MASSACHUSETTS

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Medical Policy
Transcutaneous Electrical Nerve Stimulation

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Policy Number: 003

BCBSA Reference Number: 1.01.09 (For Plan internal use only)

Related Policies

- Interferential Stimulation for Treatment of Pain, #509
- Temporomandibular Joint Dysfunction, #035
- Percutaneous Electrical Nerve Stimulation or Percutaneous Neuromodulation Therapy, #172

Policy

Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity

A trial of transcutaneous electrical nerve stimulation (TENS) of at least 30 days may be considered **MEDICALLY NECESSARY** to establish efficacy for the management of refractory chronic pain (e.g., chronic musculoskeletal or neuropathic pain) that causes significant disruption of function when the following conditions have been met:

- The pain is unresponsive to at least 3 months of conservative medical therapy, **AND**
- The trial is monitored by a physician.

Refractory chronic pain is defined in this policy as pain that causes significant disruption of function and has not responded to at least 3 months of conservative therapy, including nonsteroidal anti-inflammatory medications, ice, rest, and/or physical therapy.

Documentation for the trial should include:

- Initial assessment/evaluation of the nature, duration, and perceived intensity of pain;
- The types and duration of prior treatments;
- Treatment plan including ongoing medications and proposed use of TENS unit, including the frequency and duration of treatment.

Clinical summary of the trial to determine efficacy should include:

- Perceived intensity of pain with and without TENS (e.g., 2 point or 30% improvement in visual analog scale [VAS]),
- Ongoing medication requirements for pain relief (if any),
- Other modalities (if any) in use for pain control, and
- Actual use of TENS on a daily basis (frequency and duration of application).

Continued use of TENS may be considered **MEDICALLY NECESSARY** for treatment of refractory chronic pain (e.g., chronic musculoskeletal or neuropathic pain) that causes significant disruption of function when the following conditions have been met:

- Efficacy has been demonstrated in an initial therapeutic trial; AND
- Compliance has been demonstrated in the therapeutic trial with the device used on a regular basis (eg, daily or near daily use) throughout the trial period.

Note: A TENS billed as a purchased unit (modifier NU) must meet above criteria for continued use.

TENS is **INVESTIGATIONAL** for the management of acute pain (e.g., postoperative or during labor and delivery).

TENS is considered **INVESTIGATIONAL** for the prevention or treatment of migraine headache.

TENS is considered **INVESTIGATIONAL** for the management of essential tremor.

TENS is considered **INVESTIGATIONAL** for the management of attention deficit hyperactivity disorder.

The use of TENS for any other condition, including but not limited to the treatment of dementia is **INVESTIGATIONAL**.

Prior Authorization Information

Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is **not required**.
Commercial PPO and Indemnity	Prior authorization is **not required**.

CPT Codes / HCPCS Codes / ICD Codes

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The above medical necessity criteria MUST be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity:

HCPCS Codes

HCPCS codes:	Code Description
A4595	Electrical stimulator supplies, 2 lead, per month, (e.g., TENS, NMES)
A4630	Replacement batteries, medically necessary, transcutaneous electrical stimulator, owned by patient
E0720	Transcutaneous electrical nerve stimulator (TENS) device, two lead, localized stimulation
E0730	Transcutaneous electrical nerve stimulation (TENS) device, four or more leads, for multiple nerve stimulation

E0731	Form-fitting conductive garment for delivery of TENS or NMES (with conductive fibers separated from the patient's skin by layers of fabric

The following CPT code is considered investigational for Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity.

CPT Codes

CPT codes:	Code Description
0278T	Transcutaneous electrical modulation pain reprocessing (eg, scrambler therapy), each treatment session (includes placement of electrodes)

Description

Transcutaneous electrical nerve stimulation (TENS) has been used to treat chronic intractable pain, migraine headache pain, postsurgical pain, and pain associated with active or post trauma injury unresponsive to other standard pain therapies. It has been proposed that TENS may provide pain relief through the release of endorphins in addition to potential blockade of local pain pathways. TENS has also been used to treat dementia by altering neurotransmitter activity and increasing brain activity that is thought to reduce neural degeneration and stimulate regenerative processes.

Percutaneous electrical nerve stimulation (see policy #172) is similar to TENS but uses microneedles that penetrate the skin instead of surface electrodes. Interferential stimulation (see policy #509) uses a modulated waveform for deeper tissue stimulation, and the stimulation is believed to improve blood flow to the affected area.

Summary

Description

Transcutaneous electrical nerve stimulation (TENS) describes the application of electrical stimulation to the surface of the skin. In addition to more traditional settings such as a physician's office or an outpatient clinic, TENS can be self-administered in a patient's home.

