therefore the relative reduction in pain would be of interest. We took the pragmatic decision that combining all studies reporting analgesia use would be more useful clinically than grouping specific types of analgesics. This was also extended to other aspects of clinical heterogeneity such as age groups, types of interventions and also whether the intervention was conducted awake or under general anaesthesia. The measures of heterogeneity within the meta-analyses indicated that there was a large amount of statistical heterogeneity in the main analyses for pain, analgesia use and anxiety. To mitigate this we used random effects meta-analyses. It is acknowledged that this only partially removes the impact of heterogeneity28 Nevertheless we considered that combining data would provide a more clinically useful result than including a narrower range of homogenous studies. The implication of combining clinically heterogeneous studies is that we cannot be sure whether music applies equally to all clinical scenarios. However, we investigated a number of clinically relevant subgroup analyses such as general anaesthesia vs. none, and timing and choice of music and also conducted meta-regression. The heterogeneity remains unexplained so to fully investigate this an IPD meta-analysis would be the next step.

It is surprising that the largest RCT recruited only 458 participants and one could argue that it would be interesting to discover whether a very large RCT would generate similar results to this systematic review. However, there were so many small trials showing positive effects of music in helping patients with surgical procedures, that a large trial may not now be needed. These small RCTs were hard to find in lesser-known journals, which illustrates the benefits of systemic reviews and meta-analysis. One aspect that a large RCT would additionally address would be the issues around heterogeneity.

Prediction intervals could have been calculated as this would have given a more comprehensive picture of the potential effect of music in individual settings. However, prediction intervals tend to be wider than 95% confidence intervals and, because of clinical heterogeneity, it is unclear as to how the calculation of prediction intervals would help to guide individual clinicians on the implementation of music.

**Strengths and weaknesses in relation to other systematic reviews including any differences in results**

One strength of this systematic review is the large number of included studies compared to previous systematic reviews. The most comprehensive previous systematic review used a vote-counting approach to summarise results only.25 Some of the previous systematic reviews only investigated one outcome, such as anxiety or pain, whereas we report all relevant clinical outcomes. We believe this is the most comprehensive systematic review to date on the use of music in the perioperative setting, including 6902 patients. Our results are similar to Cepeda (2010) in magnitude of effect size.24. We found no side effects reported, as did a recent Cochrane review.29

**Meaning of the study: possible mechanisms and implications for policymakers**

The general findings on the beneficial effects of music on the wellbeing of patients are consistent with expectations and the public’s perception of music. There are a number of potential mechanisms that could help to explain the effects of music, from the patient’s and the medical team’s perspective. Modern theories of pain suggest that pain experience is affected by physical and psychological factors. Cognitive activities such as listening to music can influence perceived intensity and unpleasantness of pain, allowing for a reduced pain sensation by the patient.30 Another potential mechanism could be a reduction in autonomic nervous system activity such as reduced pulse and respiration rate and lower blood pressure.31 For those undergoing general anaesthesia there is some RCT evidence that parts of the brain involved in hearing may sometimes remain perceptive during general anaesthetic.32 For approximately one in a thousand people undergoing general anaesthesia, unwanted intraoperative awareness during the anaesthetic is a risk factor for post-traumatic stress33. It is unclear at the moment whether intraoperative music might have prevented this by reducing anxiety levels.

Other primary studies and systematic reviews have found that, for medical teams, carers may be more relaxed and attentive34 where there is music playing that they enjoy, but its use may be inappropriate in certain settings. The medical team may be distracted if music is audible from the patient’s headphones. Music may impede communication with patients, particularly during an awake procedure. If patients need to be able to communicate with healthcare workers bilateral headphone use may be an obstacle. Music and noise have the potential to obstruct other interventions through negatively affecting the surgeon’s performance. Because of this, music should not be imposed on the medical team, particularly during the procedure. If medical teams intend to introduce music into the perioperative setting care needs to be taken that music does not interfere with the communication between the medical team.35,36

**Unanswered questions and future research**

Music is a non-invasive, safe and inexpensive intervention that can be delivered easily and successfully in a hospital setting. We consider that there now appears sufficient research to demonstrate that music should be available to all undergoing operative procedures. Patients should be able to choose the type of music they would like to hear, but it is unclear currently whether this should be of their own choice or from a playlist. However, some might prefer for religious reasons to listen to recitations or natural sounds. The timing of music does not make much difference to outcomes so may be adapted to the individual clinical setting and medical team. For example some may want to implement intraoperative music whereas other may prefer the patient to listen to their own electronic musical device, such as an MP3 player, before the procedure or as soon as they arrive back onto the ward. The appropriate volume to be used in different settings is also currently unclear. Whether other distracting stimuli might have a similar effect, such as watching videos or listening to talking books, is also unclear. There is some experimental evidence that distraction using video gaming can reduce experimentally-induced pain in adults37 but no evidence examining the effectiveness of talking radio or talking books during surgery in the adult population.

One type of research needed now would be around barriers to implementation in the clinical setting, such as copyright and intellectual property issues. On a local scale encouraging patients to listen to music could be introduced into patient information leaflets and hospital guidelines and its use then audited. This audit would need to be published to inform wider circles of decision-makers.

