7

Nonpharmacological techniques

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7.0 | Nonpharmacological techniques

7.1 | Psychological interventions

The role of psychological interventions in the management of acute pain is usually as adjunctive therapies to traditional pharmacological and physical treatment modalities; there is increasing evidence for their role in pre-emptive and multimodal acute pain therapy as well as in reducing the risk of chronic postsurgical pain (CPSP) (Horn 2020 **NR**).

By their very nature, psychological interventions share several common features. Some of these features may also apply to effective pharmacological and physical interventions. Typically, the treatment provider is encouraged to firstly establish a degree of rapport or acceptance with the patient as well as give some information about the purpose and nature of the intervention and reasonable expectations the patient should hold for their outcome. These aspects may be seen as necessary to gain both the informed consent of the patient for treatment, as well as their active cooperation.

Psychological interventions may be divided into four broad categories:

- Information provision (procedural information, description of expected sensory experience or behavioural instructions) (see also Section 3.1.1);
- Stress or tension reduction (relaxation and hypnotic strategies);
- Attentional strategies;
- Cognitive-behavioural interventions.

It should be emphasised that these are rarely 'stand-alone' interventions and elements of each may form a single intervention package.

Similar to physical therapies, a lack of clinician blinding and questions as to what constitutes an adequate psychology placebo arm in an RCT, as well as heterogeneous interventions, limit the strength of conclusions (Guidi 2018 **NR**). In the Cochrane meta-analysis presented below, almost all RCTs were ranked at high risk of performance bias due to lack of clinician blinding (Powell 2016 **Level I** [Cochrane], 105 RCTs, n=10,302).

When pooled for all pre-procedural psychological interventions in a range of surgery types (including cardiothoracic 10 RCTs and coronary artery bypass surgery [CABG] 17 RCTs) and procedures, there is a small reduction in postoperative pain scores (SMD -0.2; 95%CI -0.35 to -0.06) (38 RCTs, n=2,713), length of stay (LOS) (MD -0.52 d; 95%CI -0.82 to -0.22) (36 RCTs, n=3,313) and reduction in negative affect (SMD -0.35; 95%CI -0.54 to -0.16) (31 RCTs, n=2,496) (Powell 2016 **Level I** [Cochrane], 105 RCTs, n=10,302). However, multiple pooled psychological interventions for acute pain after open heart surgery do not reduce postoperative pain intensity or PCA usage but do slightly reduce postoperative mental distress over the short and longer term in RCTs of low quality (Ziehm 2017 **Level I** [Cochrane], 23 RCTs, n=2,669) (5 RCTs overlap).

For paediatric specific information, see 10.7.5 and 10.11.1.

7.1.1 | Provision of information

7.1.1.1 | Procedural information

Procedural information is information given to a patient before any treatment that summarises what will happen during that treatment. Here, four information factors were each associated with global evaluations of care by patients: surgical information, recovery information, general information and sensory information (Krupat 2000 **Level IV**, n=3,602). Procedural information (often combined with behavioural instructions, like exercises or body positions) effectively reduces reported pain in 3 of 7 RCTs and pain medications in 7 of 12 RCTs (Johnston 1993 **Level I**, 38 RCTs, n=1,734).

In orthopaedic surgery, patient education regarding the procedure or recovery provided a small improvement in post-operative pain (SMD -0.21; 95%CI -0.02 to -0.39) (12 RCTs, n=1,242), pre-operative anxiety (SMD -0.27; 95%CI -0.10 to -0.44) (12 RCTs, n=1,260) and post-operative anxiety (SMD -0.26; 95%CI -0.08 to -0.43) (11 RCTs, n=921), but had no impact on analgesic use (10 RCTs, n=860) (Szeverenyi 2018 **Level I** [PRISMA], 62 RCTs, n=4,908).

7.1.1.2 | Sensory information

Sensory information is information that describes the sensory experiences the patient may expect during treatment. Sensory information given alone has some positive, albeit inconsistent, effects vs no instruction (Suls 1989 **Level III-3 SR**, 21 studies, n unspecified). With all but two studies involving adults, sensory information reduced self-rated pain more than procedural information; however, the effect sizes were variable. In contrast, a subsequent meta-analysis shows a beneficial effect on pain in three RCTs and shows a reduction in the use of pain medication in two of five RCTs (Johnston 1993 **Level I**, 38 RCTs [7 RCTs sensory information], n=1,734). A subsequent RCT found sensory only information had no significant effect on postoperative pain perception (Campbell 1999 **Level II**, n=63, JS 2).

7.1.1.3 | Combine sensory-procedural preparatory information

Combined sensory-procedural preparatory information, when compared to procedural information and sensory information given alone, yielded the strongest and most consistent benefits in reducing negative affect, pain reports and other related distress (Suls 1989 **Level III-3 SR**, 21 studies, n unspecified). However, many studies relate to medical procedures such as pelvic examination or to experimental pain. Subsequent systematic reviews are consistent with these findings (Johnston 1993 **Level I**, 38 RCTs, n=1,734; Devine 1992 **Level IV SR**, 191 studies, n unspecified). Interventions investigated include the provision of information about medical procedures and associated emotional responses and sensations before, during and after surgery, and instructions about how to adhere to medical advice to support the recovery, with teaching or instructing patients in different relaxation techniques or helping patients to understand their thoughts and feelings that influence their behaviour.

In some patients, especially those with an avoidant coping style, giving too much information or asking them to make too many decisions may exacerbate anxiety and pain (Wilson 1981 **Level II**, n=70, JS 2). However, later evidence suggested that this may not be a strong effect (Miro 1999 **Level II**, n=92, JS 3). Nevertheless, it may be useful to assess a patient's normal approach to managing stress to identify the best option for that patient. This concept is supported by the finding in patients undergoing colposcopy where stress related to the procedure was reduced when information was tailored to individual coping styles (Kola 2013 **Level II**, n=117, JS 2).

See also Section 3.1.1 on patient education.

7.1.2 | Relaxation techniques

Relaxation training usually involves teaching a patient ways to reduce their feelings of stress and/or arousal. Techniques used may be taught by audio recording or written or spoken instructions. The use of audio recording often includes the use of calming music or suitable imagery (mental pictures of relaxing scenes). Typically, all methods require the patient to practise the technique regularly, especially when feeling stressed. Some methods focus on altering muscle tension, often sequentially, while others focus on altering breathing patterns (eg emphasising releasing tension with exhalation). Relaxation techniques are closely related to, and often indistinguishable from, forms of meditation and self-hypnosis.

A systematic review of relaxation techniques, when used alone for the management of pain after surgery and during procedures, concluded that there was weak evidence to support the use of relaxation in these settings; three of the 7 RCTs reported significant reductions in pain and distress (Seers 1998 **Level I**, 7 RCTs, n=362). Methodological shortcomings of the included RCTs meant that a meta-analysis was not possible, limiting the strength of the findings. Similar conclusions were made in another systematic review, which found that 8 of 15 RCTs (again, most had weaknesses in methodology) demonstrated reductions in pain (Kwekkeboom 2006 **Level I**, 15 RCTs, n=1,269); the most supported methods were progressive muscle relaxation for arthritis pain and a systematic relaxation technique for postoperative pain. Little evidence was found for autogenic training (another relaxation technique), and no support for rhythmic breathing or other relaxation techniques. Another review of studies using relaxation techniques for burns pain also found insufficient high-quality evidence to draw any conclusions but did recommend further research into the use of a technique that combined focusing on breathing and jaw muscle relaxation (de Jong 2006, **Level III-3 SR**, 11 studies, n=1,541) (1 RCT overlap). The most recent meta-analysis found a reduction in post-operative pain (SMD -0.45; 95%CI -0.11 to -0.79) (9 RCTs, n=473) but no effect on analgesic consumption (SMD -0.36; 95%CI 0.25 to -0.98) (7 RCTs, n=183) (Szeverenyi 2018 **Level I** [PRISMA], 62 RCTs, n=4,908) (0 to 1 RCT overlap).

In patients with acute whiplash associated disorder, physiotherapy directed exercises and education combined with stress inoculation training (comprising relaxation training, guidance on problem solving strategies, and their application to stressful situations) reduced pain-related disability vs exercise alone at 6 wk, 6 mth and 12 mth (Sterling 2019 **Level II**, n=108, JS 3).

Studies of relaxation techniques with cancer patients (in acute pain) provide moderately strong support for its effectiveness in improving pain, but also nausea, pulse rate and blood pressure, as well as emotional adjustment variables (depression, anxiety and hostility) (Luebbert 2001 **Level I**, 15 RCTs, n=742).

7.1.3 | Mindfulness-based interventions (MBI)

Mindfulness meditation is a type of attentional technique that includes attending to pain sensations. It has much in common with breathing-based relaxation techniques. This approach encourages the patient to deliberately experience their pain in a calm manner just like any nonpainful sensation (ie without judging it as good or bad), often while engaging in slowed breathing styles (Kabat-Zinn 2003 **NR**). This approach derives from ancient Buddhist methods. Mindfulness-based approaches have been used to promote adjustment in people experiencing chronic pain, often in conjunction with a form of cognitive-behavioural therapy (CBT) called acceptance and commitment therapy (ACT) (McCracken 2007 **Level IV**, n=105).

MBI/ACT for experimental pain vs other emotion-regulation techniques are superior for pain tolerance (except for distraction) but not for pain intensity (Kohl 2012 **Level I EH** [PRISMA], 30 RCTs, n=2,085). Two subsequent RCTs have provided slightly conflicting findings. In healthy participants undergoing experimental pain (electric shock), both acceptance methods and suppression were equally effective, and both were superior to a control condition in reducing pain and anxiety (Braams 2012 **Level II EH**, n=123, JS 3). In contrast, in healthy students, mindfulness was as ineffective as relaxation training in reducing experimental pain (with the cold-pressor test) (Sharpe 2013 **Level II EH**, n=140, JS 1).

Brief MBI in mostly healthy volunteers (including adult, some children & adolescent groups) or patients with chronic pain delivered by either audio/video recorder instruction or provider delivered instruction is of unclear effectiveness (McClintock 2019 **Level IV SR**, 18 RCTs & 2 studies, n=1,740). However, brief MBI delivered by a clinician and lasting more than 5 min may be more useful than shorter durations and virtual delivery. The single clinical RCT in acute pain included in this review compared brief MBI vs hypnotic suggestions vs psychosocial education in patients with pre-existing "*intolerable pain*" or "*inadequate pain control*" and found both brief MBI and suggestion were superior to education for pain relief, anxiety and desire for opioids (Garland 2017 **Level II**, n=244, JS 3).

A pilot RCT in veterans after major orthopaedic surgery at high risk of CPSP (severe preoperative pain, moderate postoperative pain, depression or anxiety), found a 1 d ACT workshop vs standard care did not reduce time to cessation of pain (HR 1.42; 95%CI 0.68 to 2.95) or cessation of opioids (HR 1.62; 95% CI 0.82 to 3.21) (Dindo 2018, **Level II**, n=88, JS 3).

7.1.4 | Hypnosis

Hypnosis shares many features of relaxation with imagery and has a long history of use in acute pain conditions. Techniques vary but they have the common feature of one person responding to suggestions made by another regarding experiences involving changes in perception, memory and voluntary actions (Kihlstrom 1985 **NR**). The variable nature of hypnotic procedures has made it difficult to compare studies or draw general conclusions (Ellis 1994 **NR**) although some more standardised (according to a manual) procedures have been reported (Liossi 2003 **Level II**, n=80, JS 2).

Preoperative hypnosis was investigated as one of several methods to reduce postoperative pain in surgical patients; there is no effect on postoperative pain but partial support for improvements in psychological wellbeing measures (Nelson 2013 **Level III-1 SR**, 4 studies [hypnosis], n=144). Another meta-analysis looking at women having breast cancer surgery found preoperative hypnosis does not reduce postoperative pain but reduces perioperative distress (Holger 2012 **Level I**, 4 RCTs, n=550). However, a subsequent meta-analysis found that live and recorded hypnosis both reduce anxiety and live hypnosis reduces pain scores (SMD -0.51; 95%CI -0.06 to -0.96) (8 RCTs, n=669) but both have no effect on analgesic use; while therapeutic suggestion has no effect on anxiety, pain scores or analgesic use (Kekecs 2014 **Level I**, 26 RCTs, n=1,890) (2 RCTs overlap).

Note: reversal of conclusion
This reverses the Level I key message in the previous edition of this document; a preceding meta-analysis had described no effect of hypnosis on postoperative pain scores.