Summary of Evidence

For individuals who have chronic pain (eg, musculoskeletal, neuropathic, and mixed pain conditions) who receive transcutaneous electrical nerve stimulation (TENS), the evidence includes numerous randomized controlled trials (RCTs) and systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life (QOL), and medication use. The overall strength of the evidence is weak. The best evidence exists for the treatment of chronic, intractable pain. Available evidence indicates that TENS can improve chronic intractable pain in some patients, and there is support for its use in clinical guidelines by specialty societies. To best direct TENS toward patients who will benefit, a short-term trial of TENS is appropriate, with continuation only in patients who show an initial improvement. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have acute pain (eg, surgical, musculoskeletal, labor, and mixed pain conditions) who receive TENS, the evidence includes RCTs and systematic reviews. Relevant outcomes are symptoms, functional outcomes, QOL, and medication use. Overall, evidence for the use of TENS from high-quality trials remains inconclusive for most indications. A systematic review of TENS for acute and chronic pain found some evidence that TENS reduces pain intensity over and above that seen with placebo and other control groups in patients with acute pain, but small-sized trials contributed to imprecision in magnitude estimates. Systematic reviews have found that TENS may help reduce pain in patients with post-operative pain (post-caesarean and total knee arthroplasty), dysmenorrhea, and pain associated with labor and delivery. For low back pain, systematic reviews have found insufficient evidence to support or refute the use of TENS. Randomized controlled trials have reported mixed results in the efficacy of TENS across various acute pain conditions. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have essential tremor who receive TENS, the evidence includes a nonrandomized study. Relevant outcomes are symptoms, functional outcomes, QOL, and medication use. Results from the nonrandomized study suggest that TENS therapy is effective and safe for patients with essential tremor. However, the trial was limited by its open-label, single-arm design, lack of defined standards for what constitutes a clinically meaningful improvement in stated endpoints, and exclusion of patients who exited the study early from the pre-specified primary and secondary endpoint analyses. Further studies comparing TENS to standard of care therapy for essential tremor are needed. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have attention deficit hyperactivity disorder (ADHD) who receive TENS, the evidence includes an RCT. Relevant outcomes are symptoms, functional outcomes, QOL, and medication use. Results of the RCT concluded that TENS is an effective and safe treatment option for pediatric patients with ADHD. However, the study included a small patient sample and was of short duration. Further studies comparing TENS to standard of care therapy for ADHD are needed. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have chronic or episodic migraine who receive TENS for treatment of acute migraine, the evidence includes 3 double-blind, sham-controlled RCTs. Two of the RCTs evaluated healthcare-provider administration of a TENS device during a single episode in emergency departments, and 1 evaluated self-administration of the device at home during acute episodes over a 3-month period. The studies conducted in emergency departments showed clinically and statistically significant reductions in pain intensity and medication use within 2 hours of use. The self-administration study had mixed results: The difference in median pain scores before and after treatment was significantly higher in the TENS group at months 1 and 2, but at month 3 the difference was not statistically significant. Function and analgesic medication use did not differ between groups at any time point. Strengths of the RCTs included the use of a sham device and blinded outcome assessment using validated outcome measures. Although short-term pain relief was demonstrated at some time points, the quality of the overall body of evidence was downgraded due to inconsistency of results and heterogeneity in study settings. It is not clear whether the pain intensity reductions demonstrated in emergency department settings would generalize to other settings over longer time periods. Supporting evidence from RCTs is needed. Additionally, based on the existing evidence, it is unclear how TENS would fit into the current migraine treatment pathway, although it could provide benefit for those who do not receive adequate benefit from pharmacologic first- or second-line therapies, or who may have a contraindication to pharmacologic therapies. The specific intended use must be specified in order to adequately evaluate net health benefit. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have chronic or episodic migraine who receive TENS for migraine prevention, the evidence includes 1 RCT. Relevant outcomes are symptoms, functional outcomes, QOL, and medication use. The RCT (N=67) reported a greater proportion of participants achieving at least a 50% reduction in migraines with TENS than with sham placebo and modest reductions in the number of total headache and migraine days. In the intention-to-treat analysis, the reduction in the number of migraine days (run-in vs. 3-months) was not statistically significant. The proportion of responders (≥50% reduction in the number of migraine days/month) significantly higher in the TENS group. The number of migraine attacks from the run-in period to the 3-month evaluation, number of headache days, and antimigraine medication use were significantly lower for the active TENS group. The severity of migraine days did not differ significantly between groups. This manufacturer-sponsored trial needs corroboration before conclusions can be made with certainty about the efficacy of TENS for preventing migraine headaches. Additionally, based on the existing evidence, it is unclear how TENS would fit into the current migraine prevention pathway, although it could provide benefit for those who do not receive adequate benefit from pharmacologic first- or second-line therapies, or who may have a contraindication to pharmacologic therapies. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Policy History

