10_OL-TABLE3_ExcludedStudies

ONLINE TABLE 3

Excluded studies, with reasons, based on screening full text records

Reference	Reason for exclusion	Description of study
Aguilar Ferrandiz et al., 2016 [1]	Not standard TENS - auto-targeted neurostimulation	Evaluated Nervomatrix Soleve® auto-targeted neurostimulation device providing TENS-stimulation and mechanical pressure for chronic low back pain. Technical specifications differ from a standard TENS device
Albayrak, 2017 [2]	Not an RCT	Evaluated TENS on persistent post-surgical pain after total knee arthroplasty. Retrospective study of prospectively collected data
Alhusaini et al., 2019 [3]	No pain outcomes – Primary outcomes grip strength and function; secondary outcome manual ability	Evaluated TENS combined with therapeutic exercises for hand function by reducing spasticity in children with hemiplegic cerebral palsy
Altas et al., 2019 [4]	Not possible to isolate TENS	Evaluated the effect of physical therapy modalities on pain, sleep, mental status, and quality of life of patients with osteoarthritis.
Al Zamil et al., 2019 [5]	Not full report - Abstract of conference presentation	Evaluated TENS of median nerves and acupuncture in the treatment of carpal tunnel syndrome
Askin et al., 2014 [6]	Not possible to isolate effect of TENS	Evaluated ultrasound therapy for stellate ganglion blockade in complex regional pain syndrome type I. TENS delivered in combination with drug medication, contrast bath and exercise to all groups.
Atalay et al., 2009 [7]	No pain outcomes	Evaluated TENS for viability of skin flaps created during mastectomy in breast cancer patients. No pain outcomes
Augustinsson et al., 1977 [8]	Not an RCT	Evaluated TENS for pain during delivery labour pain). Open label pre-post study single group study without comparison intervention(s)
Avramidis et al., 2003 [9]	Not standard TENS – neuromuscular electrical stimulation	Evaluated electric muscle stimulation during rehabilitation after total knee arthroplasty - MicroStim 2-channel (MS-2) neuromuscular stimulator
Aydın et al., 2015 [10]	TENS administered internally - intravaginal	Evaluated vaginal electrical stimulation for sexual function using the insertion of a vaginal probe inserted delivering medium-frequency (50 Hz) alternating current (duty cycle 5 seconds on followed by 5 seconds off) generated by a MyoBravo electro stimulation instrument (MTR+ Vertiebs GmbH, Berlin)
Aydogan et al., 2014 [11]	Not standard TENS - Frequency Rhythmic Electrical Modulation System	Evaluated pre-emptive frequency rhythmic electrical modulation using a Phyback device (PBK2C) in patients undergoing lumbar stabilization
Ayyildiz et al. 2004 [12]	Not an RCT	Evaluated TENS for pain associated with extracorporeal short-wave lithotripsy. Open label pre-post study single group study without comparison intervention(s).
Bai et al., 2018 [13]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electric acupoint stimulation (TEAS) on stress response during extubation after general anaesthesia in patients undergoing elective supratentorial craniotomy. Primary purpose of TEAS was not to treat pain. TEAS was administered using a Hwato electronic acupuncture treatment instrument (model no.: SDZ-II) delivering an alternate dense- disperse frequency of 2/10 Hz (2 Hz for 10 s and 10 Hz) to various acupuncture points
Behm et al., 2019 [14]	Not pain outcomes - Fatigue rather than pain	Evaluated if TENS-induced pain suppression would augment force output during a fatiguing protocol in the treated and contralateral muscles.
Belmonte et al., 2012 [15]	Not standard TENS - microcurrent electrical stimulation and bioresonance device	Evaluated low-frequency low-intensity electrotherapy in the treatment of chronic upper limb breast cancer-related lymphoedema. Used a Flowave2Home device delivering microcurrents via a wave of carrier frequency ranging from 0.31 to 6.16 Hz and a modulation between 400 and 2120 Hz; the low offset voltage is always between +12 and –12 V.
Bouafif and Ellouze, 2019 [16]	Not an RCT	Evaluated modulated PWM-TENS for non-cancer pain. PWM-TENS used sinusoidal waves sinusoidal carrier whose frequency varies according to the mode of stimulation. There was a comparison with 'classical TENS' but this was not a RCT.
Bundsen et al., 1981 [17]	Not an RCT	Evaluated TENS for labour pain. Retrospective (stated as prospective in title) open label questionnaire with each patient matched with a control without randomisation.
Burch et al., 2008 [18]	Not standard TENS - low-current TENS (0.5mA used as control	Evaluated combination of interferential and patterned muscle stimulation for osteoarthritis of knee. Control group received low-current TENS biphasic square wave with a 0.2 Hz frequency and a fixed amplitude of 60 mA, with pulse width adjusted to provide a net output of 73 nC and delivered across 300 microseconds equivalent to a peak output of 0.5 mA. This did not meet our criteria for standard TENS
Burssens et al., 2003 [19]	No pain outcomes	Evaluated burst TENS on the healing of Achilles tendon suture
Carbonario et al., 2013 [20]	Not an RCT	Evaluated TENS for tender points in fibromyalgia. Patients were allocated 'sequentially' and there was no mention of randomisation within the report (quasi-RCT). This was included in the Cochrane review on Fibromyalgia.