For labour, hypnosis (eight antenatal and one intrapartum intervention) may reduce pharmacological analgesic use (RR 0.73; 95% CI 0.57 to 0.94) (8 RCTs, n=2,916) but has no effect on rate of spontaneous vaginal birth (6 RCTs, n=2,361), sense of coping with labour (1 RCT, n=420) or satisfaction with pain relief when combined with either pethidine (1 RCT, n=72) or epidural analgesia (1 RCT, n=127) (Madden 2016 **Level I** [Cochrane], 9 RCTs, n=2,954).

Note: reversal of conclusion
This reverses the Level I key message in the previous edition of this document; a preceding meta-analysis had described no effect of hypnosis in the management of labour pain.

A reduction is seen with hypnosis in a small majority of study measurements during procedural pain in paediatric and adult patients vs standard care, attention control or other active treatments (Kendrick 2016 **Level I** [PRISMA], 29 RCTs, n=2,202).

Hypnosis vs control for needle-related procedural pain in children reduces pain scores (SMD -1.4; 95%CI -2.32 to -0.48) (5 RCTs n=176), distress scores (SMD -2.53; 95%CI -3.93 to -1.12) (5 RCTs, n=176) and behavioural measures of distress (SMD -1.15; 95%CI -1.76 to -0.53) (6 RCTs, n=193) (Birnie 2018 **Level I** [Cochrane], 59 RCTs, n=5,550) (6 RCT overlap). Analgesic benefits of hypnosis are confirmed in children undergoing cancer-related procedures (Tome-Pires 2012 **Level I**, 10 RCTs [procedural pain], n=394) (5 RCTs overlap). See also Section 10.7.5.

7.1.5 | Attentional techniques

A range of attention-based strategies have been reported, from those involving distraction from the pain through shifting attention to cognitive tasks, imagined stimuli or external stimuli (such as audio, video, tactile sensations, smells or a combination) (Bascour-Sandoval 2019 **NR**). Use of distraction (video, toys, music or stories) is effective in infants, young children and adolescents across a range of procedures eg needle-related pain (Birnie 2018 **Level I** [Cochrane], 59 RCTs, n=5,550; Birnie 2015 **Level III-1 SR**, 22 studies, n=1,717 [10 RCTs overlap]; Pillai Riddell 2015 **Level III-1 SR**, 10 studies, n=1,259 [0 RCT overlap]). See also paediatric sections for vaccine injection (10.7.3.4) and other procedural pain (10.7.5) including that related to paediatric cancer (10.8.2) and burns (10.9.2).

Some techniques also involve deliberately attending to the pain (or pain site) but in ways intended to modify the threat value of pain rather than to divert attention from pain. There is some evidence that this method can alter pain perception but possibly mainly among subgroups of patients (Haythornthwaite 2001 **Level II**, n=42, JS 1; Logan 1995 **Level III-2**; Baron 1993 **NR**).

Attempting to alter the patient's emotional state, from distress or fear to relative comfort or peace, is also a common feature of many of these techniques. Commonly, these techniques are used in conjunction with relaxation methods and at times may be inseparable (Williams 1996 **NR**).

Patients may exhibit pre-existing attention bias which prioritises painful sensations or pain-related experiences over other sensory experiences which may be amenable to attention bias modification); however, results are equivocal, especially when used in isolation (Van Ryckeghem 2019 **Level IV SR EH**, 52 studies, n=4,466).

7.1.5.1 | Music

Music therapy may be either active or passive: active therapy is when the patient participates in creating sounds; in passive music therapy, the patient listens to recorded or live music. When played by medical staff or with music therapists, music reduces acute or procedural pain (MD -1.11/10; 95%CI -1.45 to -0.77) (67 RCTs, n=5,679) with other beneficial effects in terms of emotional distress, anaesthetic use, opioid use, non-opioid use, heart rate, blood pressure and respiratory rate (Lee 2016 **Level I**, 97 RCTs, n=9,184). Patient, rather than clinician or researcher selected music, may be most effective (Lunde 2019 **NR**). In two subsequent RCTs, patient selected music was of benefit during shockwave lithotripsy (Cakmak 2017 **Level II**, n=200, JS 3), but Mozart's Symphony No. 40 played during colposcopy provided no benefit (Hilal 2018, **Level II**, n=215, JS 3).

Similarly, music reduces pain in cancer patients (SMD -0.59; 95%CI -0.92 to -0.27) (Bradt 2011 **Level I** [Cochrane], 30 RCTs, n=1,891). In burns patients, music interventions are helpful for pain alleviation, anxiety relief and heart rate reduction (Li 2017c **Level I** [PRISMA], 17 RCTs, n=804).

In children, music is effective during dental procedures (see 10.7.2.7), heel lance (see 10.7.1.1), burns dressing changes (see 10.7.2.9), vaccination (see 10.7.5) and general procedural pain (see 10.7.3.4).

7.1.5.2 | Virtual reality

Virtual reality (VR) has led to reductions in pain unpleasantness and pain-related brain activity in volunteers using thermal pain stimulation and measuring pain-related brain activity with functional magnetic resonance imaging (fMRI): where both opioids and immersive VR reduced pain and the combination was more effective than opioid alone (Honzel 2019 **NR)**.

VR may be effective at reducing procedural pain eg for needles and burns dressing changes vs usual care (SMD -0.49; 95%CI -0.83 to -0.41) (Chan 2018 **Level III-2 SR** [PRISMA], 9 RCTs & 7 crossover studies, n=656). However, studies were heterogeneous and inherently unblinded.

In burns patients, VR reduces pain intensity, time spent thinking about pain and unpleasantness (Luo 2019b **Level I** [PRISMA], 13 RCTs, n=362; Scheffler 2018 **Level I** [PRISMA], 21 RCTs, n=660) (4 RCTs overlap).

See 8.5.5 for more information on VR use in burns pain and 10.7.5 on VR use in the paediatric population.

7.1.5.3 | Smell

Olfaction can induce analgesia and emotional changes in both humans and animals and may play a role in pain therapy (Lotsch 2016 **NR**).

See 4.14.3 and 8.5.5 for effects of aromatherapy in adults and 10.11.1 in paediatric patients.

7.1.5.4 | Tactile sensations

See 10.7.3.4 for information on use of vibration in paediatric vaccine injection pain.

7.1.6 | Cognitive-behavioural interventions

Typically, cognitive-behavioural interventions involve the application of a range of behaviour-change principles, such as differential positive reinforcement of desired behaviours, identification and modification of unhelpful thoughts and goal setting, in order to achieve change in targeted behaviours. In the context of acute pain this would include encouraging the use of the techniques outlined above to modify the pain experience, reduce distress, and to provide alternative, more helpful responses.

Cognitive-behavioural methods focus on both overt behaviours and cognitions (thought processes) in patients, but interactions with environmental factors are also often addressed. This means that interactions between patients and others, especially medical and nursing staff as well as families, may need to be addressed to support the desired responses in the patient. The latter may entail displaying a calm and reassuring manner and encouragement to persevere with a given task or procedure. Specific training in skills (eg relaxation and other coping strategies), other behavioural techniques (eg modelling and systematic desensitisation), information provision and reconceptualisation of the experiences of the patient may also be provided as part of this approach (as outlined above).

Cognitive-behavioural interventions are usually aimed at reducing the distressing or threat value of pain and enhancing a patient's sense of his or her ability to cope with pain (pain self-efficacy). Effective coping with pain may be reflected in minimal pain-related distress (eg reduced catastrophising) or disability (interference in normal activities). If patients are able to perceive their pain as less threatening, they might also evaluate their pain as less severe. However, in this context, reduced severity would be seen more as a by-product than as the primary goal.

Critically, in using cognitive-behavioural methods, the patient must be an active participant in the process, rather than a passive recipient, as he or she must apply the methods taught as needed.

7.1.6.1 | Applying pain coping strategies within a cognitive-behavioural intervention

Generally, while some responses by patients to their pain may be helpful, others may not. For example, those who respond with overly alarmist (or catastrophic) thoughts tend to experience more pain and distress, vs those who do not respond in this way (eg Haythornthwaite 2001 **Level II**, n=42, JS 1; Sullivan 2001 **NR**; Jensen 1991 **NR**). Identifying unhelpful responses, whether they are cognitive or behavioural, and changing these responses is a common feature of many cognitive-behavioural interventions.

Catastrophic thinking has been associated with increased postsurgical acute pain, opioid use and reduced function (Darnall 2016 **NR**) as well as being a risk factor for development of persistent postsurgical pain (OR 1.55-2.10) (15 RCTs) (Theunissen 2012 **Level IV SR**, 29 studies, n=6,628). Thus, identifying and reducing catastrophic thoughts about pain has become a common intervention within this approach, whether the pain is acute or persistent. A single preoperative 130 min lecture session was effective at reducing pain catastrophisation (Darnall 2014 **Level III-2**, n=76). Before breast cancer surgery, delivery of virtual psychoeducation vs general health education reduced time to opioid cessation (5 d vs 13) (Darnall 2019 **Level II**, n=68, JS 3). However, attrition rates were higher in the psychoeducation group vs general education (44% vs 18%). For breast cancer surgery, patients who received stress management training (mainly relaxation and coping skills) had less depression and fatigue up to 3 mth post-surgery, but there were no differences for anxiety, pain and sleep problems vs a usual care control group (Garssen 2013 **Level II**, n=70, JS 3).

Perioperative CBT may improve pain and functional outcomes; however, heterogeneity of interventions (only in 1 of 6 RCTs delivered by psychologist), outcome measures and time frames limits firm conclusions (Nicholls 2018 **Level I** [PRISMA], 6 RCTs, n=578). A previous meta-analysis found that during preparation for surgery or painful medical procedures, training in cognitive coping methods and behavioural instructions in addition to relaxation training and procedural information, improves patients' pain measures and reduces postoperative use of analgesics (Johnston 1993 **Level I**, 38 RCTs, n=1,734). These interventions effectively improve measures of negative affect, LOS, and recovery.

It has also been recognised that a given coping strategy may not always be useful and that this may depend upon circumstances and timing (Turk 2002 **NR**). For example, ignoring or denying the presence of pain may be useful when first injured (to reduce distress) but, if it means that appropriate help is not sought, it could place the person in danger or at risk of treatment for complications being delayed.

Details on the psychological management of post-operative pain have been incorporated into guidelines (Chou 2016 **GL**).

For information on paediatric cognitive behavioural interventions for procedural pain see 10.7.5

7.1.6.2 | Complex psychosocial interventions

Increasingly, researchers are reporting the application of psychologically-based interventions in complex acute pain settings, especially in relation to work-related injuries and their management. Instead of employing a single technique (like relaxation), the researchers may employ strategies aimed at the patient's responses (eg distress and avoidance) as well as the responses of key environmental factors, such as in the workplace and in the family.

Injured workers identified within 5 to 15 d of injury as at risk for delayed recovery offered a comprehensive management plan (that included medical/physical treatments, brief CBT-based intervention by a psychologist, and workplace accommodations) had half the time off work (32 d vs 67 d) in the following 2 y vs the usual care recipients (Nicholas 2020 **Level III-2**, n=113). These results are consistent with those reported by a systematic review of interventions for return to work (Cullen 2018 **Level III-2 SR,** 36 studies**,** n≈195,722).

KEY MESSAGES

1. Preoperative psychological interventions may be effective at reducing pain, length of stay and negative affect after various procedures (**N**) (**Level I** [Cochrane Review]) but may not be effective after cardiac surgery (**N**) (**Level I** [Cochrane Review]).
2. Distraction (including with video, toys, music or stories) and hypnosis reduces needle related pain (**S**) and distress (**N**) in children and adolescents (**Level I** [Cochrane Review])
3. Hypnosis may reduce procedural pain and anxiety (**N**) (**Level I** [Cochrane Review]), postoperative pain (**R**) (**Level I**), postoperative anxiety (**N**) and analgesia consumption in labour (**R**) (**Level I** [Cochrane Review]).
4. Listening to music produces a small reduction in postoperative or procedural pain, analgesic requirements and emotional distress (**S**) (**Level I**); patient selected music may be more effective than clinician selected music (**N**) (**Level II**).
5. Patient education regarding the procedure or recovery may reduce postoperative pain (**Q**), preoperative anxiety (**N**) and postoperative anxiety (**N**) but does not affect analgesia use (**U**) (**Level I** [PRISMA]).
6. Training in coping methods or behavioural instruction prior to surgery reduces pain, negative affect and analgesic use (**U**) (**Level I**).
7. Relaxation techniques may reduce postoperative pain but do not reduce analgesic consumption (**S**) (**Level I**).
8. Immersive virtual reality distraction is effective in reducing pain (**S**) and anxiety (**N**) in some clinical situations (**Level III-2 SR** [PRISMA]).
9. In work injury-related acute pain, psychologically informed and workplace-oriented interventions may reduce time lost from work (**N**) (**Level III-2 SR**).