**Declaration of interest**

None of the authors had any financial or personal relationships with other people or organisations that could bias the present paper.

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Figure 1. PRISMA flow diagram

Potentially eligible trials identified through literature search.

*n* = 4261

Excluded *n* = 3616

Excluded *n* = 187

* Not RCT *n* = 80
* No usable outcomes *n* = 39
* Combined interventions/outcomes *n* = 2
* No data on group numbers *n* = 5
* Multiple publications *n* = 10
* Head/Neck/CNS surgery *n* = 5
* Systematic review *n* = 15
* Not published studies *n* = 10
* No operation *n* = 6
* No music *n* = 1
* Control also given music *n* = 1
* Unable to access at British Library *n* = 13

Number of studies included in qualitative synthesis (Meta-analysis)

*n* = 72

Number of studies included in qualitative synthesis

*n* = 73

Number of full-text articles assessed for eligibility

*n* = 260

Number of records screened

*n* = 3876

Number of records after duplicates removed

*n* = 3876

Figure 2**. Funnel plot using pain outcome**



Figure 3. Summary forest plot



**Table 1 Study characteristics**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study** | **Number of Participants****Intervention Control** | **Comparison Groups** | **Procedure** | **General Anaesthetic?** | **Music Type** | **Patient Choice** | **Timing of delivery** | **Duration of music** |
| Agwu & Okoye 2006 | 50 | 50 | 1. Routine Care | Hysterosalping-ography | No | Patient’s own |  ✓ |  | Intra-operatively | Duration of procedure |
| Allred 2010 | 39 | 39 | 1. Rest Period | Knee Arthroplasty | NS | Easy listening | ✓ |  | Post-operatively | 20 minutes |
| Andrada 2004 | 63 | 55 | 1. Routine Care | Colonoscopy | No | Classical | 🗶 |  | Pre & Intra-operatively | Duration of procedure |
| Angioli et al 2013 | 185 | 187 | 1. Routine Care | Hysteroscopy | No | Patient Choice | ✓ |  | Intra-operatively | Duration of procedure |
| Argstatter et al 2006 | 1. music (28)2. music & coaching (28) | 27 | 1. Routine Care | Intra-cardiac Catheterisation | No | Relaxation | 🗶 |  | Intra-operatively | Duration of procedure |
| Ayoub 2005 | 31 | 1. 282. 31 | 1. Operating room noise2. White noise | Urological procedures | No | Urological procedure | ✓ |  | Intra-operatively | Duration of procedure |
| Bally 2003 | 58 | 55 | 1. Routine Care  | Coronary Angiography | No | Patient’s own | ✓ |  | Pre, Intra & Post-operatively |  - |
| Barnason 1995 | 1. music (33)2. music & visual imaging (29) | 34 | 1. Undisturbed bed rest | CABG | Yes | Soothing | ✓ |  | Post-operatively | 30 minutes |
| Bechtold 2006 | 85 | 81 | 1. Routine Care | Colonoscopy  | No | Watermark by Enya | 🗶 |  | Pre & Intra-operatively | Duration of procedure |
| Binns-Turner et al 2011 | 15 | 15 | 1. Blank iPod | Mastectomy  | Yes | Various  | ✓ |  | Pre & Intra-operatively | Duration of procedure |
| Blankfield et al 1995 | 1. music (32)2. music & therapeutic suggestion (34) | 29 | 1. Blank Cassette tape | CABG | Yes | Dream flight 2 | 🗶 |  | Intra& Post-operatively | Duration of procedure |
| Chan 2003 | 112 | 108 | 1. Routine Care | Colposcopy  | No | Slow rhythmic  | 🗶 |  | Intra-operatively | Duration of procedure |
| Chan 2007  | 35 | 35 | 1. Undisturbed bed rest | C-clamp post PCI | No | Slow & soft  | 🗶 |  | Intra-operatively | 45 minutes |
| Chlan 2000 | 30 | 34 | 1. Routine Care | Sigmoidoscopy | No | Various | ✓ |  | Intra-operatively | Duration of procedure |
| Colt 1999 | 30 | 30 | 1. Headphones only | Bronchoscopy  | No | Soft piano  | 🗶 |  | Intra-operatively | Duration of procedure |
| Costa et al 2010 | 56 | 53 | 1. Mute headphone | Colonoscopy  | No | Various  | ✓ |  | Pre & Intra-operatively | Duration of procedure |
| Cutshall 2011 | 49 | 51 | 1. Bed rest | Cardiac surgery | Yes | Relaxing | ✓ |  | Post-operatively | 20 minutes |
| Danhauer 2007 | 56 |  | 1. Routine Care (58)2. Guided imagery (56)  | Colposcopy  | No | Relaxing  | ✓ |  | Intra-operatively | Duration of procedure |
| Ebneshahidi 2008 | 38 | 39 | 1. No music, headphones | Caesarean-section  | NS | Patient choice | ✓ |  | Post-operatively | 30 minutes |