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Reference	Reason for exclusion	Description of study
Chao et al., 2007 [21]	TENS delivered to acupuncture points distant to pain	Evaluated TENS on acupuncture points for pain during the first stage of labour using two pairs of electrodes placed at bilateral Li 4 (Hegu) points (midpoint between first and second carpal bones, first web space dorsal side) and Sp6 (Sanyinjiao) points (5 cm above medial malleolus in lower leg)
Chee and Walton 1986 [22]	Not standard TENS - microcurrent electrical stimulation	Evaluated treatment of trigger points with micro amperage TENS using an Electro-acuscope 80 stimulator
Cheing and Hui-Chan, 2004 [23]	No pain outcomes	Evaluated addition of TENS to exercise training for knee osteoarthritis but measured functional outcomes only. There were no pain outcomes in report
Chen et al., 2013 [24]	Not standard TENS electrodes	Evaluated TENS for knee osteoarthritis using silver spike point electrodes, similar to IFT suction cups, rather than self-adhering carbon-rubber TENS electrodes
Chen et al. 2013 [25]	TENS on acupuncture points using TEAS	Evaluated electroacupuncture, TENS and acupoint massage on periarthritis of shoulder.
Chen et al., 2015 [26]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electric acupoint stimulation on post-procedural abdominal pain after colonoscopy at Jiaji (EX-B2) points were located on both sides of the spinous column using a Han's Acupoint Nerve Stimulator (HANS-200A, Nanjing Jisheng Medical Technology Co., Ltd., Nanjing, China), delivering a dense-and-disperse frequency at 2/100 Hz for 30 min prior to induction.
Chen et al., 2015 [27]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electric acupoint stimulation for remifentanil-induced hyperalgesia in patients undergoing thyroidectomy and delivered as 30 min of stimulation (6-9 mA, 2/10 Hz) on the Hegu (LI4) and Neiguan (PC6) before anaesthesia (pre-emptive) and terminated before the end of surgery. Stimulation was not at site of pain or over nerve bundles.
Chen et al., 2015 [28]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electric acupoint stimulation on postoperative quality of recovery after thyroidectomy with general anaesthesia administered at bilateral Hegu (LI4) and Neiguan (PC6) before induction of anaesthesia (pre-emptive). TEAS was delivered at a disperse-dense frequency of 2/10 Hz and an intensity of 6-9 mA for 30 min using the Hans electronic acupuncture apparatus (HANS-100A)
Chen et al., 2020 [29]	Not Standard TENS -TEAS	Evaluated efficacy of TEAS for sedation and postoperative analgesia in lung cancer patients undergoing thoracoscopic pulmonary resection.
Cheng and Pomeranz, 1986 [30]	Not standard TENS - Codetron	Evaluated 'acupuncture-like stimulation' using a Codetron device for chronic musculoskeletal pain and delivering currents randomly to acupuncture points at different locations on the body via seven electrodes.
Chiu et al., 1999 [31]	TENS delivered to acupuncture points distant to pain	Evaluated TENS for pain during hemorrhoidectomy. Electrodes were positioned on acupuncture points distant to the painful area (i.e. dorsal web between the first and the second metacarpal bones (Hegu, Large Intestine meridian, 4th ampoint, negative electrode) and on radial side 3 cm proximal to the wrist crease (Lieque, Lung meridian, 7th ampoint, positive electrode) using a Han Acutens, WQ1002F device
Coletta et al., 1988 [32]	Unable to isolate TENS effects	Evaluated TENS vs. TENS + ointment containing Etofenamate. Not possible to isolate effects of TENS
Conn et al., 1986 [33]	Some participants not adults	Evaluated TENS for pain following appendicectomy. Included children (minimum age = 13 years (TENS), 15 (sham) and 13 (control))
Cornell et al., 1984 [34]	Not an RCT	Evaluated TENS for pain following foot surgery. Data gathered prospectively during TENS was compared with retrospective data of patients that did not receive TENS harvested from medical records
Demidas et al., 2019 [35]	Healthy humans	Evaluated touch and pain sensations and the correlation between them in diadynamic current and TEN.S
Duzyj et al., 2020 [36]	Not full report – Abstract of conference poster presentation	Evaluated effect of TENS therapy in the pain management of women after caesarean delivery.
Dodick et al., 2015 [37]	Not standard TENS - invasive technique	Evaluated peripheral nerve stimulation (PNS) of the occipital nerves for managing chronic migraine using implanted with a neurostimulation system Not TENS
Eidy et al., 2016 [38]	TENS given pre-emptive to general anaesthesia / surgery - pain measured after surgery with no TENS post op	Evaluated effects of preoperative TENS on post inguinal hernia repair pain
Ertzgaard et al., 2018 [39]	Not standard TENS electrodes	Evaluation of TENS for spasticity using an AT Mollii® electrotherapy system consisting of a two-piece garment equipped with 58 electrodes and a control unit.
Fagade and Obilade, 2003 [40]	No pain outcomes	Evaluated TENS on post-IMF trismus and pain in Nigerian Patients. No pain outcomes

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Reference	Reason for exclusion	Description of study
Fargas-Babjak et al., 1989 [41]	Not standard TENS – Codetron	Evaluated 'acupuncture-like stimulation' for osteoarthritis of the hip or knee using a Codetron device
Fargas-Babjak et al., 1992 [42]	Not standard TENS – Codetron	Evaluated 'acupuncture-like stimulation' for chronic pain syndrome or osteoarthritis using a Codetron device
Fary et al., 2011 [43]	Not standard TENS - subsensory pulsed electrical stimulation	Evaluated pulsed electrical stimulation for osteoarthritis of the knee using a commercially available TENS stimulator (Metron Digi-10s) that was modified by a biomedical engineer to deliver pulsed, asymmetrically biphasic, exponentially decreasing waveform currents with a frequency of 100 Hz and pulse width of 4 msec. Author's state " *Participants attached the device and turned the intensity up until they could feel pins and needles or a prickling sensation under one or both electrodes. After achieving sensory output, participants were instructed to turn the intensity down until they could no longer feel any electrical stimulation. At this stage, a built-in locking mechanism was engaged that prevented subsequent adjustment of intensity without restarting the device.*" Thus, subsensory stimulation.
Fletcher-Smith et al., 2019 [44]	Not standard TENS - Neuromuscular Electrical Stimulation "… current intensity was increased to produce an alternating contraction of the flexors and extensors using a flex-hold-extend-hold pattern, ensuring that a pure movement was produced with no/minimal ulnar or radial deviation."	Evaluated feasibility of initiating electrical stimulation treatment of wrist extensors and flexors in patients early after stroke to prevent muscle contractures and pain.
Gadsby et al., 1997 [45]	TENS delivered to acupuncture points distant to pain	Evaluated acupuncture-like TENS within palliative care delivered to acupuncture points PC6 (Neiguan) and LI4 (Hegu) of the dominant hand
Gao et al., 2017 [46]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electric acupoint stimulation for procedural pain during and post thyroidectomy administered at PC6 (Neiguan) and LI4 (Hegu) and distant from the painful site. Full article in Chinese.
Garaud et al., 2018 [47]	Cannot isolate effects of TENS	Evaluated efficacy of TENS in the treatment LBP when associated to a therapeutic education program (TEP).
Garland et al., 2007 [48]	Not standard TENS - highly optimized, capacitively coupled, pulsed electrical stimulator	Evaluated highly optimized, capacitively coupled, pulsed electrical stimulator for osteoarthritis of the knee using a knee garment with flexible, embedded electrodes and a small battery-operated generator that produced a 100-Hz, negative pulsed signal (BioniCare Medical Technologies, Inc., Sparks, Maryland.). Authors state - "*They then turned on the device, increased the signal amplitude to between 0 and 12 V by rotating a dial until a tingling sensation was felt over the knee or thigh, and then reducing the amplitude until this sensation disappeared. Thus, active treatment remained imperceptible and indistinguishable from placebo*." P631 and "In fact, TENS and PES differ in many ways." P635
Gaul et al., 2016 [49]	Not standard TENS - invasive vagus nerve stimulation	Evaluated non-invasive vagus nerve stimulation for prevention and acute treatment of chronic cluster headache using "*… a low-voltage electrical signal (5-kHz sine wave series that occurred for 1 ms and repeated every 40 ms (25Hz)).*" p 535
Geirsson et al., 1993 [50]	Not standard TENS - posterior tibial nerve stimulation	Evaluated TENS of the tibial nerve in patients with interstitial cystitis using electrodes positioned over the tibial nerve on the foot. Thus, TENS delivered distant to symptoms. Posterior tibial nerve stimulation is a neuromodulation technique to treat overactive bladder and associated symptoms. TENS is administered over tibial nerve distant from sensations associated with urinary urgency.
Ghoname et al., 1999c [51]	Not standard TENS - percutaneous electrical nerve stimulation	Evaluated the effect of stimulus frequency on response to percutaneous electrical nerve stimulation in patients with chronic low back pain delivered via ten, 32-gauge (0.2 mm) stainless steel acupuncture-like needle probes placed into soft tissue and/or muscle in the low back region to a depth of 2–4 cm.
Gokce et al., 2020 [52]	Not RCT	Evaluated bilateral transcutaneous tibial nerve stimulation on constipation severity in geriatric patients with refractory chronic constipation.
Gottfried et al., 2019 [53]	Not focussed on pain - Not TENS - abstract	Evaluated transcutaneous vagal nerve stimulation improves symptoms, pain, and gastric emptying in patients with idiopathic gastroparesis.
Govil et al., 2020 [54]	Not RCT	Evaluated extent to which genetic variability modifies Transcutaneous Electrical Nerve Stimulation (TENS) effectiveness in osteoarthritic knee pain
Gu et al., 2019 [55]	Not standard TENS - TEAS	Evaluated effects of TEAS on gastrointestinal function recovery after laparoscopic radical gastrectomy
Gorodetskyi et al., 2007 [56]	Not standard TENS - non-invasive interactive neurostimulation (InterX)	Evaluated non-invasive interactive neurostimulation in the post-operative recovery of patients with a trochanteric fracture of the femur. Currents delivered using a handheld, non-invasive, interactive neurostimulation device (InterX 5000; Neuro Resource Group, Plano, Texas) device that " *… generates a high peak amplitude averaging 17 volts on the skin with a low current of about 6 mA, and damped biphasic electrical impulses which are delivered to the tissue through a pair of concentric electrodes placed in direct contact with the target area. The device is able to adjust its strength and damping of the biphasic stimulus changes in accordance with the impedance of the underlying tissue (Fig. 1), resulting in a highly sensitive and variable voltage in order to maintain constant peak current.*"