The following tick boxes represent conclusions based on clinical experience and expert opinion:

☑ Pain catastrophisation and anxiety negatively impact the postoperative experience and are risk factors for the development of chronic postsurgical pain and prolonged opioid use. Interventions aimed at reducing catastrophisation may be useful in improving patient outcomes, but retaining patient engagement with perioperative psychoeducation may also prove challenging (**N**).

☑ Preoperative psychoeducation may be cost effective from the perspective of reducing length of stay (**N**).

☑ The evidence that sensory and combined sensory-procedural information is effective in reducing procedure-related pain is equivocal and not sufficient to make recommendations (**U**).

☑ There is insufficient evidence to make a recommendation about the role of brief mindfulness-based interventions in acute pain (**N**).

7.2 | Transcutaneous electrical nerve stimulation

Transcutaneous electrical nerve stimulation (TENS) is the application of pulses of electrical current between two or more transcutaneous electrodes in order to stimulate cutaneous nerves. Unlike medications which only have dosage and route of administration as variables, TENS varies by anatomical location of electrodes, duration of usage, pulse amplitude, pulse frequency, pulse duration and pattern (eg burst, continuous or modulated). The variable ways in which TENS can be applied and lack of uniform reporting in studies makes pooling of results and interpretation of conflicting studies challenging. Furthermore, the blinding of such a physical intervention is difficult. Sham TENS varies in studies between a passive deactivated box connected to the patient where no stimulus is felt and devices which provide a short duration of therapeutic TENS. In a trial of inactive sham TENS vs 45 s transient sham TENS vs real TENS the investigators and patients were blinded 0% and 21% for inactive sham TENS, and 100% and 40% for transient sham TENS (Rakel 2010 **EH**). Thus, for the purposes of applying the Jadad score to studies we have not considered inactive TENS to be an adequate placebo.

TENS reduces acute pain (procedural and nonprocedural) vs no treatment (MD -19/100; 95%CI -27.3 to -10.8) (6 RCTs, n=413) and sham TENS (MD -24.6/100; 95%CI -31.79 to -17.46) (6 RCTs, n=376), with more participants achieving ≥50% reduction in pain vs sham TENS (RR 3.91; 95%CI 2.42 to 6.32) (4 RCTs, n=157) (Johnson 2015b **Level I** [Cochrane], 19 RCTs, n=1,346). These results are limited by a high risk of bias due to inadequate sample sizes in the trials and unsuccessful blinding including the use of non-TENS-naïve patients. Minor adverse effects reported were mild erythema, itching and participants disliking the TENS sensation (7 RCTs).

7.2.1 | Orthopaedic surgery

TENS vs placebo TENS reduces pain after total knee arthroplasty (TKA) at 12 h (SMD -0.26; 95%CI -0.44 to -0.08), 24 h (SMD -0.24; 95%CI -0.43 to -0.06) and 48 h (SMD -0.21; 95%CI -0.40 to -0.03) and opioid consumption at 12, 24, and 48 h (Li 2017b **Level I** [PRISMA], 5 RCTs, n=472). TENS also reduces the incidence of postoperative nausea by 9.8% and vomiting by 9.4%, but not the hospital LOS. The results are limited by small sample sizes in the trials; however, the quality of evidence is high. Repeated TENS provides long term pain reduction up to 6 mth postoperatively vs placebo TENS (2 RCTs, n=189) (Tedesco 2017 **Level I** [PRISMA], 39 RCTs, n=5,509). However, after anterior cruciate ligament repair, adding high-frequency transcutaneous TENS to exercise vs exercise alone did not improve pain and function in early rehabilitation (Forogh 2019 **Level II**, n=70, JS 4).

After rotator cuff repair TENS for four 45 min sessions/d for the first postoperative wk reduced pain at 12 h (3.1/10 ± 3.6 vs. 5.8/10 ± 4.4) and 1 wk (3.6/10 ± 2.1 vs. 5.8/10 ± 1.2) with less oxycodone 5 mg/paracetamol 325 mg requirements at 48 h (12.8 tablets ± 4.7 vs. 17.2 ± 6.3) and 7 d (25.2 tablets ± 10.0 vs. 33.8 ± 14.3) vs placebo TENS (Mahure 2017 **Level II**, n=37, JS 5).

Postoperative TENS applied to the surgical site for 15 min/d consecutively for 5 d after surgery did not reduce pain or analgesic use after Colles' Fracture vs placebo TENS (Lee 2015b **Level II**, n=36, JS 3).

7.2.2 | General and thoracic surgery

After thoracic surgery (thoracotomy or sternotomy), TENS reduces pain intensity vs sham TENS (thoracotomy -1.3/10; 95%CI -1.9 to -0.7; sternotomy -1.3/10; 95%CI -1.9 to -0.8) (Sbruzzi 2012

Level I [PRISMA], 11 RCTs, n=570). Subsequent RCT findings are consistent with these results (Sezen 2017 **Level II**, n=96, JS 1; Engen 2016 **Level II**, n=40, JS 3; Erden 2015 **Level II**, n=40, JS 1; Esteban Gonzalez 2015 **Level II**, n=50, JS 3). Although TENS was not more effective than a paravertebral (PVB) in relieving pain or reducing PCA usage following thoracotomy procedures, it had fewer adverse effects (Baki 2015 **Level II,** n=40, JS 1).

After liposuction, TENS vs placebo TENS reduced pain intensity (0/10 vs 4/10) and need for rescue analgesia at 6 h (95.2% vs. 47.6%) (da Silva 2015 **Level II**, n=42, JS 3).

After cessation of epidural analgesia following open colon resection, TENS reduced pain at 24 h post cessation (10/100 vs 23/100) vs placebo TENS, but no differences in quality of recovery or opioid use were found (Bjersa 2015 **Level II,** n=28, JS 5).

TENS (starting 1 h pre-operatively for inguinal hernia repair and ceased on induction) reduced pain at 2 h (3.5/10 ±1.5 vs 5.1/10 ±1.4) and 4 h (4.0/10 ±1.5 vs 4.8/10 ±1.4) and diclofenac use at 12 h (15.2% vs 39.4%), with no difference in other time points or anti-emetic use (Eidy 2016 **Level II**, n=66, JS 3).

7.2.3 | Procedural pain and prehospital analgesia

TENS reduced procedural pain (MD -2.7/10; 95%CI -1.6 to – 4.0) during carboxytherapy in patients with cellulite in the gluteal region vs placebo TENS (Sadala 2018 **Level II**, n=84, JS 1).

TENS used in the prehospital setting reduces pain intensity vs scores before TENS use (MD 38/100; 95%CI 28 to 44) and vs sham TENS (MD 33/100; 95%CI 21 to 44), as well as acute anxiety secondary to pain (Simpson 2014 **Level I** [PRISMA], 4 RCTs, n=261).

7.2.4 | Gynaecological surgery and obstetrics

In labour, TENS has no effect on pain, interventions or outcomes vs sham TENS (10 RCTs) or routine care (7 RCTs), when applied to the back (13 RCTs, n=1,150) or cranium (2 RCTs, n=140), with the exception of a reduction in reports of severe pain when applied to acupuncture points (2 RCTs, n=190) (Dowswell 2009 **Level I** [Cochrane], 17 RCTs, n=1,466). These findings of no analgesic effect are confirmed by two subsequent meta-analyses (Bedwell 2011 **Level I**, 14 RCTs, n=1,456 (14 RCTs overlap); Mello 2011 **Level I**, 9 RCTs, n=1,076 (3 RCTs overlap)).

Three subsequent RCTs not included in the above meta-analyses showed benefit from TENS in labour. A 30 min session of TENS over thoracic and sacrum area reduced immediate pain during the active phases of labour vs non-TENS control (Santana 2016 **Level II**, n =46, JS 3) or placebo TENS box (Baez-Suarez 2018 **Level II**, n =63, JS 3). TENS with varying high-frequency (80 to 100 Hz) was more effective than TENS of constant frequency (100 Hz) (Baez-Suarez 2018 **Level II**, n =63, JS 3). TENS produced sustained pain relief 4 h after the intervention and had shortened first-stage labour vs placebo or no TENS controls (Shahoei 2017 **Level II**, n=90, JS 1).

High-frequency TENS is effective in primary dysmenorrhoea (Proctor 2002 **Level I** [Cochrane], 7 RCTs, n=164). A subsequent systematic review did not add new information except for highlighting that quality of life is not reported in any RCT (Igwea 2016 **Level I**, 6 RCTs [TENS], n=247) (2 RCTs overlap). Subsequent RCTs reported similar results of daily TENS during menstrual bleeding; pain intensity, hours in pain and use of pain medications were reduced with inconsistent results on quality of life improvement vs placebo (Bai 2017 **Level II**, n=134, JS 3; Lauretti 2015 **Level II**, n=40, JS 3). TENS plus thermotherapy reduced period pain and duration in pain vs placebo TENS, without impact on analgesic use or quality of life (Lee 2015a **Level II**, n=115, JS 3).

7.2.5 | Migraine

TENS use in migraine reduces affected days/mth (SMD -0.5; 95%CI -0.7 to -0.2) and pharmacological treatment intake (SMD -0.8; 95%CI -1.1 to -0.4) (Tao 2018 **Level I** [PRISMA], 4 RCTs, n=161). Similarly, TENS over the supraorbital nerve (for 12 wk) reduced days in migraine and days using rescue medications among patients with refractory migraine and not responding to topiramate (Vikelis 2017 **Level IV**, n=35).

One 60 min TENS session reduced pain intensity of acute migraine attacks at one and 24 h after treatment by 50%, and two-thirds of the patients did not require rescue pain medication at 24 h (Chou 2017 **Level IV**, n=30).

7.2.6 | Musculoskeletal pain

One 30 min TENS session reduces acute low back pain in an emergency setting (MD – 28.0/100; 95%CI – 32.7 to −23.3) (1 RCT, n=63), whereas a course of TENS for 4-5 wk does not reduce sub-acute low back pain (MD −2.8/100; 95%CI −11.6 to 6.1) (2 RCTs, n=132) (Binny 2019 **Level I**, 3 RCTs, n=192). The evidence is limited by low quality and insufficient sample size.

One TENS session over shoulder myofascial trigger points increased pressure pain threshold and improved range of motion vs sham intervention (Takla 2018 **Level II**, n=70, JS 3). Burst-TENS was superior to medium-frequency, low intensity amplitude modulated frequency treatment.

7.2.7 | Neuropathic and phantom limb pain

In patients with herpes zoster, 10 to 15 TENS sessions reduced pain and incidence of PHN vs anti-viral agent alone and TENS/anti-viral agents (Stepanovic 2015 **Level II**, n=222, JS 1). However, the trial reporting quality is very low.

A systematic review of TENS in the treatment of phantom limb pain found no studies (Johnson 2015a **Level I** [Cochrane], 0 RCTs, n=0). However, a subsequent RCT found TENS vs mirror therapy equally effective at reducing pain scores from baseline (Barbin 2016 **Level I** [PRISMA], 1 RCT: Tilak 2016 **Level II**, n=25, JS 3).

KEY MESSAGES

1. Transcutaneous electrical nerve stimulation compared to sham reduces acute pain (procedural and nonprocedural) (**U**) (**Level I** [Cochrane Review]), including pain after thoracic surgery (**U**) (**Level I** [PRISMA), after total knee replacement (**N**) and in the prehospital setting (**N**) (**Level I** [PRISMA]).
2. High-frequency transcutaneous electrical nerve stimulation is effective in primary dysmenorrhoea (**U**) (**Level I** [Cochrane Review]).
3. Transcutaneous electrical nerve stimulation has no effect on pain, interventions or outcomes in labour with the exception of a reduction of reports of severe pain when applied to acupuncture points (**U**) (**Level I** [Cochrane Review]).
4. Transcutaneous electrical nerve stimulation used preventatively in migraine reduces attack frequency and medication use (**N**) (**Level I** [PRISMA])

7.3 | Acupuncture and acupressure

Acupuncture, originally a Chinese practice, involves inserting fine needles through the skin at specific points (acupoints) to cure disease or relieve pain. However, the term acupuncture is often interpreted broadly in many meta-analyses to incorporate all forms of acupoint stimulation including by electroacupuncture (EA: where a small electric current is passed between pairs of acupuncture needles), laser (laser acupuncture), pressure (acupressure), transcutaneous electrical acupoint stimulation (TEAS), chemical (capsicum plaster) or heat (moxibustion). Acupuncture needling or acupressure can be applied to the specific points on the ears and this form of technique is called auricular acupuncture (AA) or auriculotherapy. Even for traditional needle-based acupuncture angle, depth, location, rotation, duration and temperature of needles can all vary between studies.