Date	Action
2/2024	Annual policy review. Policy updated with literature review through September 27, 2023, references added. Removed outdated clinical input. Separated out evidence

	on migraine from the chronic pain and acute pain sections. Added new policy statement to clarify that TENS is investigational for both prevention and treatment of migraine headache. Other policy statements unchanged
1/2023	Annual policy review. Description, summary, and references updated. Policy statement unchanged.
5/2022	Policy revised. New investigational indications described for TENS devices for essential tremor and attention deficit hyperactivity disorder. Effective 5/1/2022.
1/2021	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
1/2021	Medicare information removed. See MP #132 Medicare Advantage Management for local coverage determination and national coverage determination reference.
1/2020	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
1/2019	Annual policy review. Description, summary, and references updated. Policy statements unchanged. Clarified coding information.
1/2018	Annual policy review. New references added.
1/2018	Clarified coding information.
8/2016	Clarified coding information.
12/2015	Annual policy review. New references added.
12/2015	Added coding language.
6/2015	Annual policy review. New references added.
9/2014	Annual policy review. New investigational indications described. Coding information clarified. Effective 9/1/2014.
5/2014	Updated Coding section with ICD10 procedure and diagnosis codes. Effective 10/2015.
12/2013	Medically necessary indications clarified.
10/2013	Annual policy review. New references added
11/2011-4/2012	Medical policy ICD 10 remediation: Formatting, editing and coding updates. No changes to policy statements.
1/2012	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.
6/2011	Reviewed - Medical Policy Group - Orthopedics, Rehabilitation Medicine and Rheumatology. No changes to policy statements.
1/2011	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.
7/2010	Reviewed - Medical Policy Group - Orthopedics, Rehabilitation Medicine and Rheumatology. No changes to policy statements.
3/2010	Annual policy review. Changes to policy statements.
2/2010	Annual policy review. Changes to policy statements.
7/2009	Annual policy review. Changes to policy statements.

Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:
Medical Policy Terms of Use
Managed Care Guidelines
Indemnity/PPO Guidelines
Clinical Exception Process
Medical Technology Assessment Guidelines

References

1. Food and Drug Administration. De Novo Classification Request for Cefaly Device. 2012; http://www.accessdata.fda.gov/cdrh_docs/reviews/K122566.pdf. Accessed September 24, 2023.
2. Food and Drug Administration. Cefaly Dual Device: K173006. 2017; https://www.accessdata.fda.gov/cdrh_docs/pdf17/K173006.pdf. Accessed September 25, 2023.