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Reference	Reason for exclusion	Description of study
Harrison et al., 1987 [57]	Not an RCT – May also be using part of sample in Harrison 1986	Evaluated TENS for labour pain. Patient self-selected treatment – not random allocation/RCT "All patients were informed about the methods of analgesia available, including TENS. They were asked if they had decided upon a specific form of analgesia and what it was. Information regarding the trial and its aims was then given to all potential participants and those giving informed consent were enrolled in their specific group of choice."
Hedner et al., 1996 [58]	Not an RCT – narrative review	This is a narrative overview that describes the RCT by Milson et al., 1994 - included
Herman et al., 1994 [59]	Not standard TENS - Codetron	Evaluated 'acupuncture-like stimulation' using a Codetron device for acute occupational low back pain. Codetron is a neuromodulation technique described as the delivery of acupuncture-like stimulation to six locations on the body in a random order.
Hettrick et al., 2004 [60]	No pain outcome – measured itch	Evaluated the role of TENS for the management of burn-related pruritus
Hsieh et al., 1992 [61]	Not an RCT – analysis of scales used in an RCT by [62] which was excluded	Evaluated reliability of instruments used in a RCT of transcutaneous muscle stimulation on chronic low back pain. This publication pre-empted publication of RCT by Pope et al., 1994
Huang et al., 2017 [63]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electrical acupoint stimulation at different frequencies on perioperative anaesthetic dosage, recovery, complications, and prognosis in video-assisted thoracic surgical lobectomy delivered to acupoints Neiguan (PC6), Hegu (LI4), Lieque (LU7), and Quchi (LI11) distant from pain and using a HANS-200A Acupoint Stimulator and frequency set as 2/100, 2, or 100 Hz in the dense-and-disperse mode before, during and post-surgery
Huang et al., 2018 [64]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electrical acupoint stimulation for recovery after laparoscopic colorectal cancer resection delivered to ST36 (leg) distant to pain before and during surgery
Huang et al., 2019 [65]	Not standard TENS - transcutaneous electrical acupoint stimulation	Evaluated transcutaneous electrical acupoint stimulation for pain in patients "in expansion process of skin soft tissue dilator on forehead by water injection applied to acupuncture points at the wrist (PC6), forehead (shangxing) and diwei points. Article in Chinese
Ing et al., 2015 [66]	Not standard TENS - microampere rather than milliampere	Evaluated TENS for chronic postherpetic neuralgia using electronic neuroadaptive regulation (SCENAR) delivered using a Tennant Biomodulator (TBM) device. The authors state "*The major difference between SCENAR and TBM devices and the traditional TENS units is that the former devices utilize microamps, not the milliamps utilized by the TENS units.*" P477
Issenman et al., 1985 [67]	Not an RCT	Evaluated TENS for pain control after spinal fusion with Harrington rods and assessed 'hospital charts' of patients who used TENS with sex and age matched controls. It was described as an evaluation of the effectiveness of their postoperative pain management programme with no statement that this was a prospective study with randomisation
Itoh et al., 2008 [68]	Not standard TENS – electrical characteristics are interferential therapy	Evaluated TENS for osteoarthritis of the knee versus acupuncture or acupuncture combined with TENS or topical poultice. The authors describe this as TENS but inspection of the reported electric characteristics suggest this is IFT "single-channel portable TENS unit (model HVF3000, OMRON Healthcare Co Ltd, Japan), which sends between two electrodes a premixed amplitude-modulated frequency of 122 Hz (beat frequency) generated by two medium frequency sinusoidal waves of 4.0 and 4.122 kHz (feed frequency)."
Itoh et al., 2009 [69]	Not standard TENS – electrical characteristics are interferential therapy	Evaluated TENS for chronic low back pain versus acupuncture or acupuncture combined with TENS or topical poultice. The authors describe this as TENS but inspection of the reported electric characteristics suggest this is IFT "single-channel portable TENS unit (model HVF3000, OMRON Healthcare Co Ltd, Japan), which sends between two electrodes a premixed amplitude-modulated frequency of 122 Hz (beat frequency) generated by two medium frequency sinusoidal waves of 4.0 and 4.122 kHz (feed frequency)."
Jarden et al., 1999 [70]	Conference abstract - ? reporting RCT by Jarzem et al., 2005 (included	Evaluated conventional transcutaneous electrical nerve stimulation [TENS] with sham therapy using a randomized double-blind crossover design. Transcutaneous electrical nerve stimulation for non-acute low back pain: a randomized double-blind study of conventional, nu-waveform, acupuncture-type and sham therapies.
Jeans et al., 1979 [71]	Not an RCT	Evaluated the effect of brief, intense transcutaneous electrical stimulation on chronic pain
Jiang et al., 2019 [72]	Not standard TENS - Cefaly	Evaluated efficacy and safety of combination therapy of flunarizine plus transcutaneous supraorbital neurostimulation (tSNS) compared with either flunarizine or tSNS alone for migraine prophylaxis
Juarez-Albuixech et al., 2019 [73]	Not RCT	Evaluated efficacy of Volta Therapy and transcutaneous electrical nerve stimulation (TENS) in the treatment of lumbosciatica