A significant amount of the literature is published in the Chinese language; these references were excluded from this assessment in line with the agreed methodology, although many quoted meta-analyses incorporate Chinese language papers.

Similar to other physical therapies, blinding in acupuncture studies is difficult to achieve. Options such as non-penetrative needles (eg toothpicks) or using real acupuncture needles in non-acupoint locations might blind the patient, but do not blind the proceduralist and may be unintentionally therapeutic (Langevin 2011 **NR**). Furthermore, both experienced proceduralists and patients may expect to feel *De qi* (the Chinese expression for the sensation of tingling, heaviness and numbness associated with the needle application and rotation). Placebo acupuncture needles which look identical but retract to a short needle on use may also not fool proceduralists and, similar to using acupuncture in non-acupoint locations, might also be unintentionally therapeutic (Langevin 2011 **NR**). In one RCT, 68% of patients and 83% of proceduralists correctly guessed their allocation (vs an expected 50% if blinding was appropriate) (Vase 2015 **Level II**, n=67, JS 5). These blinding issues combined with extremely heterogeneous methods for heterogeneous conditions and often small sample sizes weaken the strength of recommendations from pooled results of these meta-analyses.

For paediatric specific acupuncture information see 10.11.2.

7.3.1 | Postoperative pain

The effect of acupuncture on postoperative pain has been examined in different surgical procedures, such as cardiac, abdominal, orthopaedic, gynaecological and obstetric surgery.

Overall, acupuncture (excluding AA), compared with sham controls reduces postoperative pain at 24 h (WMD -1.27/10; 95%CI -1.83 to -0.71) and opioid consumption at 24 h (SMD -0.72; 95%CI -1.21 to -0.22) (Wu 2016 **Level I**, 11 RCTs, n=682). A subgroup analysis found TEAS (5 RCTs, n=305) reduces both pain and opioid consumption, needle acupuncture (2 RCTs, n=165) reduces pain, but EA has no effect (4 RCTs, n=212).

In a prior meta-analysis (9 RCTs overlap), all forms of acupuncture (body or auricular points) reduce postoperative pain (at 24 h) vs both sham controls (SMD -0.72; 95% CI -1.03 to -0.41) (23 RCTs, n=1,284) and standard treatment (SMD -1.05; 95% CI -1.44 to -0.67) (20 RCTs, n=1,227) (Liu 2015a **Level I**, 59 RCTS, n=4,578). Opioid analgesia use decreases (ME −4.99mg; 95%CI −7.51 to −2.47) (6 RCTs, n=399) over an unspecified time period.

Similar findings were reported for a number of specific postoperative settings as outlined below.

7.3.1.1 | Abdominal and general surgery

After open abdominal surgeries (including Caesarean section, gynaecological and general surgical), acupuncture vs sham or no treatment reduces postoperative pain at rest (-7 to -13/100) (18 RCTs, n=1,088), and with movement (-4 to -26/100) (6 RCTs, n=436) at 4 to 48 h, and reduces opioid consumption at 24 h (WMD -9.17 mg; 95%CI -12.47 to - 5.87) (13 RCTs, n=806) (Zhu 2019 **Level I** [PRISMA], 35 RCTs, n=2,015). Pain scores are less at 4 h in patients who receive distal acupuncture vs peri-incisional acupuncture. However, reduction of opioids at 24 h is four times more in the peri-incisional acupuncture group than that in distal acupuncture group. Distal acupuncture reduces the incidence of post-operative nausea and dizziness; however, this data was not reported in the studies of peri-incisional acupuncture.

Haemorrhoidectomy

After haemorrhoidectomy, 30 min EA around the surgical site vs sham reduced pain intensity at 6 h, 24 h and during defecation, with no difference in eating, sleeping and anxiety (Wu 2018 **Level II**, n=72, JS 3).

Hernia repair

Combined pre-emptive acupuncture on body points and intraoperative acupuncture at the incision site for open inguinal hernia repair reduced postoperative pain intensity at 0.5 to 6 h postoperatively as well as PCA requirements and dizziness (Taghavi 2013 **Level II**, n=90, JS 1). Pre- and intraoperative EA resulted in a late reduction in pain scores at POD 4 and 7 only (Dias 2010 **Level II**, n=33, JS 5). For inguinal herniorrhaphy under spinal anaesthesia, preoperative acupuncture on body points enhanced intraoperative sedation and reduced postoperative pain intensity and opioid requirements (Parthasarathy 2009 **Level II**, n=50, JS 3). Preoperative and intra-operative EA had similar pain reduction and opioid sparing effect in inguinal hernia (mesh) repair under general anaesthesia (Dalamagka 2015, **Level II**, n=54, JS 2).

Laparoscopic Surgery

Intraoperative EA for laparoscopic cholecystectomy had no impact on pain, PCA use or PONV vs no acupuncture (El-Rakshy 2009 **Level II**, n=107, JS 5). However, one to two sessions of postoperative acupuncture reduced shoulder pain in patients with established shoulder pain after laparoscopic abdominal surgery (mostly cholecystectomy) (mean reduction 6.4/10 [SD 2.3]) (Kreindler 2014 **Level IV**, n=25).

Appendicectomy

Sustained acupressure with an 'acuband' after open appendicectomy was better than sham control in relieving postoperative pain (Adib-Hajbaghery 2013 **Level II**, n=70, JS 3).

7.3.1.2 | Orthopaedic surgery

Lumbar spinal surgery

Needle acupuncture after lumbar spinal surgery reduces pain at 24 h (SMD -0.67; 95%CI -1.04 to -0.31) (Cho 2015 **Level I** [PRISMA], 5 RCTs, n=480). In addition to PCA, postoperative AA and TEAS improved pain scores vs sham only, and reduced opioid use vs both sham and control groups (Chung 2014 **Level II**, n=135, JS 3). During the rehabilitation phase, EA in addition to standard medical and physiotherapy care, reduced disability at 2 mth postoperatively, but did not reduce pain or improve quality of life (Heo 2018 **Level II**, n=39, JS 3).

Total Knee Arthroplasty

Perioperative acupuncture for TKA reduces pain at POD 2 (WM -1.14/10; 95%CI −1.90 to −0.38) and delayed time to first PCA use (WMD 46 min; 95%CI 20.8 to 71.5) (Tedesco 2017 **Level I** [PRISMA], 3 RCTs, n=230), with no effect on opioid consumption within the first 48 h. Acupressure may improve range of motion vs sham controls (He 2013 **Level II**, n=90, JS 5; Chang 2012 **Level II**, n=68, JS 5). During the rehabilitation phase, acupuncture in addition to exercise was not better than exercise alone either in reducing pain or improving function at 3 mth post TKA (Petersen 2018 **Level II**, n=172, JS 3).

Total Hip Arthroplasty

Perioperative AA or acupressure continuing into the postoperative period reduces pain after THA at 12 h, 24 h, 48 h, 72 h, POD 5, POD 7 (1 to 6 RCTs) and intraoperative fentanyl use (SMD -0.73; 95%CI -1.09 to -0.36) (3 RCTs, n=250) (Ye 2019 **Level I**, 9 RCTs, n=605). There were no differences in the time to first analgesic request or PONV.

Shoulder Surgery

One session of postoperative acupuncture performed in PACU reduced pain after arthroscopic shoulder surgery on POD1 and improved sleep quality vs non-acupuncture control (Ward 2013 **Level III-1**, n=22).

7.3.1.3 | Cardiac & thoracic surgery

Cardiac surgery

For cardiac surgery, EA started 20 to 30 min prior to induction of GA may improve some perioperative outcomes, but has no impact on opioid requirements (Asmussen 2019 **Level I** [PRISMA], 7 RCTs, n=321).

Preoperative EA administered 12–18 h before cardiac surgery (including myocardial revascularisation and valve replacement) reduced postoperative pain intensity (2.5/10 ± 1.1 vs 4.0/10 ± 2.0) and PCA fentanyl use by 41% vs placebo (Coura 2011 **Level II**, n=22, JS 5). Postoperative acupressure reduced pain intensity after cardiac surgery via median sternotomy and improved lung function vs acupressure to nonspecific points or no acupressure control (Maimer 2013 **Level II**, n=100, JS 5). When acupuncture was repeated daily for 7 d, the benefit for pain and lung function accumulated and improved over time (Colak 2010 **Level II**, n=30, JS 3).

Thoracic surgery

Repeated postoperative EA (delivered distant to the surgery site over three days) reduced post-thoracic pain at 2, 24, 48 and 72 h and breakthrough pethidine consumption (9.2 mg ± 2.8 vs 11.5 mg ± 1.8) (Chen 2016 **Level II**, n=92, JS 3). EA also reduced nausea (21.7% vs 47.8%) but not vomiting. There was shortened time to first flatus (24.3 h ± 8.2 vs 35.7 h ± 7.76) and defaecation (42.7 h ± 13.9 vs 59.2 h ± 11.3) n=).

7.3.1.4 | Gynaecological and obstetric surgery

Hysterectomy

After open hysterectomy, EA improved postoperative analgesia over 24 h vs control and sham acupuncture (Lee 2011 **Level II**, n=47, JS 3). Postoperative auricular EA applied ≈24 h after open hysterectomy reduced pain at rest and on movement vs control and sham stimulation (Tsang 2011 **Level II**, n=48, JS 5).

EA during surgery under general anaesthesia provided no benefit vs no acupuncture for pain, PCA opioid use or PONV after open hysterectomy and laparoscopic cholecystectomy (El-Rakshy 2009 **Level II**, n=107, JS 5).

Oncological surgery

After open gynaecological surgery for malignancy, EA was superior to traditional acupuncture in relieving pain initially but not at 48 h (Gavronsky 2012 **Level II**, n=20, JS 1).

Laparoscopic gynaecological surgery

Auricular EA did not affect pain or opioid requirements after laparoscopic gynaecological surgery (Holzer 2011 **Level II**, n=40, JS 5); whereas EA to body points delivered 24 h prior to surgery or during surgery reduced pain and PONV (Li 2017d **Level II**, n=40, JS 3; Praveena Seevaunnamtum 2016 **Level II**, n=64, JS 3).

Oocyte retrieval

For oocyte retrieval, conscious sedation plus EA reduces procedural and postoperative pain more than sedation plus placebo, or sedation alone (Kwan 2018 **Level I** [Cochrane], 6 RCTs, n=1,159). However, a paracervical block achieves lower procedural pain scores than EA (4 RCTs, n=781).

Caesarean section

After Caesarean section, postoperative EA and acupuncture reduced pain scores and PCA requirements for up to 2 h (Wu 2009 **Level II**, n=60, JS 3).

7.3.1.5 | Ear, nose and throat surgery

For tonsillectomy, perioperative acupuncture vs sham or no therapy reduces pain for the first 48 h, postoperative analgesia requirements and PONV (Cho 2016 **Level I** [PRISMA], 12 RCTs, n=1,025 [11 RCTs in children & adolescents, 1 in adults]).

Battlefield auricular acupressure vs usual care reduces post-tonsillectomy pain in adults at discharge, with no effect on pain or opioid use at POD 10 (Plunkett 2018 **Level II**, n=95, JS 3).

7.3.1.6 | Neurosurgery

TEAS vs placebo reduces post craniotomy pain, PCA fentanyl use from 0 to 6 h and reduces dizziness and feelings of "a full head" up to 24 h (Tsaousi 2017 **Level I** [PRISMA], 2 RCTs [TEAS], n=176).