3. Food and Drug Administration. Cefaly Acute Device: K171446. 2017; https://www.accessdata.fda.gov/cdrh_docs/pdf17/K171446.pdf. Accessed September 26, 2023.
4. Food and Drug Administration. HeadaTerm Device: K172450. 2018; https://www.accessdata.fda.gov/cdrh_docs/pdf17/K172450.pdf. Accessed September 23, 2023.
5. Food and Drug Administration. Allive Device: K192773. 2019; https://www.accessdata.fda.gov/cdrh_docs/pdf19/K192773.pdf. Accessed September 27, 2023.
6. Food and Drug Administration. Relivion Device: K203419. February 2021. https://www.accessdata.fda.gov/cdrh_docs/pdf20/K203419.pdf. Accessed October 6, 2023.
7. Cala Health news release. Cala Health receives FDA breakthrough device designation for Cala Trio therapy to treat action tremors in Parkinson's disease. https://www.businesswire.com/news/home/20201022005276/en/Cala-Health-Receives-FDA-Breakthrough-Device-Designation-for-Cala-Trio%E2%84%A2-Therapy-to-Treat-Action-Tremors-in-Parkinsons-Disease. Accessed September 27, 2023.
8. FDA news release. FDA permits marketing of first medical device for treatment of ADHD. April 19, 2019. https://www.fda.gov/news-events/press-announcements/fda-permits-marketing-first-medical-device-treatment-adhd. Accessed September 27, 2023.
9. Food and Drug Administration. Axon Therapy Device: K210021. 2021; https://www.accessdata.fda.gov/cdrh_docs/pdf21/K210021.pdf. Accessed October 4, 2023.
10. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). TENS or PENS in the treatment of chronic and postoperative pain. TEC Assessments. 1996;Volume 11, Tab 21. PMID
11. Bronfort G, Nilsson N, Haas M, et al. Non-invasive physical treatments for chronic/recurrent headache. Cochrane Database Syst Rev. 2004; (3): CD001878. PMID 15266458
12. Brosseau L, Judd MG, Marchand S, et al. Transcutaneous electrical nerve stimulation (TENS) for the treatment of rheumatoid arthritis in the hand. Cochrane Database Syst Rev. 2003; 2003(3): CD004377. PMID 12918009
13. Brosseau LU, Pelland LU, Casimiro LY, et al. Electrical stimulation for the treatment of rheumatoid arthritis. Cochrane Database Syst Rev. 2002; 2002(2): CD003687. PMID 12076504
14. Cameron M, Lonergan E, Lee H. Transcutaneous electrical nerve stimulation (TENS) for dementia. Cochrane Database Syst Rev. 2003; 2003(3): CD004032. PMID 12917999
15. Carroll D, Moore RA, McQuay HJ, et al. Transcutaneous electrical nerve stimulation (TENS) for chronic pain. Cochrane Database Syst Rev. 2001; (3): CD003222. PMID 11687055
16. Dowswell T, Bedwell C, Lavender T, et al. Transcutaneous electrical nerve stimulation (TENS) for pain relief in labour. Cochrane Database Syst Rev. Apr 15 2009; (2): CD007214. PMID 19370680
17. Hurlow A, Bennett MI, Robb KA, et al. Transcutaneous electric nerve stimulation (TENS) for cancer pain in adults. Cochrane Database Syst Rev. Mar 14 2012; 2012(3): CD006276. PMID 22419313
18. Khadilkar A, Milne S, Brosseau L, et al. Transcutaneous electrical nerve stimulation (TENS) for chronic low-back pain. Cochrane Database Syst Rev. Jul 20 2005; (3): CD003008. PMID 16034883
19. Khadilkar A, Odebiyi DO, Brosseau L, et al. Transcutaneous electrical nerve stimulation (TENS) versus placebo for chronic low-back pain. Cochrane Database Syst Rev. Oct 08 2008; 2008(4): CD003008. PMID 18843638
20. Kroeling P, Gross A, Goldsmith CH, et al. Electrotherapy for neck pain. Cochrane Database Syst Rev. Oct 07 2009; (4): CD004251. PMID 19821322
21. Martimbianco ALC, Porfírio GJ, Pacheco RL, et al. Transcutaneous electrical nerve stimulation (TENS) for chronic neck pain. Cochrane Database Syst Rev. Dec 12 2019; 12(12): CD011927. PMID 31830313
22. Milne S, Welch V, Brosseau L, et al. Transcutaneous electrical nerve stimulation (TENS) for chronic low back pain. Cochrane Database Syst Rev. 2001; (2): CD003008. PMID 11406059
23. Mulvey MR, Bagnall AM, Johnson MI, et al. Transcutaneous electrical nerve stimulation (TENS) for phantom pain and stump pain following amputation in adults. Cochrane Database Syst Rev. May 12 2010; (5): CD007264. PMID 20464749
24. Nnoaham KE, Kumbang J. Transcutaneous electrical nerve stimulation (TENS) for chronic pain. Cochrane Database Syst Rev. Jul 16 2008; (3): CD003222. PMID 18646088
25. Osiri M, Welch V, Brosseau L, et al. Transcutaneous electrical nerve stimulation for knee osteoarthritis. Cochrane Database Syst Rev. 2000; (4): CD002823. PMID 11034768
26. Price CI, Pandyan AD. Electrical stimulation for preventing and treating post-stroke shoulder pain. Cochrane Database Syst Rev. 2000; 2000(4): CD001698. PMID 11034725