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Reference	Reason for exclusion	Description of study
Junger et al., 2008 [74]	Not standard TENS - microcurrent electrical stimulation	Evaluated Local therapy and treatment costs of chronic, venous leg ulcers treated with electrical stimulation using a Dermapulse device (Gerromed, Hamburg, Germany) delivering currents with varying polarity at a pulse frequency of 128 Hz and an average current strength of 300 microamperes (initially 300 mA, if pain or paraesthesia was noted, it was reduced)
Kaplan et al., 1994 [75]	Not an RCT	Evaluated TENS for dysmenorrhea. Open label single group without a comparison group
Katz and Melzack 1991 [76]	TENS delivered to acupuncture points distant to pain	Evaluated low frequency high intensity auricular TENS for phantom limb pain.
Kempf et al., 2018 [77]	Not standard TENS – H wave	Evaluated short-term application of High-Tone Electrical Muscle Stimulation (HTEMS) compared to Transcutaneous Electrical Nerve Stimulation (TENS) with chronic sciatica.
Kho et al., 1991 [78]	Unable to isolate TENS effects	Evaluated transcutaneous stimulation combined with acupuncture for surgery for retroperitoneal lymph node dissection major surgery. Not possible to isolate the effects of TENS from those of acupuncture
Kocyigit et al., 2012 [79]	Not an RCT – experimental study	Evaluated effects of Low-frequency Transcutaneous Electrical Nerve Stimulation on Central Pain Modulation in patients with subacromial impingement syndrome of the shoulder. The experimental paradigm was to evaluate pain-induced activation in the brain during low-frequency TENS application in response to experimentally induced painful stimuli although the nature of the stimuli unclear "*The involved arm of the patient was grasped by the researcher*"
Kolen et al., 2012 [80]	Not standard TENS device or electrodes	Evaluated different ways of delivering TENS for osteoarthritis of the knee. Used a prototype TENS device with a matrix electrode array.
Kolu et al., 2018 [81]	Unable to isolate TENS effects	Evaluated transcutaneous nerve stimulation combined with high-intensity laser therapy and ultrasound treatment in patients with chronic lumbar radiculopathy. Not possible to isolate TENS
Koo et al., 2015 [82]	Unable to isolate TENS effects	Evaluated Noxipoint Therapy to conventional physiotherapy that consisted of TENS, exercise, and manual and heat therapies for the treatment of chronic neck and shoulder. Noxipoint Therapy is a modified technique to deliver TENS over tender muscle points to produce a sore pain and does not meet our criteria for standard TENS and the comparator group included TENS combined with other treatments
Kumar et al., 1997 [83]	Not standard TENS – H-wave therapy	Evaluated transcutaneous electrostimulation for chronic painful peripheral neuropathy. The authors state "Electrotherapy was given by a portable, rechargeable unit, the H-Wave machine (Electronic Waveform Lab, Huntington Beach, CA), which has output parameters that are distinct from the other available transcutaneous electrical nerve stimulation (TENS) modalities." P 1703 Current is biphasic, exponentially decaying waveform with pulse widths of 4 ms and $\leq$35 V The electric current strength varies with voltage setup to a maximum of 35 mA, and the pulse frequency is user adjustable (2-70 Hz).
Kumar et al., 1998 [84]	Not standard TENS - H-wave therapy	Evaluated transcutaneous electrostimulation for chronic painful peripheral neuropathy using H-Wave device with parameters distinct from standard TENS.
Labrunee et al., 2015 [85]	No pain outcomes	Evaluated randomized placebo control study to determine whether applying TENS before exercise in PAD patients could delay onset of pain and lead to longer walking distances
Lan et al., 2012 [86]	TENS delivered to acupuncture points distant to pain	Evaluated TENS on six acupuncture points for pain after total hip arthroplasty for elderly patients. Acupuncture points were generally distant to the site of pain (bilateral P6 on anterior surface of the forearm; L14 on dorsum of hand; ipsilateral to the surgery ST36 anterior crest of the tibia; GB31 between greater trochanter of femur and hiatus of sacrum).
Lanham et al., 1984 [87]	Not an RCT	Evaluated TENS combined with hypothermia in podiatric surgery by describing a series of 69 patients that received treatment. There was no comparison group
Lee et al., 1997 [88]	Not standard TENS - medium frequency AC plus galvanic	Evaluated electrical stimulation for pain associated with myofascial trigger points. The type of current was a combination of medium-frequency AC current and Galvanic current at a frequency of 50-100Hz Not standard TENS - combination of medium frequency AC plus galvanic
Lee et al., 2015 [89]	Unable to isolate TENS effects	Evaluated effect of a device combining high-frequency transcutaneous electrical nerve stimulation and thermotherapy (I-Rune I-200L, Midirune Co.) for primary dysmenorrhea. Not possible to isolate TENS because TENS and thermal therapies combined
Lehmann et al., 1983 [90]	Not standard TENS characteristics – delivered below sensory detection threshold (subthreshold TENS – reporting data from same sample as Lehmann et al., 1986	Evaluated subthreshold TENS versus placebo TENS and electroacupuncture for chronic low back pain. Analysis of nonorganic findings.
Lehmann et al., 1986 [91]	Not standard TENS characteristics – delivered below sensory detection threshold (subthreshold TENS – probably reporting same data as Lehmann et al., 1983	Evaluated subthreshold TENS versus placebo TENS and electroacupuncture for chronic low back pain. Analysis of efficacy.

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Reference	Reason for exclusion	Description of study
Lerma et al., 2020 [92]	Not full report – Abstract of conference poster	Evaluated TENS for pain control during first-trimester abortion.
Li et al., 2019 [93]	Not standard TENS - TEAS	Explored effect and mechanisms of TEA on postoperative recovery after caesarean section
Lin et al., 2017 [94]	Not standard TENS – TEAS delivered to acupuncture points	Evaluated regulatory effects of acupoint electric stimulation on the analgesic substances and the relevant indices of nerve-immunity-endocrine system in the patients undergoing general anaesthesia anorectal operation
Liu et al., 2015 [95]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electrical acupuncture stimulation combined with sufentanil anaesthesia for intraoperative and postoperative supratentorial craniotomy. Electrodes applied at five pairs of acupuncture points: Hegu (LI4) and Waiguan (TE5), Jinmen (BL63) and Taichong (LR3), Zusanli (ST36) and Qiuxu (GB 40), and Fengchi (GB20) with Tianzhu (BL10) and Cuanzhu (BL2) with Yuyao (EX-HN4) on the craniotomy side and currents delivered using a Han's acupoint nerve stimulator (LH202H, Beijing Huawei Co, Ltd, Beijing, China) with a dense-disperse frequency of 2/100 Hz (alternated once every 3 s; 0.6 ms at 2 Hz and 0.2 ms at 100 Hz).
Loeser et al., 1975 [96]	Not an RCT	Evaluated TENS for various chronic pains. No comparison groups
Lone et al., 2003 [97]	Not an RCT	Evaluated TENS for osteoarthritis of the knee. Authors state "*The results of this non-randomised controlled single-blind continuous trial ….*" p481
Lorenzana et al., 1999 [98]	TENS on remote acupuncture points	Evaluated the efficacy of transcutaneous electrical nerve stimulation (TENS) versus lidocaine in the relief of episiotomy pain
Lv et al., 2018 [99]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous acupoint electrical stimulation combined with sufentanil pre-treatment on incidence and severity of etomidate-induced myoclonus delivered bilaterally, at hegu and waiguan acupoints (on arm) using to 2/100Hz "dilatational waves". Acupoint not covering painful site
Macdonald and Coates, 1995 [100]	Not standard TENS - transcutaneous spinal electroanalgesia and TENS control group not applied at site of pain	Evaluated Transcutaneous Spinal Electroanalgesia for Chronic Pain. Used TENS as a control for comparison but stated "Normally one would not apply TENS to these locations" p656
Malmir et al., 2017 [101]	Not clinical pain - sample of pain-free participants	Evaluated TENS on experimentally induced delayed onset muscle soreness in Amateur Athletes
Maria Fernandez-Seguin et al., 2019 [102]	Not TENS	Evaluated radiological changes after combining static stretching and transcutaneous electrical stimulation of the plantar fascia in adults with idiopathic cavus foot
Matsuse et al., 2020 [103]	No pain outcomes - Not treating pain	Evaluated effectiveness of a hybrid training system with walking that simultaneously applies electrical stimulation to the knee extensors/flexors during walking in obese women with knee pain
McGough et al., 2019 [104]	No pain outcomes - Not pain	Evaluated efficacy and safety of TNS for Attention-Deficit/Hyperactivity Disorder and potential changes in brain spectral power using resting state quantitative electroencephalography
Meade et al., 2010 [105]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electric acupoint stimulation as adjunctive treatment for opioid detoxification using a Han's Acupoint Nerve Stimulator to deliver currents to "hegu" and "neiguan" acupoints on dorsal and palmar surface of one hand, and dorsal and ventral surface of the other forearm. Frequency of stimulation alternated between 2 and 100 Hz at 3-second intervals. Primary outcome was opioid consumption although physical pain in past 24 hours assessed using the Brief Pain Inventory was a secondary outcome.
Meechan et al., 1998 [106]	TENS administered internally – intra-oral	Evaluated transcutaneous electronic nerve stimulation for discomfort associated with regional anaesthesia in dentistry using an injection-assist TENS machine (3M, St Paul, Minnesota, USA) with electrodes positioned in the mouth either side of the needle puncture point.
Melzack et al., 1975 [107]	Not standard TENS device and electrodes	Evaluated TENS for various chronic pains using a Grass model S8 stimulator and EEG disc electrode to deliver currents
Melzack et al., 1980 [108]	Not an RCT - "Patients were assigned alternately, as they arrived at the clinic, to each order of treatment."	Evaluated TENS versus ice massage in patients with chronic low back pain
Mi et al., 2018 [109]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated the effect of transcutaneous electrical acupoint stimulation (TEAS) on the quality of recovery during the early period after laparoscopic cholecystectomy and the dosage of anaesthetic and analgesic
Miller Jones et al., 1980 [110]	Not an RCT	Evaluated TENS for labour Pain. Not prospective randomisation -patients were given TENS and followed. Then retrospectively they were compared with a sample taken from patients who had not received TENS - EXCLUDE AS NOT RADMOSIED
Monaco et al., 2013 [111]	No pain outcomes	Evaluated effect of TENS on electromyographic and kinesiographic activity in patients with temporomandibular disorder. No pain outcomes