| Fredriksson 2009 | 1. Mu-OS-Mu (25)2. OS-Mu-OS (25) |  |  | Various | NS | Musicure | 🗶 |  | Post-operatively | 30 minutes per sound |
| Ghetti 2011 | 1. music (9)2. music & discussion (11) | 9 | 1. Routine Care | Transplant surgery  | Yes  | Instrumental  |  ✓ |  | Post-operatively | 30-40 minutes |
| Good 1995 | 1. music (21)2. music & relaxation (21) |  | 1. Routine Care (21)2. Jaw relaxation (21)  | Abdominal surgery | Yes | Sedative | ✓ |  | Post-operatively | 2 minutes & whenever else they liked |
| Good 1999 | 1. music (122)2. music & jaw relaxation (109) |  | 1. Routine Care (111)2. Jaw relaxation (116) | Abdominal Surgery | Yes | Sedative  | ✓ |  | Post-operatively | Pre, during and after ambulation. |
| Gravesen 2013 | 40 | 35 | 1. Routine Care | Laparascopic cholecystectomy  | Yes | Soft music | 🗶 |  | Pre, Intra & Post-operatively | Until patient discharge |
| Guerrero 2011 | 54 | 47 | 1. Routine Care | MVA abortion | No | Patient choice  | ✓ |  | Intra-operatively | Duration of procedure  |
| Harikumar et al 2006 | 38 | 40 | 1. No music, headphones | Colonoscopy  | No | Various  | ✓ |  | Intra-operatively | Duration of procedure |
| Hook et al 2008 | 51 | 51 | 1. Routine Care | General Abdominal  | Yes | Various | ✓ |  | Post-operatively | 8 x 30 minutes |
| Iblher 2011 | 1. early post-op music (25)2. late post-op music (24) |  | 1. No music, headphones early post-op (25)2. No music, headphones late post-op (27)3. Routine care (25) | Open cardiac surgery  | Yes | Baroque  | 🗶 |  | Post-operatively | 60 minutes  |
| Ikonomidou 2004 | 29 | 26 | 1. White noise, headphones | Lap Sterilization | Yes | Pan flute music | 🗶 |  | Pre & Post-operatively | 30 minutes |
| Jafari 2012 | 30 | 30 | 1. No music, headphones | CABG/Valve repair | Yes | 60-80bpm | ✓ |  | Pre & Post-operatively | 30 minutes |
| Jimenez 2013 | 20 | 20 | 1. Routine Care | Varicose vein surgery | No | Classical  | 🗶 |  | Intra-operatively | Duration of procedure |
| Johnson 2012 | 43 | 43 | 1. No music, headphones | Gynaecological surgery  | Varies | Various  | ✓ |  | Pre-operatively |  - |
| Kliempt 1999 | 1. music (25)2. hemisync (25) | 26 | 1.No music, headphones  | General surgery | Yes | Classical  | 🗶 |  | Intra-operatively | Duration of procedure |
| Lee et al 2002 | 1. music & PCA (55)2. music & requested analgesia (55) | 55 | 1. Routine Care & PCA | Colonoscopy | No | Various | ✓ |  | Intra-operatively | Duration of procedure |
| Lepage et al 2001 | 25 | 25 | 1. Routine Care | Ambulatory surgery | No | Various | ✓ |  | Pre & Post-operatively |  |
| Li 2012 | 30 | 30 | 1. relaxation  | LSCS | No | Chinese classical  | ✓ |  | Pre-operatively | 30 minutes  |
| Maeyama 2009 | 29 | 29 | 1. Routine Care | Various  | No | Classical | 🗶 |  | Intra-operatively | Duration of procedure |
| McCaffrey 2006 | 62 | 62 | 1. Routine Care | Lower limb orthopaedic | Yes | Various | ✓ |  | Post-operatively | Minimum 4 hours daily |
| Migneault 2004 | 15 | 15 | 1. No music, headphones | Open gynaecological  | Yes | Various  | ✓ |  | Intra-operatively | Duration of procedure  |
| Mullooly 1988 | 14 | 14 | 1. Routine care  | Hysterectomy | Yes | Instrumental | 🗶 |  | Post-operatively | 10 minutes |
| Nilsson 2001 | 1. music (30)2. music & therapeutic suggestion (31) | 34 | 1. music sound of operating room | Hysterectomy  | Yes | Soothing | 🗶 |  | Intra-operatively | Duration of procedure |
| Nilsson 2003a | 1. music (62)2. music & therapeutic suggestion (57) | 63 | 1. Blank tape, headphones | Hernia / varicose vein surgery | Yes | Soft instrumental  | 🗶 |  | Post-operatively | Patient requests cessation |
| Nilsson 2003b | 1. intra-op music, white noise post-op (51)2. post-op music, intra-op white noise (51) | 49 | 1. white noise | Hernia / varicose vein surgery | Yes | Instrumental  | 🗶 |  | Intra-operatively | Duration of procedure & 1 hour post-operatively  |
| Nilsson 2005 | 1. intra-op music (25)2. post-op music (25) | 25 | 1. No music, headphones | Hernia repair | Yes | Relaxing | 🗶 |  | Intra& Post-operatively  | Duration of the procedure |