7.3.2 | Other acute pain states

7.3.2.1 | Emergency department and acute trauma setting

AA including acupressure improves pain relief vs control treatment for pain due to acute hip fracture (1 RCT), acute biliary colic (1 RCT) and acute burn and acute emergency conditions (SMD 1.35; 95%CI 0.08 to 2.64) (2 RCTs, n=111) (Asher 2010 **Level I** [PRISMA], 4 RCTs [acute pain], n=197). These findings were confirmed in a later meta-analysis which found AA vs sham or standard care reduces pain (WMD -2.6/10; 95%CI -2.00 to -3.22) but had a variable effect on analgesic use with only 1 of 3 studies reporting a difference (Jan 2017a **Level I** [PRISMA], 4 RCTs, n=281) (3 RCTs overlap). Adverse effects of AA were documented in only 2 studies in which minor pain was experienced in 2 patients. It takes about 2 to 10 min to apply the treatment at the cost of AU$7.50 per patient (Jan 2017b **Level I** [PRISMA], 4 RCTs, n=281).

Needle acupuncture on the body was faster (16 ± 8 min vs 28 ± 14 min) and more successful (92% vs 78%) at reducing pain by 50% with less nausea and vomiting vs IV morphine control (mean dose 0.17 mg/kg ± 0.08) (Grissa 2016 **Level II**, n=300 [46% abdominal pain, 54% musculoskeletal or other pain], JS 3). Similarly, for renal colic a 30 min acupuncture session vs titrated IV morphine achieved a 50% pain reduction faster (14 min vs 28), with far fewer patients experiencing side effects (acupuncture 3/54 vs morphine 42/61) (Beltaief 2018, **Level II**, n=115, JS 3). An RCT of acupuncture vs acupuncture/pharmacotherapy vs pharmacotherapy alone for back pain, ankle sprain and migraine found no difference between pain scores at 1 h or satisfaction at 1 h or 24 h (Cohen 2017 **Level II**, n=528, JS 3). The acupuncture alone group required more rescue analgesia vs the pharmacology alone and combination groups, with lower hospital admission rate in the combination group.

Acupuncture reduced pain (by 2.3/10) and nausea (by 1.2/6) in patients with acute pain vs retrospectively matched controls, with a high satisfaction rate (98%) (Zhang 2014 **Level III-3**, n=400 [59% musculoskeletal, 25% abdominal pain]). Acupuncture treatment provided before medical consultation reduced the staff time spent managing the patient vs acupuncture given after medical consultation.

Acupuncture vs sham reduced pain on movement in bed and cough after rib fracture but not pain on deep breathing (Ho 2014 **Level II**, n=58, JS 5). Acupressure reduced acute musculoskeletal pain due to sports injuries vs sham or no acupressure (Macznik 2017 **Level II**, n=79, JS 3).

In acute pain due to sports injury, athletes had significant pain reduction (4 to 8/10) after auricular acupuncture treatment (deWeber 2011 **Level IV**, n=8).

Acupressure performed during prehospital transport led to better pain relief vs sham acupressure after hip fracture (auricular) (Barker 2006 **Level II**, n=38, JS 5) and radial fracture (Lang 2007 **Level II**, n=32, JS 5), and after minor trauma vs sham and no acupressure (Kober 2002 **Level II**, n=60, JS 5).

7.3.2.2 | Acute back pain

Compared to sham acupuncture, one session of acupuncture reduces pain intensity (MD -9.38/100; 95%CI -17.00 to -1.76) (2 RCTs, n=100) but not function or disability in acute back pain (3 RCTs, n=148) (Lee 2013 **Level I** [PRISMA], 11 RCTs, n=1,139). Slightly more patients improved with acupuncture than NSAIDs (RR 1.11; 95%CI 1.06 to 1.16) (5 RCTs, n=662).

In a large well-designed RCT, five sessions of acupuncture over 14 d were added to conventional treatment for acute low-back pain (Vas 2012 **Level II**, n=275, JS 5). Acupuncture was more effective in reducing pain and analgesic use and improving work readiness vs conventional treatment alone; but there was little difference between real acupuncture, sham acupuncture (penetrating) and placebo acupuncture (nonpenetrating). One session of acupuncture with concurrent gentle exercise produced better analgesia for severely disabling acute low-back pain (Oswestry Disability Index [ODI] value ≥60%) than diclofenac (75 mg IM) (Shin 2013 **Level II**, n=58, JS 3). Patients in the acupuncture group had less pain at 30 min after treatment (MD 3.12/10; 95%CI 2.26 to 3.98), much improved function (decreased ODI by 33%; 95%CI 27 to 39) and fewer hospital admissions (66 vs 93%). The pain reduction was maintained at 2 wk and 4 wk follow-up.

Battlefield AA plus standard therapy has better pain reduction for acute low back pain in ED over standard care alone with no differences in functional recovery (Fox 2018 **Level II**, n=30, JS 3). Acupuncture with concurrent lumbar exercise has better sustained pain reduction in acute lumbar sprain than conventional acupuncture, sham intervention or TENS at 24 h (Lin 2016 **Level II**, n=60, JS 3). Similar results are shown in a cohort study (Liu 2015c **Level III-2**, n=74).

Acupuncture plus spinal manipulation has similar pain reduction in sub-acute low back pain vs acupuncture alone or spinal manipulation alone (Kizhakkeveettil 2017 **Level II**, n=101, JS 3).

7.3.2.3 | Labour and post-partum pain

With regard to use of acupuncture in labour (Smith 2020 **Level I** [Cochrane], 28 RCTs, n=3,960):

- Acupuncture vs sham does not reduce pain scores (2 RCTs, n=325), but does increase satisfaction with pain relief (RR 2.38; 95%CI 1.78 to 3.19) (1 RCT, n=150) and decrease use of pharmacological analgesia (RR 0.75; 95%CI 0.63 to 0.89);
- Acupuncture vs usual care reduces pain scores (4 RCTs, n=495) and use of pharmacological analgesia (6 RCTs, n=1,059) but does not improve satisfaction (2 RCTs, n=343).
- Acupuncture vs no treatment reduces pain scores (1 RCT, n=163);
- Acupuncture vs water injection did not reduce use of pharmacological analgesia (1 RCT, n=128);
- Acupressure vs sham lowered VAS (MD -1.93/10; 95%CI -3.31 to -0.55) but had no effect on use of pharmacological analgesia (6 RCTs, n=472);
- Acupressure vs usual care reduced VAS (SD -1.07; 95%CI -1.45 to -0.69) (8 RCTs, n=620) and improved satisfaction (1 RCT, n=105);
- Acupressure vs both placebo and usual care reduced VAS (-0.42 SD; 95%CI -0.65 to -0.18) (2 RCTs, n=322) and marginally increased satisfaction with analgesia (1 RCT, n=212).

There was no effect on Caesarean section rate for all interventions. No study was at a low risk of bias on all domains.

Note: reversal of conclusion
This reverses the Level I key message in the previous edition of this document; a preceding meta-analysis had described a reduction of Caesarean section rate by use of acupuncture.

A critical review (Levett 2014 **NR**) of the previous iteration of this and another meta-analysis (Cho 2010 **Level I**, [PRISMA], 10 RCTs, n=2,038) suggests that these meta-analyses may compare very different approaches in very different settings, in particular by comparing trials of efficacy with trials of effectiveness.

TEAS provided inferior analgesia in labour vs epidural (SMD -53.00/100; 95%CI -58 to -48) or tramadol/ondansetron PCA but was superior to placebo (Anim-Somuah 2018 **Level I** [Cochrane], 1 RCT: Liu 2015b **Level II**, n=120, JS 3).

Patients with mastitis are less likely to have severe symptoms 5 d after acupuncture in 1 of 2 RCTs (Mangesi 2016 **Level I** [Cochrane], 2 RCTs, n=293).

Auricular acupressure (by taping seeds to the ear) did not reduce acute postpartum perineal pain in women with 1st or 2nd degree tears or episiotomies (Kwan 2014 **Level II**, n=266, JS 3) contrasting with a previous study where wrist-ankle needle acupuncture for perineal pain after episiotomy reduced requirements for rescue analgesia vs controls (Marra 2011 **Level III-1**, n=42) (See also section 9.1.3.5).

7.3.2.4 | Dysmenorrhoea

Acupuncture may reduce pain in primary dysmenorrhoea vs NSAIDs (14 RCTs, n=850) or no-acupuncture controls (6 RCTs, n=384), but not vs sham or placebo controls (6 RCTs, n=477); whereas acupressure reduces pain vs sham or placebo control (5 RCTs, n=538), but not vs NSAIDs (1 RCT, n=136) or no treatment (2 RCTs, n=140) (Smith 2016 **Level I** [Cochrane], 42 RCTs, n=4,640). Only one of the 42 RCTs was considered of low risk of bias in all domains and generally data was unsuitable for pooling due to heterogeneity.

A subsequent network meta-analysis found acupuncture may be more effective than NSAIDs in reducing the risk of pain episodes of primary dysmenorrhoea, with EA being the most effective (Luo 2019a **Level I** [NMA], 17 RCTs, n=1,511). Another systematic review found EA more effective than needle acupuncture or NSAIDs (Woo 2018 **Level I** [PRISMA], 60 RCTs, n=5,901) (6 RCT overlap). While, another meta-analysis found acupuncture (pooled all types) reduces symptom severity scores (6 RCTs, n=621) but not pain scores (2 RCTs, n=168) (Xu 2017 **Level I** [PRISMA], 19 RCTs, n=1,690) (5 RCTs overlap with Smith 2016).

Acupressure to SP6 (a lower leg acupoint) delivered by trained therapists reduces pain in primary dysmenorrhoea vs controls and the effect lasts for 3 h (5 RCTs), whereas patient self-administered acupressure does not reduce pain immediately, and takes 3 mth to be effective (3 RCTs) (Abaraogu 2016 **Level III-1 SR** [PRISMA], 5 RCTS & 1 study, n=461).

7.3.2.5 | Dental pain

Acupuncture may be useful for pain during dental procedures (Ernst 1998 **Level I**, 16 RCTs, n=941). Acupuncture reduced dental pain from 6.6/10 to ≈1.0/10 in an ED case series, with 119/120 patients responding (Grillo 2014 **Level IV**, n=120).

7.3.2.6 | Acute neuropathic pain

In severe pain due to acute herpes zoster (NRS >7/10), acupuncture was as effective as standard pharmacological treatment (pregabalin, local anaesthetics and TD buprenorphine or oral oxycodone) at 4 wk (Ursini 2011 **Level II**, n=102, JS 3).

7.3.2.7 | Headache

Acupuncture (at least 6 sessions) provides clinically relevant improvement in pain for tension type headache (TTH) over 3 mth vs standard care (2 RCTs, n=1,472), but only minimal clinical improvement vs sham treatment (5 RCTs, n=703) (Linde 2016a **Level I** [Cochrane], 12 RCTs, n=2,349).

Similarly, acupuncture reduces migraine frequency at 3 mth vs no treatment or routine care (4 RCTs, n=2,199), but only minor improvements were seen vs sham treatments (14 RCTs, n=1,825) (Linde 2016b **Level I** [Cochrane], 22 RCTs, n=4,985). Acupuncture reported fewer adverse effects (5 RCTs, n=931) vs pharmacological prophylaxis and acupuncture was slightly superior at 3 mth but not at 6 mth (3 RCTs, n=739). A subsequent RCT also found a prophylactic effect of EA (5 sessions per wk for 12 wk) on migraine (Li 2017a, **Level II**, n=61, JS 3).

In the guidelines for headache by the National Clinical Guideline Centre of the UK, 10 sessions of acupuncture are recommended for TTH treatment and as a prophylaxis, and for migraine when prophylactic medications are ineffective (NICE 2012 **GL**).

Acupuncture vs sham as a treatment for acute migraine attacks reduced pain intensity, but had no impact on pain freedom at or beyond 24 h or risk of recurrence (Wang 2012 **Level II**, n=150, JS 5).

AA was marginally better than sham acupuncture at 15, 30, 45 and 60 min in reducing migraine pain and recurrent analgesia usage within 24 h occurred in 1/30 of AA vs 13/30 of sham patients (Farahmand 2018 **Level II**, n=60, JS 3).

7.3.2.8 | Other painful conditions

Battlefield AA reduced sore throat vs standard therapy (Moss 2015, **Level II**, n=54, JS 3). Acupressure also reduced procedure pain and anxiety related to venepuncture over sham or standard care (Hosseinabadi 2015, **Level II**, n=187, JS 2).

Acupuncture may reduce post-stroke pain (MD −1.59/10; 95%CI −1.86 to −1.32]) when added to routine rehabilitation (25 RCTs), however with low certainty due to poor study quality (Liu 2019 **Level I** [PRISMA], 38 RCTs, n=3,184).