27. Proctor ML, Smith CA, Farquhar CM, et al. Transcutaneous electrical nerve stimulation and acupuncture for primary dysmenorrhoea. Cochrane Database Syst Rev. 2002; 2002(1): CD002123. PMID 11869624
28. Robb KA, Bennett MI, Johnson MI, et al. Transcutaneous electric nerve stimulation (TENS) for cancer pain in adults. Cochrane Database Syst Rev. Jul 16 2008; (3): CD006276. PMID 18646140
29. Rutjes AW, Nüesch E, Sterchi R, et al. Transcutaneous electrostimulation for osteoarthritis of the knee. Cochrane Database Syst Rev. Oct 07 2009; 2009(4): CD002823. PMID 19821296
30. Walsh DM, Howe TE, Johnson MI, et al. Transcutaneous electrical nerve stimulation for acute pain. Cochrane Database Syst Rev. Apr 15 2009; (2): CD006142. PMID 19370629
31. Zimpel SA, Torloni MR, Porfírio GJ, et al. Complementary and alternative therapies for post-caesarean pain. Cochrane Database Syst Rev. Sep 01 2020; 9(9): CD011216. PMID 32871021
32. Dubinsky RM, Miyasaki J. Assessment: efficacy of transcutaneous electric nerve stimulation in the treatment of pain in neurologic disorders (an evidence-based review): report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. Neurology. Jan 12 2010; 74(2): 173-6. PMID 20042705
33. Wu LC, Weng PW, Chen CH, et al. Literature Review and Meta-Analysis of Transcutaneous Electrical Nerve Stimulation in Treating Chronic Back Pain. Reg Anesth Pain Med. May 2018; 43(4): 425-433. PMID 29394211
34. Jalalvandi F, Ghasemi R, Mirzaei M, et al. Effects of back exercises versus transcutaneous electric nerve stimulation on relief of pain and disability in operating room nurses with chronic non-specific LBP: a randomized clinical trial. BMC Musculoskelet Disord. Mar 26 2022; 23(1): 291. PMID 35337314
35. Leemans L, Elma Ö, Nijs J, et al. Transcutaneous electrical nerve stimulation and heat to reduce pain in a chronic low back pain population: a randomized controlled clinical trial. Braz J Phys Ther. 2021; 25(1): 86-96. PMID 32434666
36. Keskin EA, Onur O, Keskin HL, et al. Transcutaneous electrical nerve stimulation improves low back pain during pregnancy. Gynecol Obstet Invest. 2012; 74(1): 76-83. PMID 22722614
37. Jamison RN, Wan L, Edwards RR, et al. Outcome of a High-Frequency Transcutaneous Electrical Nerve Stimulator (hfTENS) Device for Low Back Pain: A Randomized Controlled Trial. Pain Pract. Jun 2019; 19(5): 466-475. PMID 30636101
38. Gossrau G, Wähner M, Kuschke M, et al. Microcurrent transcutaneous electric nerve stimulation in painful diabetic neuropathy: a randomized placebo-controlled study. Pain Med. Jun 2011; 12(6): 953-60. PMID 21627767
39. Amer-Cuenca JJ, Badenes-Ribera L, Biviá-Roig G, et al. The dose-dependent effects of transcutaneous electrical nerve stimulation for pain relief in individuals with fibromyalgia: a systematic review and meta-analysis. Pain. Aug 01 2023; 164(8): 1645-1657. PMID 36893318
40. Dailey DL, Rakel BA, Vance CGT, et al. Transcutaneous electrical nerve stimulation reduces pain, fatigue and hyperalgesia while restoring central inhibition in primary fibromyalgia. Pain. Nov 2013; 154(11): 2554-2562. PMID 23900134
41. Lauretti GR, Chubaci EF, Mattos AL. Efficacy of the use of two simultaneously TENS devices for fibromyalgia pain. Rheumatol Int. Aug 2013; 33(8): 2117-22. PMID 23423539
42. Jamison RN, Edwards RR, Curran S, et al. Effects of Wearable Transcutaneous Electrical Nerve Stimulation on Fibromyalgia: A Randomized Controlled Trial. J Pain Res. 2021; 14: 2265-2282. PMID 34335055
43. Schneider MP, Tellenbach M, Mordasini L, et al. Refractory chronic pelvic pain syndrome in men: can transcutaneous electrical nerve stimulation help?. BJU Int. Jul 2013; 112(2): E159-63. PMID 23433012
44. Reichenbach S, Jüni P, Hincapié CA, et al. Effect of transcutaneous electrical nerve stimulation (TENS) on knee pain and physical function in patients with symptomatic knee osteoarthritis: the ETRELKA randomized clinical trial. Osteoarthritis Cartilage. Mar 2022; 30(3): 426-435. PMID 34826572
45. Cherian JJ, Harrison PE, Benjamin SA, et al. Do the Effects of Transcutaneous Electrical Nerve Stimulation on Knee Osteoarthritis Pain and Function Last?. J Knee Surg. Aug 2016; 29(6): 497-501. PMID 26540652
46. Palmer S, Domaille M, Cramp F, et al. Transcutaneous electrical nerve stimulation as an adjunct to education and exercise for knee osteoarthritis: a randomized controlled trial. Arthritis Care Res (Hoboken). Mar 2014; 66(3): 387-94. PMID 23983090