10_OL-TABLE3_ExcludedStudies

Reference	Reason for exclusion	Description of study
Mucuk and Baser, 2014 [112]	Not standard TENS - TENS-acupuncture pen	Evaluated non-invasive electroacupuncture on labour pain using a TENS-acupuncture pen with a maximum output of 0.6mA administered to acupuncture points LI4 (hand)SP6 (leg/foot)
Mummolo et al., 2019 [113]	Not RCT – retrospective evaluation	Evaluated effects of ultra-low-frequency transcutaneous electrical nerve stimulation (ULF-TENS) on pain and electromyographic values in subjects affected by temporomandibular disorder
Murina et al., 2008 [114]	TENS administered internally - intravaginal	Evaluated TENS to treat vestibulodynia using a dual channel portable TENS unit (YSY-EST device) and a commercially available plastic vaginal probe with two gold metallic transversal rings as electrodes (Periprobe VAG2ST Beac, Pavia, Italy) inserted 20 mm into the vagina
Murina et al., 2018 [115]	TENS administered internally - intravaginal	Evaluated TENS plus diazepam to treat vestibulodynia using a dual channel portable TENS unit (NeuroTrac Continence; VerityMedical, London, UK) and a commercially available plastic vaginal probe with two gold metallic transversal rings (Periprobe VAG2ST Beac, Pavia, Italy) inserted 20 mm into the vagina
Mysliwiec et al., 2011 [116]	No pain outcomes	Evaluated effect of cervical traction and TENS on strength of painless grip
Naeser et al., 2002 [117]	Not standard TENS – microcurrent electrical stimulation	Evaluated carpal tunnel syndrome pain treated with low-level laser and microamperes transcutaneous electric nerve stimulation
Nakano et al., 2019 [118]	Not RCT	Evaluated effects of TENS on pain and other physical symptoms in 20 in-patients with advanced cancer receiving palliative care
Ngai et al., 2010 [119]	Not clinical pain	Evaluated Acu-TENS on functional capacity and beta-endorphin level in subjects with chronic obstructive pulmonary disease
Noehren et al., 2015 [120]	Protocol – ongoing study	Protocol of an RCT to evaluate TENS for fibromyalgia: a double-blind randomized clinical trial. Full RCT published **after our search** Dailey et al., 2019 Arthritis Rheumatol. 2019 Nov 18. doi: 10.1002/art.41170.
Nourbakhsh and Fearon, 2008 [121]	Not standard TENS device or electrodes	Evaluation of noxious level electrical stimulation on chronic lateral epicondylitis administered using a MRL Neuroprobe System V (CR Kesner Company, Geneva, IL, USA) as painful stimulation of trigger points for 30s using 4Hz interupted DC current and a probe electrode
Okonkwo et al., 2018 [122]	Not an RCT	Evaluation of TENS for post-injection sciatic pain in a non-randomized controlled clinical trial.
Oyibo et al., 2004 [123]	Not standard TENS - microcurrent electrical stimulation	Evaluated electrical stimulation therapy through silver-plated nylon-Dacron™ stocking electrodes (Micro-Z, Prizm Medical, Duluth, GA, USA) for painful diabetic neuropathy. Pulsed electric current were delivered a subsensory dose approximately 50 micro amps at 80 pulses per second for the first 10 min, then 8 pulses per second for the next 10 min each hour over an 8-h period.
Ozen et al., 2019 [124]	Cannot isolate TENS - hotpack, transcutaneous electrical nerve stimulation (TENS , and ultrasound	Evaluated effects of physiotherapy modalities with those of acupuncture on pain, daily function, and quality of life in FMS patients.
Park et al., 2014 [125]	No pain outcomes	Evaluated TENS with exercise on spasticity, balance, and gait in patients with chronic stroke. No pain outcomes.
Patel et al., 2016 [126]	Unable to isolate TENS effects	Evaluated TENS with McKenzie method for lumbar radiculopathy. Not possible to isolate the effects of TENS from McKenzie
Peng et al., 2010 [127]	Not an RCT	Evaluated TENS on Acupoints for labour pain. Stated a Non-randomized Controlled Study
Polat et al., 2017 [128]	Not an RCT	Evaluated TENS combined with hot pack and home exercise program for osteoarthritis of the knee with and without neuropathic pain. There was no comparison intervention
Pope et al., 1994 [129]	Not standard TENS - neuromuscular electrical stimulation	Evaluated transcutaneous muscle stimulation for sub-acute low back pain using a Myocare PLUS device which is considered to be a neuromuscular stimulator and thus excluded. Note: Currents produced physiological stimulation that could be considered within the scope of 'standard TENS' Biphasic pulses 37pps pulse duration 225 us with pulse amplitude modulated (ramped up in 2 s held for 6s then ramped off in 2s … then a pause before cycle repeated. 4 electrodes placed on back around pain and current delivered to maintain sensation as high as possible – no mention of muscle twitching
Pour et al., 2012 [130]	TENS applied to acupuncture points away from painful area [TENS applied to acupuncture points on foot and SP6 for labour pain]	Evaluated effect of two methods of compressive medicine and electrical stimulation of the skin on the severity of labour pains in the first pregnant women.
Quinton et al., 1987 [131]	Some participants not adults	Evaluated TENS in acute hand infections. Sample included at least one child under 16years of age (age range from 15 to 66 years).
Radhakrishna et al., 2020 [132]	TENS applied pre-emptive before general surgery and pain measured post operatively without TENS	Evaluated the effect of immediate preoperative TENS on intraoperative anaesthetic drug consumption in patients undergoing lumbar discectomy under general anaesthesia