KEY MESSAGES

1. Acupuncture and acupressure for labour pain may reduce pain, use of pharmacological pain relief and increase satisfaction with pain management versus standard care or placebo (**Q**) (**Level I** [Cochrane Review]); Caesarean section rates are unchanged (**R**) (**Level I** [Cochrane Review]).
2. For oocyte retrieval, electroacupuncture plus sedation reduced procedural and postoperative pain compared with sedation plus placebo or sedation alone (**U**), but may be inferior to paracervical block plus sedation (**Q**) (**Level I** [Cochrane Review]).
3. Acupuncture or acupressure may be effective in the treatment of primary dysmenorrhoea (**S**) (**Level I** [Cochrane Review]).
4. Acupuncture may reduce the frequency of tension-type headaches and migraine (**U**) (**Level I** [Cochrane Review]); in migraine, it may be better tolerated than pharmacological prophylaxis (**N**) (**Level I** [Cochrane Review]).
5. Acupuncture may be effective in a variety of acute pain conditions in the emergency department setting (**S**) (**Level I** [PRISMA]) including back pain (**N**) (**Level I** [PRISMA])
6. Acupuncture by a variety of techniques may reduce postoperative pain and opioid consumption for a variety of surgical types (**S**) (**Level I**); specifically, the benefit may occur after lumbar spinal surgery (**U**) (**Level I** [PRISMA]), total knee arthroplasty (**U**) (**Level I** [PRISMA]), total hip arthroplasty (**N**) (**Level I**) and craniotomy (**N**) (**Level I** [PRISMA]).
7. There is no difference between distant acupuncture and acupuncture at the incisional site for open abdominal surgery (**S**) (**Level I** [PRISMA]).
8. Acupuncture may reduce post-stroke pain (**N**) (**Level I** [PRISMA]).

7.4 | Photobiomodulation

Photobiomodulation (PBM), previously called low-level laser therapy (LLLT), is the application of non-thermal laser in the red and near-infrared light wave lengths (600 to 1,000 nm) to tissue in order to produce biological effects. Light-matter interactions are well appreciated to occur where the encounter between a photon (or series of photons) causes the biology to enter an altered energetic state which causes an altered function. Sometimes this is destructive (eg UV and DNA), other times the effects are transient. PBM has multiple potential mechanisms of action including the displacement of inhibitory nitric oxide from cytochrome c oxidase increasing mitochondrial ATP production as well as interaction with light-sensitive ion channels, ultimately resulting in reversible inhibition of peripheral nerve conduction (Chow 2011 **SR EH BS**, 44 studies [18 human, 26 animal]) and reduced levels of prostaglandin E2 and inflammatory mediators (de Freitas 2016 **NR**). Studies vary in both total energy (J), energy density (J/cm^2) and wavelength of light used.

7.4.1 | Mucositis and stomatitis

A systematic review of PBM for recurrent aphthous stomatitis could not carry out a meta-analysis, but reports pain relief in 5 of 6 RCTs immediately after treatment, and 7 of 9 RCTs in the days following treatment (Suter 2017 **Level I**, 10 RCTs, n=512).

PBM may be effective in reducing pain intensity, severity and duration of mucositis based on moderate evidence (Anschau 2019 **Level I** [PRISMA], 5 RCTs, n=315). This is in line with findings of two small low-quality RCTs not included in the meta-analysis (Abramoff 2008 **Level II**, n=11, JS 2; Arora 2008 **Level II**, n=28, JS 2).

PBM used prophylactically reduces the risk of severe mucositis and pain in patients with cancer or undergoing hematopoietic stem cell transplantation (Oberoi 2014 **Level I** [PRISMA], 18 RCTs, n=1,144). This approach is recommended in a specific clinical practice guideline (Zadik 2019 **GL**).

For more details see also Section 8.9.8.2 and for paediatric mucositis see Section 10.8.3.1.

7.4.2 | Maxillofacial, ENT and dental surgery

After surgical removal of third molars, PBM reduces postoperative pain on POD 2 (WMD -1.42/10; 95%CI -2.18 to -0.67) (11 studies, n=434) and less on POD 7 (WMD -0.59/10; 95%CI -0.96 to -0.22) (10 studies, n=350) (Dawdy 2017 **Level III-2 SR [**PRISMA], 11 studies, n=434). However, studies were assessed as high risk of bias in multiple domains and had high heterogeneity. Similarly, an earlier meta-analysis finds reductions in pain from POD 1 to POD 3 after 3rd molar surgery (He 2015 **Level III-2** [PRISMA], 4 RCTs, n=150) (3 RCTs overlap). A subsequent study also showed reductions in postprocedural pain (Singh 2019 **Level III-2**, n=25).

After Le Fort I osteotomy in patients acting as their own controls, PBM vs no treatment reduced pain on the irradiated side of the face at 24 and 72 h after surgery, but not during the immediate post-operative assessment and there was no pain on either side by POD 7 (Bittencourt 2017 **Level III-2 SR** [PRISMA], 1 study: Gasperini 2014 **Level III-2**, n=10).

After orthodontic treatment with fixed appliances in children and young adults, 11 of 13 studies reported a reduction in acute pain, however, no meta-analysis was performed and studies were broadly of low quality (Sonesson 2016 **Level III-1 SR** [PRISMA], 13 studies, n=333).

Paracetamol usage in children undergoing secondary palatal surgery was reduced by PBM (970 nm, 2 W, 35 J/cm^2) vs undescribed placebo on POD 2 and POD 3 (Ezzat 2016 **Level II**, n=20, JS 2).

See also orofacial pain in Section 8.6.7.

7.4.2.1 | Tonsillectomy

Immediately after tonsillectomy in 5 to 15 y old children, intraoperative PBM (685 nm, 4 J/cm^2) vs no treatment reduced pain scores on POD 1, POD 2, POD 4 and POD 5 as well as the need for breakthrough non-opioid analgesic on POD 1 (45% vs 100%) (Neiva 2010, **Level II**, n=18, JS 1).

Intraoperative PBM (980 nm, 4 J/cm^2) applied immediately after tonsillectomy in adults vs unpowered probe application reduced mean pain scores in the first 24 h (1.43/4 vs 2.11/4) and need for rescue opioids (6.6% vs 33.3%) (Aghamohammadi 2013 **Level II**, n=60, JS 1).

7.4.2.2 | Vascular access

PBM reduces the incidence of needle pain during arteriovenous fistulas access vs placebo (RR 0.08; 95%CI 0.06 to 0.10) (Wan 2017 **Level I**, 3 RCTs, n=186), however, heterogeneity was reported as high.

7.4.2.3 | Cardiothoracic surgery

PBM (660 nm, 6 J/cm^2, 2.4 J) reduced sternotomy pain after CABG surgery on POD 6 and POD 8 vs both placebo and usual care groups, but all groups had negligible pain 1 mth after surgery (Fernandes 2017 **Level II**, n=90, JS 4).

After off-pump CABG surgery, pain was reduced post PBM (980 nm, 10 J/cm^2, 150 J; commenced 30 min post-extubation) at 1 h and 24 h vs pre-PBM levels (Karlekar 2015 **Level IV**, n=100).

7.4.2.4 | Musculoskeletal pain and orthopaedic surgery

After the first presentation with acute ankle sprain, two sessions of PBM (635 nm, 4.5 and 9 J/cm^2), in addition to standard care of rest, icing, compression and elevation, did not reduce pain at 10 d or 6 wk vs standard care (Calin 2019, **Level II**, n=19, JS 2).

After tibial fracture surgery, PBM (808 nm, 6 J/cm^2 and 650 nm, 3 J/cm^2) reduced pain scores from 2 h to 24 h and IV pethidine administration over 24 h (51.6 mg ± 29.5 vs 89.3 ± 35.5) (Nesioonpour 2014b **Level II**, n=54, JS 1).

In patients undergoing radius fracture fixation under intravenous regional anaesthesia (IVRA) the addition of cervical and affected extremity PBM (808 nm) reduced procedural and post procedural pain and opioid consumption (Nesioonpour 2014a **Level II**, n=48, JS 3).

After total hip arthroplasty, PBM (905 nm, 875 nm and 640 nm, total 201.5 J) reduced pain scores from baseline more vs placebo, as well as IL-8 and TNF-α concentrations (Langella 2018 **Level II**, n=18, JS 5). However, pain scores were higher in the PBM group initially and absolute pain scores were not reported in the study.

7.4.2.5 | Labour, puerperium and Caesarean section

After episiotomy, PBM (780 nm or 660 nm, 8.8 J/cm^2, 1.05 J) did not reduce pain immediately or at 30 min (Santos Jde 2012 **Level II**, n=114, JS 5). A subsequent RCT had similar findings with PBM (780 nm, 5 J/cm^2, 5.4 J) applied 6-10 h postpartum for episiotomy being ineffective for pain (Alvarenga 2017 **Level II**, n=54, JS 5).

PBM (650 nm and 804 nm, total 21 to 30 J) after Caesarean section under spinal reduced pain at 1 h to 24 h and pethidine consumption (57.83 mg ± 29.57 vs 107.78 mg ± 34.28) and prolonged time to first analgesia request (226.5 min ± 14.56 vs 88.5 min ± 15.78) (Poursalehan 2018 **Level II**, n=80, JS 2).

7.4.2.6 | Other surgery

After breast augmentation, application of pre-incision PBM (630 to 640 nm) reduced pain scores at 24 h (21.4/100 vs 36.8) but not at 7 d to 28 d (Jackson 2009 **Level II**, n=104, JS 2).

Post open inguinal herniorrhaphy, PBM (830 nm, 13 J/cm^2, 10.4 J) on POD 1 , POD 3 and POD 7 did not reduce pain scores at 6 mth (Carvalho 2010, **Level II**, n=28, JS 3).

KEY MESSAGES

1. Photobiomodulation may be effective for both prophylaxis and treatment of mucositis in oncology patients (**S**) (**Level I** [PRISMA]).
2. Photobiomodulation may reduce pain after 3rd molar extraction (**N**) (**Level I** [PRISMA]).
3. Needle related pain after arteriovenous fistula access may be reduced by photobiomodulation (**N**) (**Level I**)
4. After episiotomy, photobiomodulation may not reduce pain (**N**) (**Level II**).

The following tick box represents conclusions based on clinical experience and expert opinion:

☑ Photobiomodulation may have a role in acute postsurgical pain management, however evidence is currently insufficient to make any recommendations (**N**).

7.5 | Physical therapies

Physical therapies for acute pain management are typically adjunctive to the psychological and pharmacological treatments discussed elsewhere in this book. The physical therapies covered in this section include the active therapies of exercise, prehabilitation and rehabilitation as well as the passive therapies of massage and other manual therapies, warming and cooling. Other passive physical therapies discussed elsewhere include TENS (see Section 7.2), acupuncture (see Section 7.3) and PBM (low-level laser therapy [LLLT]) (see Section 7.4). Specific conditions addressed elsewhere include acute back pain (see Section 8.7) and acute musculoskeletal pain (see Section 8.8). Some therapies such as aromatherapy which are not considered core physical therapies for acute pain are not covered in this chapter, but in complementary and alternative medicine (see Section 4.14.3).

Evidence for the benefits and harm of physical therapies in acute pain management is variable. The use of physical therapies for acute pain management should reflect contemporary practice guidelines promoting the use of active self-management (including exercise) rather than a sole focus on passive therapies. Physical therapies typically incorporate contemporary education on pain, including the provision of clear and meaningful information and advice about the management of acute pain and this component is covered under education (see Section 3.1).

The evidence for physical therapies is currently limited by wide heterogeneity of multimodal interventions and conditions, limited studies with small sample sizes and difficulties with consistent blinding leading to a risk of bias.

This section focuses on the effect of physical therapies on pain outcomes; other benefits may be present but have not been thoroughly reviewed.

7.5.1 | Active exercise-based therapies

7.5.1.1 | Exercise

Total joint arthroplasty

Exercises carried out preoperatively before total knee arthroplasty (TKA) do not improve postoperative pain at 4 wk (2 RCTs, n=224) or 8 wk (3 RCTs, n=242) vs standard interventions (Umehara 2018 **Level I**, 27 RCTs**,** n=2,432). An exercise intervention in addition to standard postoperative interventions for 8 wk after discharge, reduces pain relative to standard postoperative interventions alone (SMD −0.65; 95%CI −1.22 to −0.08) and improvement in function (eg stiffness, extension strength, knee flexion range and gait speed). No differences are found for implementation of early vs late postoperative exercise for pain outcomes at 4 wk (2 RCTs, n=573) or 8 wk (2 RCTs, n=318) (Umehara 2018 **Level I**, 27 RCTs**,** n=2,432).