47. Vance CG, Rakel BA, Blodgett NP, et al. Effects of transcutaneous electrical nerve stimulation on pain, pain sensitivity, and function in people with knee osteoarthritis: a randomized controlled trial. Phys Ther. Jul 2012; 92(7): 898-910. PMID 22466027
48. Chen WL, Hsu WC, Lin YJ, et al. Comparison of intra-articular hyaluronic acid injections with transcutaneous electric nerve stimulation for the management of knee osteoarthritis: a randomized controlled trial. Arch Phys Med Rehabil. Aug 2013; 94(8): 1482-9. PMID 23628378
49. Sawant A, Dadurka K, Overend T, et al. Systematic review of efficacy of TENS for management of central pain in people with multiple sclerosis. Mult Scler Relat Disord. May 2015; 4(3): 219-27. PMID 26008938
50. Amatya B, Young J, Khan F. Non-pharmacological interventions for chronic pain in multiple sclerosis. Cochrane Database Syst Rev. Dec 19 2018; 12(12): CD012622. PMID 30567012
51. Johnson MI, Mulvey MR, Bagnall AM. Transcutaneous electrical nerve stimulation (TENS) for phantom pain and stump pain following amputation in adults. Cochrane Database Syst Rev. Aug 18 2015; 8(8): CD007264. PMID 26284511
52. Martins-de-Sousa PH, Fidelis-de-Paula-Gomes CA, Pontes-Silva A, et al. Additional effect of transcutaneous electrical nerve stimulation in a therapeutic exercise program for sedentary with chronic neck pain: A double-blind randomized controlled trial. Physiother Res Int. Jan 2023; 28(1): e1978. PMID 36252091
53. Díaz-Pulido B, Pérez-Martín Y, Pecos-Martín D, et al. Efficacy of Manual Therapy and Transcutaneous Electrical Nerve Stimulation in Cervical Mobility and Endurance in Subacute and Chronic Neck Pain: A Randomized Clinical Trial. J Clin Med. Jul 23 2021; 10(15). PMID 34362029
54. Boldt I, Eriks-Hoogland I, Brinkhof MW, et al. Non-pharmacological interventions for chronic pain in people with spinal cord injury. Cochrane Database Syst Rev. Nov 28 2014; (11): CD009177. PMID 25432061
55. De Giorgi I, Castroflorio T, Sartoris B, et al. The use of conventional transcutaneous electrical nerve stimulation in chronic facial myalgia patients. Clin Oral Investig. Jan 2017; 21(1): 275-280. PMID 27000071
56. de Castro-Carletti EM, Müggenborg F, Dennett L, et al. Effectiveness of electrotherapy for the treatment of orofacial pain: A systematic review and meta-analysis. Clin Rehabil. Jul 2023; 37(7): 891-926. PMID 36594219
57. Serrano-Muñoz D, Beltran-Alacreu H, Martín-Caro Álvarez D, et al. Effectiveness of Different Electrical Stimulation Modalities for Pain and Masticatory Function in Temporomandibular Disorders: A Systematic Review and Meta-Analysis. J Pain. Jun 2023; 24(6): 946-956. PMID 36801166
58. Ferreira AP, Costa DR, Oliveira AI, et al. Short-term transcutaneous electrical nerve stimulation reduces pain and improves the masticatory muscle activity in temporomandibular disorder patients: a randomized controlled trial. J Appl Oral Sci. 2017; 25(2): 112-120. PMID 28403351
59. Ahmed S, Plazier M, Ost J, et al. The effect of occipital nerve field stimulation on the descending pain pathway in patients with fibromyalgia: a water PET and EEG imaging study. BMC Neurol. Nov 12 2018; 18(1): 191. PMID 30419855
60. Takla MKN. Low-frequency high-intensity versus medium-frequency low-intensity combined therapy in the management of active myofascial trigger points: A randomized controlled trial. Physiother Res Int. Oct 2018; 23(4): e1737. PMID 30095858
61. Johnson MI, Paley CA, Jones G, et al. Efficacy and safety of transcutaneous electrical nerve stimulation (TENS) for acute and chronic pain in adults: a systematic review and meta-analysis of 381 studies (the meta-TENS study). BMJ Open. Feb 10 2022; 12(2): e051073. PMID 35144946
62. Gibson W, Wand BM, Meads C, et al. Transcutaneous electrical nerve stimulation (TENS) for chronic pain - an overview of Cochrane Reviews. Cochrane Database Syst Rev. Apr 03 2019; 4(4): CD011890. PMID 30941745
63. Davison P, Wilkinson R, Miller J, et al. A systematic review of using electrical stimulation to improve clinical outcomes after hip fractures. Physiother Theory Pract. Dec 2022; 38(12): 1857-1875. PMID 33890541
64. Lang T, Barker R, Steinlechner B, et al. TENS relieves acute posttraumatic hip pain during emergency transport. J Trauma. Jan 2007; 62(1): 184-8; discussion 188. PMID 17215752
65. Zhu Y, Feng Y, Peng L. Effect of transcutaneous electrical nerve stimulation for pain control after total knee arthroplasty: A systematic review and meta-analysis. J Rehabil Med. Nov 21 2017; 49(9): 700-704. PMID 28933513