| Nilsson 2009a | 121 | 119 | 1. Routine Care | Coronary angiography | No | Relaxing  | 🗶 |  | Intra-operatively | Duration of procedure |
| Nilsson 2009b | 28 | 30 | 1. Bed rest | Open CABG/Valve replacement  | Yes | Relaxing | 🗶 |  | Post-operatively | 30 minutes & 30 minutes rest |
| Nilsson 2009c | 20 | 20 | 1. Routine Care | Open CABG/Valve replacement | Yes | Relaxing | 🗶 |  | Post-operatively | 30 minutes |
| Nilsson 2012 | 34 | 34 | 1. Routine Care | Coronary angiography | No | MusiCure | 🗶 |  | Intra-operatively | Duration of procedure |
| Ovayolu 2006 | 30 | 30 | 1. Routine Care | Colonoscopy | No | Turkish Classical  | 🗶 |  | Pre & Intra-operatively | 30 minutes |
| Palakanis 1994 | 25 | 25 | 1. Routine Care | Sigmoidoscopy  | No | Various | ✓ |  | Intra-operatively | Duration of procedure |
| Reza et al 2007 | 50 | 50 | 1. White noise, headphones | Elective c-section | Yes | Spanish guitar | 🗶 |  | Intra-operatively | Duration of procedure  |
| Salmore 1999 | 1. OGD (15)2. colonoscopy (15) | 33 | 1. Routine Care | OGD & Colonoscopy | No | Relaxing | 🗶 |  | Pre & Intra-operatively | Duration of procedure |
| Sen et al 2009 | 30 | 30 | 1. No music, headphones | Urological procedures | No | Patient choice | ✓ |  | Intra-operatively | Duration of procedure  |
| Sen 2010  | 35 | 35 | 1. Routine Care | pfannenstial LSCS | Yes | Patient choice | ✓ |  | Post-operatively | 1 hour |
| Sendelbach 2006 | 50 | 36 | 1. Bed rest | Cardiac surgery | Yes | Easy listening | ✓ |  | Post-operatively | 20 minutes twice daily for 3 days |
| Shabanloei 2010 | 50 | 50 | 1. Routine Care | Bone marrow biopsy | No | Relaxing | 🗶 |  | Intra-operatively | Duration of procedure |
| Simcock 2008 | 15 | 15 | 1. White noise, headphones | Knee arthroplasty | No | Patient choice | ✓ |  | Intra-operatively | Duration of procedure |
| Smolen 2002 | 16 | 16 | 1. Routine Care | Colonoscopy | No | Patient’s own | ✓ |  | Pre & Intra-operatively | Duration of procedure |
| Szmuk 2008 | 20 | 20 | 1. No music, headphones | Laparascopic hernia repair / Cholecystectomy  | Yes | Various | ✓ |  | Intra-operatively | Duration of procedure |
| Taylor-Piliae 2002 | 15 | 15 | 1. Information on procedure | Cardiac catheterisation | No | Patient choice | ✓ |  | Pre-operatively | 15-20 minutes |
| Triller 2005 | 93 | 107 | 1. Routine Care | Bronchoscopy | No | Relaxation | 🗶 |  | Intra-operatively | Duration of procedure |
| Tsivian 2011 | 31 | 28 | 1. Routine Care | Prostate biopsy | No | Classical  | 🗶 |  | Intra-operatively | Duration of procedure |
| Twiss 2006 | 42 | 44 | 1. Routine Care | CABG / Valve surgery | Yes | Prescriptive | ✓ |  | Intra & Post-operatively | Duration of procedure & 3 days post-op |
| Vachiramon 2013 | 50 | 50 | 1. Routine Care | MOHS | No | Patient choice | ✓ |  | Pre & Intra-operatively | Duration of procedure |
| Voss 2004 | 20 | 21 | 1. Sat out talking | Open heart surgery | Yes  | Sedative  | ✓ |  | Post-operatively | 30 minutes |
| Weeks & Nilsson 2011 | 1. music-loudspeaker (30)2. music–pillow (34) | 34 | 1. Routine Care | Coronary angiogram / PCI | No | Musicure | 🗶 |  | Intra-operatively | Duration of procedure |
| Wu, F 2013 | 26 | 14 | 1. Routine Care | Hand surgery | No | Patient choice | ✓ |  | Pre & Intra-operatively | Not stated |
| Wu, J 2012 | 13 | 13 | 1. Routine Care | Termination of Pregnancy | No | Patient choice | ✓ |  | Intra-operatively | Duration of procedure  |
| Xiao-Mei 2011 | 60 | 60 | 1. Routine Care | Breast surgery | Yes | Patient choice | ✓ |  | Post-operatively | 30 minutes twice daily |
| Yeo 2012 | 35 | 35 | 1. No music, headphones | Cystoscopy  | No | Classical  | 🗶 |  | Intra-operatively | Duration of procedure |
| Zengin 2013 | 50 | 50 | 1. Routine Care | Catheter placement | No | Turkish classical | 🗶 |  | Intra-operatively | Duration of procedure |
| Zhang 2005 | 55 | 55 | 1. No music, headphones | Hysterectomy  | Yes | Calming | ✓ |  | Intra-operatively | Duration of procedure |
| Zimmerman 1996 | 1. music (32)2. music and video (32) | 32 | 1. Routine care and rest | CABG | Yes | Patient choice | ✓ |  | Post-operatively | 30 minutes  |