10_OL-TABLE3_ExcludedStudies

Reference	Reason for exclusion	Description of study
Rapoport et al., 2019 [133]	Not TENS - secondary report of Yartisky	Performed a post-hoc analysis on a subgroup of participants with migraine from a randomized, double-blind, parallel-group, sham-controlled, multicentre study
Razavi and Jansen, 2004 [134]	Not standard TENS - placebo TENS only	Evaluated acupuncture and placebo TENS in addition to exercise in treatment of rotator cuff tendinitis. No active TENS intervention.
Reich et al., 1989 [135]	Unable to isolate TENS effects	Evaluated various non-invasive treatments for vascular and muscle contraction headache including an 'Electrical Group' that received either traditional TENS or electrical neurotransmitter modulation, either singly or in combination. Data was analysed at group rather than modality level.
Reichstein et al., 2005 [136]	Not standard TENS – H wave characteristics delivered using a CEFAR Dumo TENS device	Evaluated effects of high-frequency external muscle stimulation HF) with those of TENS in patients with diabetic distal symmetrical sensory polyneuropathy.
Rodriguez-Fernandez et al., 2011 [137]	Not clinical pain - sample of pain-free participants	Evaluated burst-type TENS on cervical range of motion and latent myofascial trigger point sensitivity in a sample of individuals recruited from a pain-free population with at least 1 latent myofascial trigger point in their upper trapezius. Sample not recruited from clinical pain population.
Rooney et al., 1986 [138]	No pain outcomes	Evaluated cryoanalgesia and TENS on pulmonary function tests post thoracotomy. No pain outcome
Roth and Thrash, 1986 [139]	Not standard TENS - microampere currents, and not standard electrodes and invasive technique	Evaluated TENS for pain associated with orthodontic tooth movement. In one group TENS was applied externally over zygomatic arches using sponge pad electrodes – not standard TENS electrodes (0.5 Hz with an intensity of 500 mA). In one group TENS was applied internally (intraoral) directly to teeth using one probe electrode on the crown of each tooth and the other electrode on the palatal mucosa adjacent to the tooth (0.5 Hz, intensity of 50 mA) – Internal Currents were delivered using Alpha-Stim model 2000 which produces a biphasic waveform with varying pulse widths in the millisecond range and intensities in the microampere range (i.e. microcurrent). It is probable that 500mA and 50mA were typographical errors that should read 500 microampere and 50 microamperes. "*Both groups were told that the intensity of the current was so small that the most they would feel was a very slight tingling, if anything at all.*" p133
Santiesteban et al., 1985 [140]	TENS delivered to acupuncture points distant to pain	Evaluated TENS on acupuncture points for primary spasmodic dysmenorrhea using a MRL pain control system (5Hz, 250us, intensity to patient tolerance). Acupuncture points were not covering painful site (GB34, Sp6, (leg).
Sari et al., 2019 [141]	Unable to isolate TENS	Evaluated intermittent pneumatic compression along with conventional treatment with cold pack treatment along with conventional treatment on clinical outcomes in patients with knee osteoarthritis
Schuster et al., 1980 [142]	Not an RCT - 26 control patients were selected at random. Records were matched as closely as possible	Evaluated use of TENS and narcotic analgesics in relieving post-operative pain.
Schoenen et al., 2013 [143]	Not standard TENS - supraorbital transcutaneous stimulator	Evaluated trigeminal neurostimulation with a supraorbital transcutaneous stimulator (Cefaly, STX-Med., Herstal, Belgium) for migraine prevention. Neurostimulation delivered with one 30 mm 3x94 mm self-adhesive electrode on forehead and delivery of biphasic rectangular pulsed currents (250 μs, 60 Hz, 16 mA).
Schomburg and Carter-Baker, 1983 [144]	Not an RCT	Evaluated TENS for post laparotomy pain compared with chart review to 75 patients who had undergone similar surgical procedures performed by the same surgeon before TENS postoperative pain management had been instituted.
Selfe et al., 2008 [145]	Not standard TENS - noninvasive interactive neurostimulation (InterX5000 device	Evaluated Noninvasive Interactive Neurostimulation on Symptoms of Osteoarthritis of the Knee using an InterX5000 device (Neuro Resource Group, Plano, TX)
Shirazi et al., 2014 [146]	Not an RCT	Evaluated TENS on joint position sense in patients with knee joint osteoarthritis. Pre-post study without a comparison group.
Silberstein et al., 2016 [147]	Not standard TENS - 5KHz sine wave	Evaluated non-invasive vagus nerve stimulation for chronic migraine headache prevention using low voltage 5KHz sine wave lasting 1 millisecond with such bursts repeated every 40 milliseconds (Electrocore Ltd)
Silberstein et al., 2016 [148]	Not standard TENS - 5KHz sine wave	Evaluated non-invasive vagus nerve stimulation for the acute cluster headache using low voltage 5KHz sine wave lasting 1 millisecond with such bursts repeated every 40 milliseconds (Electrocore Ltd)
Simon et al., 2015 [149]	Not an RCT	Evaluated TENS for chronic axial low back pain on a single cohort stratified for age. Dose-response study with no other intervention comparison groups.
Simpson and Ward, 2004 [150]	Not standard TENS - transcutaneous spinal electroanalgesia	Evaluated transcutaneous spinal electroanalgesia for pain from chronic critical limb ischemia. Transcutaneous spinal electroanalgesia uses two electrodes placed over dorsal spine and delivers currents that do not cause action potentials in peripheral nerves and no sensation of paraesthesia (4 us, 1800–2500 Hz, 100–300 V, Advanced Pain Management)