66. Hatefi F, Kazemi M, Manglian P, et al. The effects of cold compress and transcutaneous electrical nerve stimulation on the pain associated with chest tube removal among patients with coronary bypass grafting. J Cardiothorac Surg. May 25 2023; 18(1): 186. PMID 37231409
67. Ramanathan D, Saleh A, Klika AK, et al. The Use of Transcutaneous Electrical Nerve Stimulation After Total Knee Arthroplasty: A Prospective Randomized Controlled Trial. Surg Technol Int. Jul 25 2017; 30: 425-434. PMID 28537354
68. Parseliunas A, Paskauskas S, Kubiliute E, et al. Transcutaneous Electric Nerve Stimulation Reduces Acute Postoperative Pain and Analgesic Use After Open Inguinal Hernia Surgery: A Randomized, Double-Blind, Placebo-Controlled Trial. J Pain. May 2021; 22(5): 533-544. PMID 33309784
69. Oztas B, Iyigun E. The effects of two different electrical stimulation methods on the pain intensity of the patients who had undergone abdominal surgery with a midline incision: Randomized controlled clinical trial. Contemp Nurse. 2019; 55(2-3): 122-138. PMID 31169066
70. Galli TT, Chiavegato LD, Liebano RE. Effects of TENS in living kidney donors submitted to open nephrectomy: a randomized placebo-controlled trial. Eur J Pain. Jan 2015; 19(1): 67-76. PMID 24831862
71. Tokuda M, Tabira K, Masuda T, et al. Effect of modulated-frequency and modulated-intensity transcutaneous electrical nerve stimulation after abdominal surgery: a randomized controlled trial. Clin J Pain. Jul 2014; 30(7): 565-70. PMID 24901753
72. Silva MB, de Melo PR, de Oliveira NM, et al. Analgesic effect of transcutaneous electrical nerve stimulation after laparoscopic cholecystectomy. Am J Phys Med Rehabil. Aug 2012; 91(8): 652-7. PMID 22311059
73. DeSantana JM, Walsh DM, Vance C, et al. Effectiveness of transcutaneous electrical nerve stimulation for treatment of hyperalgesia and pain. Curr Rheumatol Rep. Dec 2008; 10(6): 492-9. PMID 19007541
74. Forogh B, Aslanpour H, Fallah E, et al. Adding high-frequency transcutaneous electrical nerve stimulation to the first phase of post anterior cruciate ligament reconstruction rehabilitation does not improve pain and function in young male athletes more than exercise alone: a randomized single-blind clinical trial. Disabil Rehabil. Mar 2019; 41(5): 514-522. PMID 29117738
75. Tucker DL, Rockett M, Hasan M, et al. Does transcutaneous electrical nerve stimulation (TENS) alleviate the pain experienced during bone marrow sampling in addition to standard techniques? A randomised, double-blinded, controlled trial. J Clin Pathol. Jun 2015; 68(6): 479-83. PMID 25759407
76. Binny J, Joshua Wong NL, Garga S, et al. Transcutaneous electric nerve stimulation (TENS) for acute low back pain: systematic review. Scand J Pain. Apr 24 2019; 19(2): 225-233. PMID 30849052
77. Koukoulithras I, Stamouli A, Kolokotsios S, et al. The Effectiveness of Non-Pharmaceutical Interventions Upon Pregnancy-Related Low Back Pain: A Systematic Review and Meta-Analysis. Cureus. Jan 30 2021; 13(1): e13011. PMID 33728108
78. Arik MI, Kiloatar H, Aslan B, et al. The effect of TENS for pain relief in women with primary dysmenorrhea: A systematic review and meta-analysis. Explore (NY). 2022; 18(1): 108-113. PMID 32917532
79. Guy M, Foucher C, Juhel C, et al. Transcutaneous electrical neurostimulation relieves primary dysmenorrhea: A randomized, double-blind clinical study versus placebo. Prog Urol. Jul 2022; 32(7): 487-497. PMID 35249825
80. Platon B, Thörn SE, Mannheimer C, et al. Effects of high-frequency, high-intensity transcutaneous electrical nerve stimulation versus intravenous opioids for pain relief after hysteroscopy: a randomized controlled study. Obstet Gynecol Sci. Sep 2020; 63(5): 660-669. PMID 32717773
81. Lisón JF, Amer-Cuenca JJ, Piquer-Martí S, et al. Transcutaneous Nerve Stimulation for Pain Relief During Office Hysteroscopy: A Randomized Controlled Trial. Obstet Gynecol. Feb 2017; 129(2): 363-370. PMID 28079781
82. Deussen AR, Ashwood P, Martis R, et al. Relief of pain due to uterine cramping/involution after birth. Cochrane Database Syst Rev. Oct 20 2020; 10(10): CD004908. PMID 33078388
83. Thuvarakan K, Zimmermann H, Mikkelsen MK, et al. Transcutaneous Electrical Nerve Stimulation As A Pain-Relieving Approach in Labor Pain: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Neuromodulation. Aug 2020; 23(6): 732-746. PMID 32691942
84. Kurata NB, Ghatnekar RJ, Mercer E, et al. Transcutaneous Electrical Nerve Stimulation for Post-Cesarean Birth Pain Control: A Randomized Controlled Trial. Obstet Gynecol. Aug 01 2022; 140(2): 174-180. PMID 35852266