After total hip replacement (THA), adding supervised exercise (two 30 to 40 min sessions/wk for 10 wk) did not further increase leg extension, but improved walking speed and stair climbing speed vs non-supervised exercise alone (Hansen 2019 **Level I** [PRISMA], 1 RCT: Mikkelsen 2014, **Level II**, n=60, JS 3).

Meniscal lesions

There is no significant difference in knee pain between exercise therapy and meniscectomy for patients with a degenerative meniscal lesion in the short term (2 studies, n=125) (Swart 2016, **Level III-1 SR**, 12 studies, n=594). Even at two to three mth follow-up, exercise or an exercise-based physical therapy program vs arthroscopic partial meniscectomy results in no difference in pain (3 RCTs, n=344) (van de Graaf 2016, **Level I** [PRISMA], 6 RCTs, n=773).

The outcomes of exercise therapy versus no exercise therapy after meniscectomy at <3 mth are conflicting (2 RCTs, n=125), with one study finding a significant benefit of exercise on knee pain, while the other did not; however, data could not be pooled due to the measurement of pain at different time points (Swart 2016 **Level I**, **Level III-1 SR**, 12 studies, n=594).

Anterior cruciate ligament reconstruction

Immediate postoperative weight bearing significantly decreased the proportion of patients reporting pain symptoms 2 wk after anterior cruciate ligament (ACL) reconstruction and did not increase joint laxity vs patients who had 2 wk delayed weight bearing (Secrist 2016 **Level I** [PRISMA] 1 RCT: Tyler 1998 **Level II**, n=45, JS 2).

Ankle sprains

Compared with home exercise programs, physiotherapy supervised rehabilitation resulted in less pain and subjective instability at 8 wk after ankle sprain (Feger 2015 **Level I,** 1 RCT: van Rijn 2009, **Level II**, n=102, JS 3).

Dysmenorrhoea

Physical activity (single or co-intervention) in any setting or via any mode for the treatment of primary dysmenorrhea (non-athlete females with regular menstruation not using hormonal contraception) reduces pain intensity (MD -1.89/10; 95%CI -2.96 to -1.09) and pain duration (MD -3.92 h; 95%CI -4.86 to -2.97) (Matthewman 2018 **Level I** [PRISMA], 11 RCTs, n=817 [intensity] & n=469 [duration]). Yoga (20 min/day for 14 d/cycle) vs no treatment improved pain intensity from dysmenorrhea at 1 mth (MD -3.2/10; 95%CI -2.2 to -4.2) (Kannan 2014 **Level I**, 1 RCT: Rakhshaee 2011, **Level II**, n=92, JS 1). Overall quality of this evidence was rated as low due to high risk of bias.

Labour pain

The use of birth ball exercises for labour pain relief improves pain (MD -0.9/10; 95% CI -1.3 to -0.6) (Makvandi 2015, **Level I**, 3 RCTs, n=205). Overall, the quality of the studies was mixed, with most providing little information on the exact methods they used.

KEY MESSAGES

1. Following total knee arthroplasty, an exercise intervention in addition to standard post-operative interventions for 8 weeks after discharge may reduce pain and improve function (**N**) (**Level I**).
2. In primary dysmenorrhoea, exercise may reduce acute pain intensity and pain duration (**N**) (**Level I**).
3. Use of a birth ball may improve labour pain (**N**) (**Level I**).

The following tick boxes represent conclusions based on clinical experience and expert opinion:

☑ Clear recommendations on the components of exercise interventions (including time point of application, frequency, mode, dose and duration) for acute postoperative pain management cannot be made; different surgical procedures may require different exercise-based interventions (**N**).

☑ Immediate post-operative weight bearing post anterior cruciate ligament reconstruction may reduce pain and does not appear to result in increased joint laxity (**N**).

Total joint arthroplasty

Following TKA, despite improvements in function and quadriceps strength, there was no effect of prehabilitation on postoperative pain pooled across heterogeneous time points and scales nor were significant differences were found at 6 wk (3 RCTs) or 3 mth (9 RCTs) (Moyer 2017 **Level I** [PRISMA], 16 RCTs, n=1,178). Multiple systematic reviews and meta-analyses with significant study overlap come to the same conclusion, with no significant effects demonstrated for:

- Pain intensity at 1 mth (2 RCTs, n=297) or WOMAC scores at 3 mth (3 RCTs, n=252) (Cabilan 2016 **Level I**, 5 RCTs, n=549);
- Pain measured variously by WOMAC (5 RCTs), SF-36 (4 RCTs) or VAS (2 RCTs) (Kwok 2015, **Level III-1 SR**, 8 studies, n=619);
- WOMAC pain intensity between 1.5 and 3 mth (Chen 2018 **Level I**, 7 RCTs, n=424);
- Pain at 6 or 12 wk (Tedesco 2017, **Level I** [PRISMA], 3 RCTs, n=110).

For THA, in addition to improving function, prehabilitation reduces postoperative pain scores vs usual care when pooled across heterogeneous time points (SMD 0.15; 95% CI 0.03 to 0.27) (Moyer 2017, **Level I** [PRISMA], 13 RCTs, n=905). When analysed at specific time periods, pain scores are reduced at 3 mth vs usual care (3 RCTs) (SMD 0.34; 95%CI 0.07 to 0.62), but not at _6 wk (7 RCTs) or 6 mth (3 RCTs).

When any joint replacement surgery was considered, prehabilitation reduces pain at 4 wk or less (assessed by multiple scales: WOMAC, VAS, Knee injury and Osteoarthritis Outcome Score (KOOS) and 10 graded scale, subsequently converted to WOMAC 0-100 subscales) (WMD -6.1/100; 95%CI -10.6 to -1.6) (Wang 2016 **Level I** [PRISMA]**,** 2 RCTs, n=105 [THA] & 2 RCTs, n=114 [TKA]). The authors noted a low overall quality of evidence in these trials. No significant difference between prehabilitation and usual care groups for pain is seen at 6 to 8 wk (5 RCTs, n=488) or 12 wk (10 RCTs, n=806) post-operation.

Anterior cruciate ligament (ACL) reconstruction

For ACL reconstruction, despite improving function and strength, prehabilitation does not significantly improve patient reported pain vs controls (Alshewaier 2015 **Level I** [PRISMA], 3 RCTS, n=291).

Spinal Surgery

For spinal surgery, in spite of earlier discharge times and reduced time to functional milestones, prehabilitation did not improve pain at one or 3 mth (Cabilan 2016 **Level I**, 1 RCT: Nielsen 2010, **Level II**, n=60, JS 3).

Dosing of prehabilitation

A systematic review looking at prehabilitation duration in TKA, THA and spinal surgery patients shows no effects of quantity on WOMAC pain scores (Cabilan 2015 **Level I** [PRISMA], 2 RCTs [<500 min], 3 RCTs [500-999 min], 2 RCTs [1,000-1,499 min], 2 RCTs [>= 1,500 min]). A single RCT (n=23) in the 1,000 to 1,499 min range reported an improvement in pain intensity (5.5/10 2.2 vs 7.3/10 2.0), but not WOMAC scores.

KEY MESSAGES

1. Prior to total hip arthroplasty, prehabilitation may reduce postoperative hip pain at 3 months (**N**) (**Level I** [PRISMA]).

The following tick box represents conclusions based on clinical experience and expert opinion:

☑ A recommendation for the specific type of prehabilitation and dosing parameters cannot be made at this time (**N**).

7.5.1.3 | Rehabilitation

Spinal Surgery and Injuries

After spinal surgery, physiotherapy commenced within the first 4 wk reduces pain at 12 wk (SMD -0.38; 95%CI -0.66 to -0.10) and 12 to 18 mth (SMD -0.30; 95%CI -0.59 to -0.02) vs no or sham physiotherapy (Snowdon 2016 **Level I** [PRISMA], 4 RCTs, n=250). Early comprehensive physiotherapy (active rehabilitation, education on the performance of daily functional tasks, functional weight-bearing exercise, cardiovascular endurance exercise, lower limb strengthening and dynamic proximal stabilisation) does not increase the risk of adverse events (3 RCTs, n=196).

For osteoporotic vertebral compression fractures, spinal orthoses reduce pain (SMD -1.47; 95%CI -1.82 to -1.13) vs no intervention over the medium term (Rzewuska 2015 **Level I**, 2 RCTs**,** n=170). However, there was no difference in pain between a proprietary spinal orthosis (SpinoMed) and a soft lumbar orthosis at short-term follow up (Li 2015 **Level II**, n=51, JS 1).

Total knee arthroplasty (TKA)

After TKA, accelerated physiotherapy (starting within 24 h) versus standard physiotherapy (after bed rest for 24 h) reduced time to discharge by 2.1 days (1.45) and pain at the time of discharge (MD −0.96/10; 95%CI −1.21 to −0.71) (Henderson 2018, **Level I** [PRISMA], 1 RCT: Labraca 2011, **Level II**, n=273, JS 3). Twice daily vs once daily physiotherapy did not significantly reduce pain (Henderson 2018, **Level I** [PRISMA], 1 RCT: Lenssen 2006 **Level II**, n=43, JS 3).

After TKA, continuous passive motion (CPM) does not improve pain vs standard care over the short term (< 6 wk) (Tedesco 2017 **Level I** [PRISMA], 9 RCTs, n=1,025; Harvey 2014, **Level I** [Cochrane], 8 RCTs, n=414) (7 RCTs overlap). No difference was found for adverse events.

Anterior cruciate ligament (ACL) reconstruction

After outpatient ACL reconstruction, the role of mobilisation strategies was investigated (Secrist 2016 **Level I** [PRISMA], 3 RCTs, n unspecified). Individual trials showed that CPM use for 16 h/d immediately after surgery did not decrease pain vs controls, but did decrease PCA usage (41 mg 18.9 vs 65 mg 21.4) (Secrist 2016 **Level I** [PRISMA], 1 RCT: McCarthy 1993 **Level II**, n=35, JS 1). A continuous active motion device, in which the patient used the contralateral leg to pedal the injured leg, did not decrease VAS scores vs a CPM device (Secrist 2016 **Level I** [PRISMA], 1 RCT: Friemert 2006 **Level II**, n=60, JS 1). There was no difference in pain between an unhinged immobilising brace for 2 wk postoperatively and no immobilisation (Secrist 2016 **Level I** [PRISMA], 1 RCT: Hiemstra 2009 **Level II**, n=82, JS 2).

Movement representation

Movement representation (mirror therapy, motor imagery, action observation combined with standard physiotherapy or rehabilitation) techniques reduced limb pain acutely

(SMD -0.7; 95%CI -1.24 to -0.15) (Thieme 2016, **Level I** [PRISMA], 6 RCTs, n=140). A sub-analysis of both acute and chronic pain by type found reductions in pain for Complex Regional Pain Syndrome (CRPS) (SMD -2.23; 95%CI -3.88 to -0.57) (4 RCTs, n=108) and nociceptive pain conditions (ankle sprain, ACL reconstruction, TKA and rotator cuff injury) (SMD -1.26; 95%CI -1.92 to -0.61) (4 RCTs, n=64), but not phantom limb pain (3 RCTs, n=41) or post stroke pain (3 RCTs, n=116).

See also Section 8.1.5.2.

KEY MESSAGES

1. Early comprehensive active physiotherapy in the first 4 weeks post spinal surgery may reduce pain and does not appear to increase adverse events (**N**) (**Level I** [PRISMA]).
2. Movement representation interventions (mirror therapy/motor imagery) may reduce acute pain after trauma and surgery (**N**) (**Level I** [PRISMA]).

The following tick box represents conclusions based on clinical experience and expert opinion:

☑ Accelerated rehabilitation, started within 24 hours post total knee arthroplasty, may reduce pain at the time of discharge (**N**).

7.5.2 | Manual and massage therapies

Postoperative pain in general

Massage improves postoperative pain vs routine care (SMD -0.58; 95%CI -0.93 to -0.53) (Kukimoto 2017, **Level I** [PRISMA], 9 RCTs, n=1,105). Reductions in pain are seen in both single dose (SMD -0.49; 95%CI -0.64 to -0.34) (6 RCTs, n=757) and multiple doses of massage (SMD -0.53; 95%CI -0.91 to -0.14) (7 RCTs, n=1,031). When analysed for incision type, the beneficial effects of massage on postsurgical pain persists for both sternal (SMD -0.68; 95%CI -0.91 to -0.46) (4 RCTs, n=333) and abdominal incisions (SMD -0.57; 95%CI -1.04 to -0.11) (2 RCTs, n=193).