10_OL-TABLE3_ExcludedStudies

Reference	Reason for exclusion	Description of study
Solomon and Guglielmo, 1985 [151]	Not standard TENS - microcurrent electrical stimulation	Evaluated TENS for headache using a device that "… *differs from most other TENS equipment by its low amperage (maximum 4 milliamperes), high frequency (12,000 to 20,000 Hz rectified to monophasic wave form) and short pulse width (approximately 30 microsec)*" p 12
Solomon et al., 1989 [152]	Not standard TENS - microcurrent electrical stimulation	Evaluated Cranial Electrotherapy in the Treatment of Tension Headache using "… *extremely low level, high frequency current applied transcranially*" – microcurrent p 445
Sonde et al., 2000 [153]	No pain outcomes	Evaluated TENS for post-stroke paretic arm on functional outcomes including spasticity and activities of daily function but not pain
Stralka et al., 1998 [154]	Not standard TENS - high voltage pulsed direct current	Evaluated high voltage pulsed direct current built into a wrist splint for hand and wrist pain
Stratton and Smith, 1980 [155]	No pain outcomes	Evaluated TENS for postoperative thoracotomy on ventilatory function including forced vital capacity but not pain
Strayhorn et al., 1983 [156]	Not an RCT	Evaluated TENS on use of narcotic analgesics and occurrence of postoperative complications following gastric bypass surgery for control of obesity from chart review
Sun et al., 2017 [157]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated Perioperative Transcutaneous Electrical Acupoint Stimulation for Postoperative Pain Relief Following Laparoscopic Surgery using a HANS Acupoint Nerve Stimulator (HANS-200A, Nanjing Jisheng Medical Technology Company, Nanjing, China) delivering an alternating dense and disperse stimulation (2Hz (0.6 ms pulse width) alternated with 100 Hz stimulation (0.2 ms pulse width) every 3 seconds to maximum current tolerated but subnoxious) to Hegu (LI4) and Neiguan (P6) distant from pain
Sunshine et al., 1996 [158]	Not standard TENS – microcurrent electrical stimulation	Evaluated microcurrent TENS and massage for fibromyalgia (Electroacuscope device)
Takla and Rezk-Allah, 2018 [159]	Not standard TENS - combination therapy, unable to isolate effect of TENS	Evaluated simultaneous application of TENS and ultrasound phonophoresis on active myofascial trigger points as a combined therapy using an Intelect Advanced Combo therapy system (2752CC; Chattanooga DJO France SAS Industries; Mexico) device. Using an ultrasound treatment head as an electrode and not possible to isolate TENS - Combined therapy
Takla et al., 2018 [160]	Not standard TENS - combination therapy, unable to isolate effect of TENS	Evaluated low-frequency high-intensity versus medium-frequency low-intensity TENS delivered as combined therapy with ultrasound phonophoresis for management of active myofascial trigger points using an Intelect Advanced Combo therapy system (2752CC; Chattanooga DJO France SAS Industries; Mexico) device. Using an ultrasound treatment head as an electrode and not possible to isolate TENS - Combined therapy
Thiese et al., 2013 [161]	Not an RCT	Evaluated electrical stimulation for chronic non-specific low back pain in a working-age population – Report of a Protocol
Thompson et al., 2008 [162]	Not standard TENS - transcutaneous spinal electroanalgesia	Evaluated transcutaneous spinal electroanalgesia (TSE) on low back pain. "…*TSE bears a superficial resemblance to transcutaneous electrical nerve stimulation (TENS) but differs in that it is applied to the skin overlying the vertebral spine and uses stimulation frequencies far higher (2500+ Hz) than those used for TENS (circa 1–150 Hz)…. The pulse widths used for the two systems are also substantially different (4 ls for TSE compared with 50–200 ls for TENS).*"
Tok et al., 2011 [163]	Unable to isolate TENS effects	Evaluated electrical stimulation combined with continuous passive motion on symptoms, functional capacity, quality of life and balance in knee osteoarthritis. Combination therapy not possible to isolate contribution of TENS.
Tousignant-Laflamme et al., 2017 [164]	Not an RCT - only one intervention	Evaluated acupuncture-like TENS for chronic low back pain. Design was a randomized, crossover study to determine the duration of analgesia following 15- and 30-minute treatment. No comparison intervention group.
Tu et al., 2019 [165]	TENS delivered to acupuncture points distant to pain	Evaluated transcutaneous electrical acupoint stimulation on postoperative analgesia after ureteroscopic lithotripsy delivered to bilateral Shenyu (BL23) outside spinous process of L2 and SP9 between posterior tibia border and gastrocnemius muscle using a HANS LH-202 electrical stimulator.
Vance et al., 2018 [166]	Not an RCT	Development of a method to maximize intensity of TENS used for fibromyalgia by analysing baseline data from an ongoing clinical RCT investigating the effects of TENS in women with fibromyalgia – the Fibromyalgia Activity Study with TENS (FAST; NCT01888640).
VanderArk and McGrath, 1975 [167]	Some participants not adults	Evaluated TENS for post-operative pain. Some participants were not adults (13 years to 87 years).
Vincenti et al., 1982 [168]	Not an RCT	Evaluated TENS for labour pain.
Vinterberg et al. 1978 [169]	Not an RCT	Evaluated TENS for rheumatoid arthritis.

10_OL-TABLE3_ExcludedStudies

Reference	Reason for exclusion	Description of study
Wang et al., 1988 [170]	Some participants not adults	Evaluated TENS for sickle cell pain crises. Some participants were not adults (12years to 27 years)
Wang, 1997 [171]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electrical acupoint stimulation on analgesic consumption post operation lower abdomen surgery at acupuncture points (Hegu (LI14) and either side of the incision site) using dense-disperse current.
Wang et al., 2007 [172]	Not standard TENS - acupuncture acupoint stimulator	Evaluated TENS applied to acupoints for labour pain using an acupuncture acupoint stimulator (G-6502-2A). Acupuncture points LI4 PC6 SP6 LR3 not at site of pain.
Wang et al., 2007 [173]	TENS delivered to acupuncture points distant to pain	Evaluated abdominal acupuncture TENS on leg shoulder loin and neck pain using acupuncture points that are distant from pain LI4 PC6 SP6 LR3 – in Chinese Excluded based on abstract.
Wang et al., 2007 [174]	Not standard TENS - 'pen shaped' electrodes	Evaluated acupuncture-like electrical stimulation on chronic tension-type headache using a 'pen shaped' electrode with a tip diameter of 1mm delivering dense-and-disperse currents (TAO, MibiTech ApS, Helsingør, Denmark) to six acupoints distant to the pain , bilateral EX-HN5, GB 20, LI 4
Wang et al., 2008 [175]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated pre and during surgery TEAS on blood bioactive compounds involving cerebral injury during craniotomy at LI4, LI11 ST36 SP6 distant to pain not at site of pain. No pain measure in Chinese Excluded based on abstract.
Wang et al., 2009 [176]	Not standard TENS - transcutaneous electric acupoint stimulation	Wang, Z. X. (2009) Clinical observation on electroacupuncture at acupoints for treatment of senile radical sciatica. [Chinese]. Zhongguo zhen jiu = Chinese acupuncture & moxibustion 29 (2), 126-128.
Wang et al., 2014 [177]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electric acupoint stimulation on intra-operative remifentanil consumption and postoperative side-effects in patients undergoing sinusotomy delivered to Hegu (LI4), Neiguan (PC6), and Zusanli (ST36) a 6–9mA,2/10 Hz before anaesthesia.
Ward et al., 2009 [178]	Not clinical pain - sample of pain-free participants	Evaluated A efficacy of medium frequency alternating current and TENS on healthy participants.
Wattrisse et al., 1993 [179]	Not standard TENS - Limoges currents	Evaluated effect of transcutaneous cranial electrical stimulation with Limoges currents – French. Excluded based on abstract.
Weng et al., 2005 [180]	Not standard TENS - 5KHz currents modulated at lower frequencies	E*valuated modulated-frequency mode of AL-TENS on tennis elbow pain.* "*… treated with either 5 KHz modulated by 2 Hz frequency mode (LF group), 5 KHz modulated by 100 Hz frequency mode of TENS (HF group) on acupuncture points (LI10 and LI11)*". Output characteristics seems to be a carrier wave of 5KHz modulated at 2Hz or 100Hz.
Whitehair et al., 2019 [181]	Not TENS	Evaluated acute effects of TENS, transcutaneous neuromuscular electrical stimulation and no stimulation on pain-free passive range of motion of the shoulder in subjects with hemiplegic shoulder pain
Wieselmann-Penkner et al., 2001 [182]	No pain outcomes	Evaluated TENS and EMG-biofeedback on muscular relaxation in bruxism.
Williams et al., 2019 [183]	Not TENS Not RCT - healthy humans	Evaluated conditioned pain modulation efficiency in persons with and without migraine headaches
Williams 2019 [184]	Not RCT - Abstract	Evaluated feasibility of TENS as adjunctive treatment for post-operative orthopaedic pain.
Wilson and Stanczak, 2020 [185]	Not an RCT - Review	Round-up of the current body of evidence of using TENS for pain control in patients with advanced cancer and palliative pain.
Wong et al., 2003 [186]	Not standard TENS - Codetron	Evaluated acupuncture-like TENS for radiation-induced xerostomia associated with radical radiotherapy using Codetron device that delivers electrical currents randomly between 6 electrodes. Report of phase 1 of the RCT trial. Not an RCT
Wong et al., 2012 [187]	Not standard TENS - Codetron	Evaluated acupuncture-like TENS for radiation-induced xerostomia associated with radical radiotherapy using Codetron device. "*… This particular TENS device …differs from conventional TENS units, because it embeds a random circuit that enables random switching among 6 electrodes to prevent brain habituation to continuous stimulation*" page 4245. Report of phase 2 of the RCT
Wu et al., 2012 [188]	Not standard TENS - middle frequency electrical stimulation	Evaluation of middle frequency electrical stimulation for dysmenorrhea. Currents delivered at frequency of 1000 -10,0000 Hz to acupuncture points not covering pain site (LI4 SP6) using a GM390TE, GEMORE device
Xu et al., 2014 [189]	Cannot isolate TENS because all groups received identical TENS as combined therapy	Evaluated TENS in combination with cobalamin injection for postherpetic neuralgia.
Xie et al., 2017 [190]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electrical acupoint stimulation combined with palonosetron on chemotherapy-induced nausea and vomiting. No pain outcomes.
Yang et al., 2017 [191]	Not an RCT	Evaluated acupuncture like TENS on knee osteoarthritis (KOA) with low pain. Single intervention group divided according to low and high pai.n