**Table 2. Outcomes reported**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study** | **Pain Score** | **How reported?** | **Analgesia Use** | **How reported?** | **Anxiety Score** | **How reported?** | **Length of Stay** | **How reported?** | **Other Outcome** | **How reported?** |
| Agwu & Okoye 2006 |  |  |  |  |  ✓ | STAI |  |  | Physiological parameters | HR/BP |
| Allred 2010 |  ✓ | VAS |  |  |  ✓ | VAS |  |  |  |  |
| Andrada 2004 |  |  |  |  |  ✓ | SAI & TAI \*\* |  |  |  |  |
| Angioli et al 2013 |  ✓ | VAS |  |  |  ✓ | STAI |  |  |  |  |
| Argstatter et al 2006 |  |  |  |  |  ✓ | STAI & VAS \*\* |  |  | Physiological parameters | HR/BP |
| Ayoub 2005 |  |  |  ✓ | mg per drug |  |  |  ✓ | PACU admission length  |  |  |
| Bally 2003 |  ✓ | VAS |  ✓ | mg per drug |  ✓ | STAI |  |  |  |  |
| Barnason 1995 |  |  |  |  |  ✓ | STAI |  |  |  |  |
| Bechtold 2006 | ✓ | 100mm VAS \*\* |  ✓ | mg per drug \*\* |   |  |  |  | Procedural Time & Difficulty | Questionnaire |
| Binns-Turner et al 2011 |  ✓ | VAS |  |  |  ✓ | SAI |  |  | Physiological parameters | HR/MABP |
| Blankfield et al 1995 |  |  |  ✓ | (mg) drug post-op |  |  |  ✓ | Total and ICU total  | Depression Score & ADLs |  |
| Chan 2003 |  ✓ | VAS |  |  |  ✓ | STAI |  |  |  |  |
| Chan 2007 |  ✓ | UCLA tool |  |  |  |  |  |  |  |  |
| Chlan |  ✓ | NRS |  |  |  ✓ | STAI  |  |  |  |  |
| Colt 1999 |  |  |  |  |  ✓ | STAI  |  |  |  |  |
| Costa et al 2010 |  ✓ | VAS |  ✓ | Midazolam requests \*\* |  |  |  |  | Patient Satisfaction | Likert Scale |
| Cutshall 2011 |  ✓ | VAS \*\* |  ✓ | mg per drug |  ✓ | VAS \*\* |  |  | Patient Satisfaction  |  VAS \*\* |
| Danhauer 2007 |  ✓ | VAS |  |  |  ✓ | STAI |  |  |  |  |
| Ebneshahidi 2008 |  ✓ | VAS |  ✓ | mg per drug |  ✓ | VAS |  |  |  |  |
| Fredriksson 2009 |  |  |  |  |  |  |  |  | Patient wellbeing \* | Likert Scale |
| Ghetti 2011 |  ✓ | NRS |  |  |  |  |  |  | Length of ambulation & Patient Satisfaction | PANAS |
| Good 1995 |  ✓ | Pain sensation & distress |  ✓ | mg per drug |  ✓ | STAI |  |  |  |  |
| Good 1999 |  ✓ | VAS |  |  |  |  |  |  |  |  |
| Gravesen 2013 |  ✓ | VAS |  |  |  |  |  |  |  |  |
| Guerrero 2011 |  ✓ | VAS |  |  |  ✓ | STAI |  |  | Physiological parameters | HR/BP |
| Harikumar et al 2006 |  ✓ | VAS |  ✓ | Midazolam requests |  |  |  ✓ | Recovery time |  |  |
| Hook et al 2008 |  ✓ | VAS PSD \* |  ✓ | Morphine equi-analgesic dose |  ✓ | STAI & VAS \* |  |  |  |  |
| Iblher 2011 |  ✓ | ANP |  ✓ | mg per drug |  |  |  |  |  |  |
| Ikonomidou 2004 |  ✓ | VAS |  ✓ | mg per drug |  |  |  |  | Patient Wellbeing  | VAS |
| Jafari 2012 |  ✓ | NRS |  |  |  |  |  |  |  |  |
| Jimenez 2013 |  |  |  |  |  ✓ | VAS |  |  |  |  |
| Johnson 2012 |  |  |  |  |  ✓ | STAI | ✓ | Time spent in PACU \*\* |  |  |
| Kliempt 1999 |  |  |  ✓ | mg per drug |  |  |  |  |  |  |
| Lee et al 2002 |  ✓ | VAS |  ✓ | PCA use & requests  |  |  |  ✓ | Recovery time \* | Patient satisfaction | VAS |
| Lepage et al 2001 |  |  |  ✓ | Midazolam requests |  ✓ | STAI & VAS |  |  |  |  |
| Li 2012 |  ✓ | VAS |  |  |  ✓ | Zung self-rated score |  |  |  |  |
| Maeyama 2009 |  |  |  ✓ | mg per drug |  ✓ | STAI-SA |  |  |  |  |
| McCaffrey 2006 |  ✓ | VAS |  ✓ | mg per drug |  |  |  |  | Patient Satisfaction  | NRS |
| Migneault 2004 |  |  |  ✓ | mg per drug |  |  |  |  |  |  |