Cardiac and thoracic surgery

In addition to reducing anxiety, massage reduces pain intensity after cardiac surgery (MD −1.52/10; 95%CI −2.2 to −0.84) (Miozzo 2016 **Level I** [PRISMA], 10 RCTs, n=409). Different forms of massage have also been found to have significant beneficial effects on pain post cardiac surgery: Integrative massage (n=113 [2 sessions]), Swedish massage (n=152 [2 sessions]), Thai massage (n=74 [one session]) and general massage (n=40 [3 sessions]; n=65 [one session]) (Ramesh 2015, **Level I** [PRISMA], 7 RCTS, n=764). One included RCT showed no effect for general massage (n=252 [2 sessions]).

20 to 30 min of healing coach (health care professionals with special training in massage or touch therapy or massage therapist-administered massage) added to standard analgesia reduces pain vs standard care alone (MD -0.85/10; 95%CI -1.28 to -0.42) (Boitor 2017 **Level I** [PRISMA], 7 RCTs, n=1,087); similar results are found in the early period after ICU discharge (MD -0.89/10; 95%CI -1.45 to -0.33) (6 RCTs, n=684). Additionally, 10 to 20 min of massage in conjunction with analgesia administered by a nurse or massage therapist significantly reduces pain in ICU (MD -0.80/10; 95%CI -1.25 to -0.35) (3 RCTs, n=462), while massage without analgesia also reduces pain (MD-2.47/10; 95%CI -4.88 to -0.06) (2 RCTs, n=150).

Labour

Massage reduces pain intensity in first stage labour vs standard care (SMD −0.81; 95%CI −1.06 to −0.56) (6 RCTs, n=362), but not at the second (SMD −0.98; 95%CI −2.23 to 0.26) (2 RCTs, n=124) or third stage (SMD −1.03/10; 95%CI −2.17 to 0.11) (2 RCTs, n=122) vs standard care (Smith 2018, **Level I** [Cochrane], 6 RCTs, n=362). Massage vs a music intervention reduced severe labour pain (RR 0.40; 95% CI 0.18 to 0.89) (1 RCT, n=101).

An earlier systematic review (including only studies from Iran) found that in labour, massage reduces labour pain across all phases including: latent (SMD −1.23; 95%CI −1.73 to −0.74) (9 RCTs, n=642), active (SMD −1.59; 95%CI −2.06 to −1.12) (7 RCTs, n=422) and transitional (SMD −1.90; 95%CI −3.09 to −0.71) (6 RCTs, n=362) as well as having an overall effect (SMD −1.52; 95%CI −1.90 to −1.14) (Ranjbaran 2017 **Level I** [PRISMA], 10 RCTs, n=702) (1 RCT overlap).

Primary dysmenorrhea

In primary dysmenorrhea, manipulative therapy may reduce pain vs sham (WMD -0.94/10; 95%CI -0.66 to -1.2) (Abaraogu 2017 **Level I**, 3 RCTs, n=217); however, these studies were methodologically heterogeneous.

Acute back pain

Manual therapy is also considered with respect to Acute Back Pain in the NICE guidelines NICE 2018 and the older Australian Acute Musculoskeletal Pain Guidelines (Australian Acute Musculoskeletal Pain Guidelines Group 2003 **GL**). See also Section 8.7. and 8.8.

KEY MESSAGES

1. Single and multiple doses of massage in the early postoperative period may reduce pain after surgical procedures, including cardiac surgery (**N**) (**Level I** [PRISMA])
2. Massage may decrease pain in the first stage of labour pain compared to standard care (**N**) (**Level I** [Cochrane Review])

The following tick box represents conclusions based on clinical experience and expert opinion:

☑ The role of manipulative therapy in primary dysmenorrhea is currently unclear (**N**).

7.5.3 | Warming and cooling interventions

7.5.3.1 | Warming interventions

Dysmenorrhea

In a 4-arm RCT, treatment with heat pads reduced pain vs placebo (unheated pads) (MD 1.8/10; 95%CI 0.9 to 2.7), but ibuprofen plus heat pad was no more effective than ibuprofen with placebo heat pad (Kannan 2014 **Level I** 1 RCT: Akin 2001, **Level II**, n=81, JS 3). Time to noticeable pain relief was reduced from 2.8 h to 1.5 h with ibuprofen plus heat pad vs ibuprofen with placebo heat pad.

A subsequent review identified three further studies. Heat therapy interventions including heat patches (1 study, n=147), hot water (1 study, n=44) and heated red bean pillows (1 study, n=51), improves pain from dysmenorrhoea, however high heterogeneity and a lack of placebo controls prevent firm conclusions (Igwea 2016 **Level III-1 SR**, 3 studies, n=242).

Labour pain

Warm packs vs usual care reduce pain intensity in the first stage of labour (SMD −0.59; 95%CI −1.18 to −0.00) (3 RCTs, n=191) and second stage of labour (SMD -1.49; 95%CI −2.85 to −0.13) (2 RCTs, n=128) (Smith 2018 **Level I** [Cochrane], 14 RCTs, n=1,172). Thermal manual methods resulted in a reduction in pain intensity vs usual care (MD −1.44/10; 95%CI −2.24 to −0.65) (1 RCT, n=96) and intermittent hot and cold packs reduced pain in the first phase of labour vs usual care (MD −1.46/10; 95% CI −2.59 to −0.33) (1 RCT, n=48).

Periocular surgery

Warming the local anaesthetic agent so it is close to body temperature when injected decreased pain in one of two small RCTs (Gostimir 2019, **Level I** [PRISMA], 2 RCTs, n=100).

7.5.3.2 | Cooling interventions

All knee surgery

Compression cryotherapy vs cryotherapy alone after any knee surgery improves pain on POD 1 (MD -0.94/10; 95%CI -1.63 to -0.26) (7 RCTs, n=420), POD 2 (MD -0.55/10; 95%CI -0.78 to -0.32) (7 RCTs, n=420) and POD 3 (MD -0.46/10; 95%CI -0.87 to -0.05) (2 RCTs, n=100) (Song 2016 **Level I** [PRISMA], 10 RCTs [2 TKA, 3 arthroscopy, 5 ACL reconstruction], n=662).

Knee Arthroplasty

Cryotherapies reduces pain after TKA (MD -0.51/10; 95%CI -1.00 to -0.02) (8 RCTs, n=1,382) (Tedesco 2017 **Level I** [PRISMA], 12 RCTs [cryotherapy], n=1,382; Ni 2015 **Level I**, 13 RCTs [9 TKA, 2 THA, 1 mixed], n=782) (9 RCT overlap). However, when data for POD 1 (7 RCTs, n=529), POD 2 (5 RCTs, n=422) and POD 3 were considered separately, no effect is seen. Cryotherapy is also not better than compression therapy (5 RCTs, n=407).

Anterior cruciate ligament (ACL) reconstruction

Cold compress devices improve pain 48 h after ACL surgery vs no therapy (MD -1.41/10; 95%CI -1.66 to -1.17) (2 studies, n=71) (Martimbianco 2014 **Level III-1 SR** [PRISMA], 10 studies, n=573) (2 RCTs overlap with Song 2016). There is no effect from cold therapy (3 studies) or cold compression therapy with cold water vs room temperature water (placebo) (3 studies). Cold compression therapy vs ice packs reduces pain at 1 wk (1 RCT, n=44) and 6 wk (1 RCT, n=36). Cold compression devices vs ice packs or no cold therapy reduce the amount of medication taken by patients (6 studies).

A subsequent systematic review of cryotherapy following outpatient ACL surgery shows superior pain relief in 4 of 8 studies vs no cryotherapy or water at room temperature (Secrist 2016, **Level III-1 SR** [PRISMA]**,** 10 studies, n unspecified) (8 studies overlap with Martimbianco 2014).

Haemarthrosis of haemophilia

Cryotherapy has been recommended for treatment of pain and swelling in haemarthrosis due to haemophilia (Rodriguez-Merchan 2018 **NR**).

Venipuncture

Vapocoolants for pain during IV cannulation vs pooled no or placebo treatments reduce pain when assessed as a continuous measure (SMD -0.53; 95%CI -0.83 to -0.23) (8 RCTs, n=682) or dichotomised (OR 4.62; 95%CI 1.84 to 11.63) (4 RCTs, n=681) (Zhu 2018 **Level I**, 11 RCTs, n=1,410). However, in the paediatric subgroup analysis (2 RCTs, n=172), no effect is seen. A prior meta-analysis also concluded that vapocoolants are superior to pooled no or placebo treatment; however, with increased discomfort at the time of application (Griffith 2016 **Level I** [Cochrane], 9 RCTs, n=1,070) (8 RCTs overlap). In contrast, an earlier systematic review including non-RCTs does not confirm all these findings (Hogan 2014 **Level III-I SR** [PRISMA]**,** 12 studies, n unspecified) (8 RCTs overlap).

See also Section 10.7.2 for paediatric specific information.

Periocular Surgery

Application of ice for 2 min before injection of local anaesthesia reduced pain (Gostimir 2019 **Level I** 1 RCT**:** Goel 2006 **Level II**, n=39, JS 2). In a crossover trial, patients received two injections, one where treatment with ice (for 2 min) occurred prior to unbuffered lidocaine injection vs another where buffered lidocaine was injected without ice pretreatment; with less pain at the site of the ice-treated unbuffered injection (Huang 2015 **Level III-2**, n=60).

Tonsillectomy

Cryotherapy (ice lollipop) over 4 h reduced pain post-tonsillectomy in children (2 to 12 y) at 30 min and 1 h (Keefe 2018 **Level I** [PRISMA] 1 RCT**:** Sylvester 2011 **Level II**, n=87, JS 3). Intraoperative cryotherapy with a cryotherapy probe (-56°C) (1 RCT) and ice-water cooling (4°C to 10°C) (2 RCTs) reduces post-tonsillectomy pain scores consistently vs no treatment by 21 to 32% (0.9/10 to 1.8/10) (Raggio 2018 **Level I** [PRISMA], 3 RCTs, n=153).

Dental Surgery

After 3rd molar extraction, cryotherapy is effective at reducing oedema, but mixed results were found with regard to effect on pain where 5 of 11 studies were positive (Fernandes 2019 **Level IV SR**, 11 studies, n=721).

Maxillofacial surgery

Hilotherapy (the application of cold compression at a regulated temperature through a face mask) reduces pain on POD 2 after facial skeletal surgery vs cold compression (MD -2.37/10; 95%CI -3.24 to -1.50) (n=146) and reduces swelling on POD 2 and POD 3, but not POD 28 (Glass 2016 **Level I** [PRISMA], 6 RCTs, n=286).

Mucositis

Cryotherapy during chemotherapy may have a preventive effect on mucositis see Section 8.9.8.2.

Labour

Cold packs reduce pain intensity in the first stage of labour (MD −1.43/10; 95%CI −2.56 to −0.30) (Smith 2018 **Level I** [Cochrane] 1 RCT: Shirvani 2014 **Level II**, n=64, JS 3).

Puerperium perineal pain

There is only limited evidence to support the effectiveness of local cooling treatments (ice packs, cold gel pads, cold/iced baths) for relieving perineal trauma pain vs various alternatives or no interventions (East 2012 **Level I** [Cochrane], 10 RCTs, n=1,825). Ice packs provided superior analgesia vs no treatment for 24 to 72 h postpartum (RR 0.61; 95%CI 0.41 to 0.91) (1 RCT, n=208).

KEY MESSAGES

1. Heat packs may reduce labour pain during the first and second stages (**N**) (**Level I** [Cochrane Review]).
2. Vapocoolants may reduce the pain of intravenous cannulation in adults but its application is associated with discomfort (**N**) (**Level I** [Cochrane Review]).
3. Cryotherapy may reduce pain after total knee arthroplasty but is not superior to compression (**N**) (**Level I** [PRISMA]).
4. Compression cryotherapy may reduce acute pain and analgesia requirements post anterior cruciate ligament reconstruction and pain on day one to three post knee surgery (**N**) (**Level I** [PRISMA]).
5. Intraoperative cryotherapy may reduce post-tonsillectomy pain (**N**) (**Level I** [PRISMA]).
6. Hilotherapy (the application of cold compression at a regulated temperature through a face mask) may reduce pain and swelling after facial skeletal surgery vs cold compression (**N**) (**Level I** [PRISMA]).

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