10_OL-TABLE3_ExcludedStudies

Reference	Reason for exclusion	Description of study
Yang et al., 2017 [192]	Not clinical pain - slow-transit constipation	Evaluated transcutaneous electrical stimulation in women with slow-transit constipation. Primary purpose of study was to evaluate slow-transit constipation and associated symptoms of constipation, including abdominal pain as a secondary outcome. Target sample was women with slow-transit constipation rather than patients with clinical pain.
Yao et al., 2015 [193]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electric acupoint stimulation on quality of recovery and postoperative analgesia after gynaecological laparoscopic surgery to Hegu (LI4), Neiguan (PC6), Zusanli (ST36), and Sanyinjiao (SP6) acupoints distant from pain using a Hans electronic acupuncture apparatus (dense-disperse frequency (2/10 Hz), 6–9mA, HANS-100B, Nanjing Jisheng Medical Technology Company, Nanjing, China).
Yarnitsky et al., 2017)[194]	Not standard TENS - Remote Electrical Neuromodulation	Evaluated remote nonpainful electrical upper arm skin stimulation for reducing migraine attack pain. Remote Electrical Neuromodulation uses the principles of conditioned pain modulation applying high intensity TENS to the arm for migraine. Authors argue that REN on arm has neural relationship to migraine pain - we exclude because authors do not call this technique TENS, location of electrodes are remote, and currents delivered using parameters to simulate elicit conditioned pain modulation systems.
Yarnitsky et al., 2019)[195]	Not standard TENS and not at site of pain … much debate in team on this though	Evaluated efficacy and safety of a remote electrical neuromodulation (REN) device for the acute treatment of migraine.
Yeh et al., 2010 [196]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous acupoint electrical stimulation for postoperative pain in patients with patient-controlled analgesia. TEAS delivered at acupoints distant from pain, BL40, GB34, HT7, P6
Yeh et al., 2018 [197]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous acupoint electrical stimulation on post-hemorrhoidectomy-associated pain, anxiety, and heartrate variability at acupoints distant from pain, *chengshan* (BL57) and *erbai* (EX-UE2) and a stimulator (D0205KL, Ching-Ming Co., Taiwan) delivering dense disperse currents
Yilmaz et al., 2020 [198]	Not possible to isolate the effects of TENS - "a combination of US, TENS"	Evaluated high-intensity laser therapy (HILT) and a combination of transcutaneous nerve stimulation (TENS) and ultrasound (US) treatment on pain, range of motion (ROM) and functional activity on cervical pain associated with cervical disc herniation (CDH).
Yip et al., 2007 [199]	Unable to isolate TENS effects	Evaluated combined transcutaneous acupoint electrical stimulation and electromagnetic millimetre waves for spinal pain. Not possible to isolate TENS
Yousesef et al., 2015 [200]	Not standard TENS - posterior tibial nerve stimulation	Evaluated transcutaneous electrical posterior tibial nerve stimulation versus lateral internal sphincterotomy for treatment of chronic anal fissure. Transcutaneous electrical nerve stimulation of posterior tibial nerve is used for faecal and urinary incontinence and was applied using an Endomed 182 device (Enraf Nonius, Holland) with the negative contact electrode on the ankle skin behind the medial malleolus, and the positive electrode, 10 cm above the negative electrode.
Yu et al., 2019 [201]	Not standard TENS - TEAS	Evaluated TEAS on early recovery in patients undergoing gynaecological laparoscopic surgery.
Zeb et al., 2019 [202]	Not RCT	Evaluated effectiveness TENS in management of neuropathic pain in post-traumatic incomplete spinal cord injury patients.
Zhan and Tian 2019 [203]	Not standard TENS - TEAS	Evaluated effect and adverse effects of transverse abdominis plane block and TEAS on postoperative outcomes.
Zhang et al., 2014 [204]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated pre-treatment with transcutaneous electrical acupoint stimulation on the quality of recovery after ambulatory breast surgery. Transcutaneous electrical acupoint stimulation was delivered at acupoints distant from pain LI4, PC4, ST36 (hand and arm) using a TEAS - SDZ-V dense and disperse device.
Zhang et al., 2016 [205]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated TEAS before the anaesthesia induction on opioids consumption in patients undergoing off-pump coronary artery bypass grafting at distal-proximal acupoints combination (LI4 and CV17) and regional acupoints combination (CV17 and CV14) using a *Hwato* electronic acupuncture treatment instrument (model No. SDZ-V, Suzhou Medical Appliances Co., Ltd, Suzhou, China). - - InJClinExpMed 9(12)
Zhang et al., 2017 [206]	TENS delivered to body sites distant to pain	Evaluated TENS of foot for postoperative bladder spasms and pain. Stimulation not on pain site
Zhang et al., 2020 [207]	E - Not pain	Evaluated effect of transcutaneous electrical stimulation treatment in combination with intraoperative nerve staining on sexual function after radical surgery.
Zhao et al., 2015 [208]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated transcutaneous electrical acupoint stimulation for spasticity following Brain Injury using an acupoint nerve electrical stimulator (HANS-100A, Nanjing Gensun medical technology company, Nanjing, China) at Hegu (LI4)–Yuji (LU10) and Zusanli (ST36)–Chengshan (BL57). Pain on Disability Assessment Scale was a secondary outcome.
Zhou et al., 2018 [209]	Not standard TENS - transcutaneous electric acupoint stimulation	Evaluated Transcutaneous Electrical Acupoint Stimulation for gastrointestinal dysfunction after caesarean section SP6 and ST36 acupoints using a Hwato electric acupuncture treatment instrument (model No. SDZV; Suzhou Medical Appliances Co. Ltd, Suzhou, China) with a dilatational wave of 2/10 Hz (2-second cycle) for 30 min. TEAS delivered at acupoints distant from pain.

10_OL-TABLE3_ExcludedStudies

Reference	Reason for exclusion	Description of study
Zizic et al., 1995 [210]	Not standard TENS – microcurrent electrical stimulation	Evaluated pulsed electrical stimulation for osteoarthritis of the knee using low voltage (mean = 6.2V peak volts). Characteristics like those of microcurrent electrical stimulation although no overt statement to this effect in the report.

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*Note: Reference numbering in this list relates only to studies cited in this table

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