| Mullooly 1988 |  ✓ | VAS |  |  |  ✓ | Likert Scale |  |  |  |  |
| Nilsson 2001 |  ✓ | VAS |  ✓ | mg per drug |  |  |  ✓ | Mobilisation time | Patient wellbeing & Nausea | 5 grade scale |
| Nilsson 2003a |  ✓ | VAS |  ✓ | mg per drug |  ✓ | STAI |  |  |  |  |
| Nilsson 2003b |  ✓ | NRS |  ✓ | mg per drug |  ✓ | Questionnaire \* |  |  | Patient Satisfaction \*\* | NRS |
| Nilsson 2005 |  ✓ | NRS |  ✓ | mg per drug |  ✓ | NRS |  |  |  |  |
| Nilsson 2009a |  ✓ | NRS |  ✓ | mg per drug |  ✓ | STAI |  |  |  |  |
| Nilsson 2009b |  ✓ | NRS |  ✓ | mg per drug |  ✓ | NRS \*\* |  |  |  |  |
| Nilsson 2009c |  |  |  ✓ | mg per drug |  |  |  |  | Relaxation  | NRS |
| Nilsson 2012 |  |  |  ✓ | mg per drug |  ✓ | NRS |  |  | Positive Sound Experience | NRS |
| Ovayolu 2006 |  ✓ | VAS |  ✓ | mg per drug |  ✓ | STAI |  |  | Patient Satisfaction | VAS  |
| Palakanis 1994 |  |  |  |  |  ✓ | STAI \*\* |  |  | Physiological parameters | HR/MABP |
| Reza et al 2007 |  ✓ | VAS |  ✓ | mg per drug |  ✓ | VAS |  |  | Vomiting  |  |
| Salmore 1999 |  |  |  ✓ | mg per drug \*\* |  |  |  ✓ | Recovery time to d/c |  |  |
| Sen et al 2009 |  |  |  ✓ | mg per drug |  |  |  ✓ | Recovery time \* | Patient Satisfaction | VAS |
| Sen 2010 |  ✓ | VAS |  ✓ | mg per drug |  |  |  |  | Patient Satisfaction | VAS |
| Sendelbach 2006 |  ✓ | NRS \*\* |  ✓ | mg per drug |  ✓ | State Personality Inventory \*\* |  |  |  |  |
| Shabanloei 2010 |  ✓ | VAS |  |  |  ✓ | STAI |  |  |  |  |
| Simcock 2008 |  ✓ | VAS |  |  |  |  |  |  | Patient Satisfaction | 5-point scale |
| Smolen 2002 |  |  |  ✓ | mg per drug |  ✓ | SAI |  |  |  |  |
| Szmuk 2008 |  ✓ | VAS |  |  |  |  |  ✓ | Time to eye opening |  |  |
| Taylor-Piliae 2002 |  |  |  |  |  ✓ | STAI |  |  | Patient Satisfaction | Various |
| Triller 2005 |  |  |  |  |   |  |  |  | Patient Feeling | VAS |
| Tsivian 2011 |  ✓ | VAS |  |  |  ✓ | STAI \*\* |  |  |  |  |
| Twiss 2006 |  |  |  |  |  ✓ | STAI |  |  |  |  |
| Vachiramon 2013 |   |  |  |  |  ✓ | STAI |  |  |  |  |
| Voss 2004 |  ✓ | VAS |  |  |  ✓ | VAS |  |  |  |  |
| Weeks & Nilsson 2011 |  |  |  ✓ | mg per drug |  ✓ | NRS |  |  | Patient wellbeing\* | Questionnaire |
| Wu, F 2013 |  |  |  |  |  ✓ | VAS \*\* |  |  |  |  |
| Wu, J 2012 |  ✓ | NRS \*\* |  |  |  ✓ | NRS \*\* |  |  |  |  |
| Xiao-Mei 2011 |  ✓ | VAS/ PRI/ PPI |  |  |  |  |  |  |  |  |
| Yeo 2012 |  ✓ | VAS |  |  |  ✓ | STAI |  |  | Patient Satisfaction | VAS |
| Zengin 2013 |  ✓ | VAS |  |  |  ✓ | STAI |  |  |  |  |
| Zhang 2005 |  |  |  |  |  |  |  |  | Patient Satisfaction | VAS |
| Zimmerman  |  ✓ | NRS |  |  |  |  |  |  |  |  |
| \*Not included in data analysis (due to incomplete data or unusable format) \*\*Not included in numerical meta-analysis result due to absence of SD, ADL – activities of daily living, ANP = Anesthesiological Questionnaire for patients after anesthesia HR – heart rate, ICU – intensive care unit, MABP – mean arterial blood pressure, NRS – numerical rating scale, PANAS – positive and negative affect schedule, PPI – present pain intensity, PRI – pain-rated index, PSD - pain, sensation and distress, STAI – state trait anxiety inventory. SAI state anxiety inventory, TAI trait anxiety inventory. UCLA - University of California at Los Angeles universal pain assessment tool, VAS – visual analogue scale. |

**Table 3. Study quality**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Study** | **Method of Randomisation** | **Allocation Concealment** | **Blinding of Participants** | **Blinding of Investigators** | **Blinding of Outcome Assessment** |
| Agwu & Okoye 2006 | Even/Odd wrapped numbers | Not Stated | 🗶 | Not Stated | Not Stated |
| Allred 2010 | Sealed Envelope System | ✓ | 🗶 | Not Stated | Not Stated |
| Andrada 2004 | Coin Toss | 🗶 | 🗶 | 🗶 | Not Stated |
| Angioli et al 2013 | Computer Generated | Not Stated | 🗶 | 🗶 | Not Stated |
| Argstatter et al 2006 | Permuted Block randomization | Not Stated | 🗶 | 🗶 | Not Stated |
| Ayoub 2005 | Not stated  | 🗶 | 🗶 | 🗶 | ✓ |
| Bally 2003 | Randomly generated group numbers | ✓ | 🗶 | Not Stated | Not Stated |
| Barnason 1995 | Drawing Lots | Not Stated | 🗶 | Not Stated | Not Stated |
| Bechtold 2006 | Opaque envelopes music/no music | ✓ | ✓ | 🗶 | 🗶 |
| Binns-Turner et al 2011 | Drawing numbers from bag | Not Stated | 🗶 | ✓ | ✓ |
| Blankfield et al 1995 | Not stated | Not Stated | ✓ | ✓ | Not Stated |
| Chan 2003 | Computer generated | ✓ | 🗶 | 🗶 | Not Stated |
| Chan 2007 | Random digit randomizer | Not Stated | 🗶 | 🗶 | 🗶 |
| Chlan 2000 | Coin Toss | 🗶 | 🗶 | 🗶 | Not Stated |
| Colt 1999 | Random number tables | ✓ | ✓ | ✓ | ✓ |
| Costa et al 2010 | Computer Generated | ✓ | 🗶 | ✓ | ✓ |
| Cutshall 2011 | Randomized using blocks | ✓ | 🗶 | Not Stated | Not Stated |
| Danhauer 2007 | Random assignment slip | Not Stated | 🗶 | Not Stated | Not Stated |
| Ebneshahidi 2008 | Not stated | Not Stated | 🗶 | Not stated | Not Stated |
| Fredriksson 2009 | Random envelopes | Not Stated | 🗶 | Not Stated | Not Stated |
| Ghetti 2011 | Random number table | Not Stated | 🗶 | ✓ | Not Stated |
| Good 1995 | Not stated | Not Stated | 🗶 | Not Stated | Not Stated |
| Good 1999 | Computer Generated | Not Stated | 🗶 | 🗶 | Not Stated |
| Gravesen 2013 | Random envelope | 🗶 | 🗶 | 🗶 | Not Stated |
| Guerrero 2011 | Random number tables | ✓ | 🗶 | Not Stated | Not Stated |
| Harikumar et al 2006 | Computer generated | Not Stated | 🗶 | ✓ | Not Stated |
| Hook et al 2008 | Random envelopes | Not Stated | 🗶 | Not Stated | Not Stated |
| Iblher 2011 | Drawing Lots | Not Stated | 🗶 | 🗶 | 🗶 |
| Ikonomidou 2004 | Not stated | ✓ | 🗶 | ✓ | Not Stated |
| Jafari 2012 | Not stated | Not Stated | 🗶 | 🗶 | ✓ |
| Jimenez 2013 | Computer generated | Not Stated | 🗶 | 🗶 | Not Stated |
| Johnson 2012 | Not stated | Not Stated | 🗶 | Not Stated | Not Stated |
| Kliempt 1999 | Computer generated | ✓ | ✓ | ✓ | ✓ |
| Lee et al 2002 | Computer generated | Not Stated | 🗶 | ✓ | Not Stated |
| Lepage et al 2001 | Not stated | Not Stated | 🗶 | 🗶 | Not Stated |
| Li 2012 | Computer generated | 🗶 | 🗶 | 🗶 | 🗶 |
| Maeyama 2009 | Not Stated | Not Stated | 🗶 | 🗶 | Not Stated |
| McCaffrey 2006 | By room availability  | ✓ | 🗶 | 🗶 | Not Stated |
| Migneault 2004 | Not stated | Not Stated | ✓ | ✓ | Not Stated |
| Mullooly 1988 | Not stated | Not Stated | 🗶 | Not Stated | Not Stated |
| Nilsson 2001 | Computer generated | Not Stated | ✓ | Not Stated | Not Stated |
| Nilsson 2003a | Computer generated | 🗶 | 🗶 | 🗶 | Not Stated |
| Nilsson 2003b | Computer generated | Not Stated | ✓ | Not Stated | Not stated |
| Nilsson 2005 | Computer generated | Not Stated | ✓ | ✓ | Not Stated |
| Nilsson 2009a | Computer generated | 🗶 | 🗶 | 🗶 | Not Stated |
| Nilsson 2009b | Computer generated | Not Stated | 🗶 | ✓ | ✓ |
| Nilsson 2009c | Computer generated | Not Stated | 🗶 | ✓ | ✓ |
| Nilsson 2012 | Computer generated | Not Stated | 🗶 | Not Stated | Not Stated |
| Ovayolu 2006 | Computer generate random numbers | 🗶 | 🗶 | 🗶 | Not Stated |
| Palakanis 1994 | Coin Toss | Not Stated | 🗶 | Not Stated | Not Stated |
| Reza et al 2007 | Computer generated | ✓ | ✓ | ✓ | ✓ |
| Salmore 1999 | Not stated | Not Stated | 🗶 | 🗶 | Not Stated |
| Sen et al 2009 | Computer generated | Not Stated | 🗶 | 🗶 | Not Stated |
| Sen 2010  | Computer generated | Not Stated | 🗶 | 🗶 | Not Stated |
| Sendelbach 2006 | Coin Toss | Not Stated | 🗶 | Not Stated | Not Stated |
| Shabanloei 2010 | Random number table | Not Stated | 🗶 | 🗶 | Not Stated |
| Simcock 2008 | Sealed envelopes | ✓ | ✓ | ✓ | Not Stated |
| Smolen 2002 | Not stated | 🗶 | 🗶 | 🗶 | Not Stated |
| Szmuk 2008 | Not stated | ✓ | ✓ | ✓ | Not Stated |
| Taylor-Piliae 2002 | Drawing slip of paper | Not Stated | 🗶 | 🗶 | 🗶 |
| Triller 2005 | Not stated | Not Stated | 🗶 | Not Stated | Not Stated |
| Tsivian 2011 | Adapted Coin Toss | 🗶 | 🗶 | 🗶 | Not Stated |
| Twiss 2006 | Drawing slip of paper | Not Stated | 🗶 | Not Stated | Not Stated |
| Vachiramon 2013 | Randomised number table | Not Stated | 🗶 | 🗶 | Not Stated |
| Voss 2004 | Varied block size | ✓ | 🗶 | 🗶 | Not Stated |
| Weeks & Nilsson 2011 | Sealed envelopes | ✓ | 🗶 | 🗶 | Not Stated |
| Wu, F 2013 | Concealed envelopes | ✓ | 🗶 | 🗶 | Not Stated |
| Wu, J 2012 | Computer generated | ✓ | 🗶 | 🗶 | ✓ |
| Xiao-Mei 2011 | Computer generated | Not Stated | 🗶 | Not Stated | 🗶 |
| Yeo 2012 | Block randomized | 🗶 | 🗶 | Not Stated | Not Stated |
| Zengin 2013 | Computer generated | Not Stated | 🗶 | Not Stated | Not Stated |
| Zhang 2005 | Computer generated | Not Stated | ✓ | Not Stated | Not Stated |
| Zimmerman 1996 | Not stated | Not Stated | 🗶 | Not Stated | Not Stated |

# Web Appendix figures

**Figure W1 Search strategy** 3

**Figure W2 Forest plot of patient satisfaction** 3

**Figure W3. Pain at zero to four hours vs four or more hours postoperatively subgroup analysis** 4

**Figure W4. Patient choice of music subgroup analysis using pain outcomes** 5

**Figure W5. Patient choice of music subgroup analysis using analgesia use outcomes** 6

**Figure W6. Patient choice of music subgroup analysis using anxiety outcomes** 7

**Figure W7. Timing of music subgroup analysis using pain outcomes** 8

**Figure W8. Timing of music subgroup analysis using analgesia use outcomes** 9

**Figure W9. Timing of music subgroup analysis using anxiety outcomes** 10

**Figure W10. General anaesthesia vs none subgroup analysis using pain outcomes** 11

**Figure W11. General anaesthesia vs none subgroup analysis using analgesia use outcomes** 12

**Figure W12. General anaesthesia vs none subgroup analysis using anxiety outcomes** 13

References to included studies p15

**Figure W1. Search Strategy**

1. Music Therapy/ or Music/

2. surg\*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]

3. operat\*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]

4. recovery.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]

5. recuperation.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]

6. rehabilitation.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]

7. convalescence.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]

8. post-op\*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]

9. 2 or 3 or 4 or 5 or 6 or 7 or 8 10. 1 and 9

**Figure W2 Forest plot of length of stay**



**Figure W3 Forest plot of patient satisfaction**



**Figure W4. Pain at zero to four hours vs four or more hours postoperatively subgroup analysis**



**Figure W5. Patient choice of music subgroup analysis using pain outcomes**



**Figure W6. Patient choice of music subgroup analysis using analgesia use outcomes**



**Figure W7. Patient choice of music subgroup analysis using anxiety outcomes**



**Figure W8. Timing of music subgroup analysis using pain outcomes**



**Figure W9. Timing of music subgroup analysis using analgesia use outcomes**



**Figure W10. Timing of music subgroup analysis using anxiety outcomes**



**Figure W11. General anaesthesia vs none subgroup analysis using pain outcomes**



**Figure W12. General anaesthesia vs none subgroup analysis using analgesia use outcomes**



**Figure W13. General anaesthesia vs none subgroup analysis using anxiety outcomes**



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