85. Kayman-Kose S, Arioz DT, Toktas H, et al. Transcutaneous electrical nerve stimulation (TENS) for pain control after vaginal delivery and cesarean section. J Matern Fetal Neonatal Med. Oct 2014; 27(15): 1572-5. PMID 24283391
86. Báez Suárez A, Martín Castillo E, García Andújar J, et al. Evaluation of the effectiveness of transcutaneous nerve stimulation during labor in breech presentation: a case series. J Matern Fetal Neonatal Med. Jan 2021; 34(1): 24-30. PMID 30654675
87. Njogu A, Qin S, Chen Y, et al. The effects of transcutaneous electrical nerve stimulation during the first stage of labor: a randomized controlled trial. BMC Pregnancy Childbirth. Feb 24 2021; 21(1): 164. PMID 33627077
88. Goldman AR, Porsch L, Hintermeister A, et al. Transcutaneous Electrical Nerve Stimulation to Reduce Pain With Medication Abortion: A Randomized Controlled Trial. Obstet Gynecol. Jan 01 2021; 137(1): 100-107. PMID 33278292
89. Butera KA, George SZ, Borsa PA, et al. Prolonged Reduction in Shoulder Strength after Transcutaneous Electrical Nerve Stimulation Treatment of Exercise-Induced Acute Muscle Pain. Pain Pract. Nov 2018; 18(8): 954-968. PMID 29505689
90. Chesterton LS, Lewis AM, Sim J, et al. Transcutaneous electrical nerve stimulation as adjunct to primary care management for tennis elbow: pragmatic randomised controlled trial (TATE trial). BMJ. Sep 02 2013; 347: f5160. PMID 23999980
91. Isaacson SH, Peckham E, Tse W, et al. Prospective Home-use Study on Non-invasive Neuromodulation Therapy for Essential Tremor. Tremor Other Hyperkinet Mov (N Y). Aug 14 2020; 10: 29. PMID 32864188
92. McGough JJ, Sturm A, Cowen J, et al. Double-Blind, Sham-Controlled, Pilot Study of Trigeminal Nerve Stimulation for Attention-Deficit/Hyperactivity Disorder. J Am Acad Child Adolesc Psychiatry. Apr 2019; 58(4): 403-411.e3. PMID 30768393
93. Singh RBH, VanderPluym JH, Morrow AS, et al. Acute Treatments for Episodic Migraine [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2020 Dec. (Comparative Effectiveness Review, No. 239.) Available from: https://www.ncbi.nlm.nih.gov/books/NBK566246/. Accessed November 6, 2023.
94. Ailani J, Burch RC, Robbins MS. The American Headache Society Consensus Statement: Update on integrating new migraine treatments into clinical practice. Headache. Jul 2021; 61(7): 1021-1039. PMID 34160823
95. Tassorelli C, Diener HC, Silberstein SD, et al. Guidelines of the International Headache Society for clinical trials with neuromodulation devices for the treatment of migraine. Cephalalgia. Oct 2021; 41(11-12): 1135-1151. PMID 33990161
96. Diener HC, Tassorelli C, Dodick DW, et al. Guidelines of the International Headache Society for controlled trials of acute treatment of migraine attacks in adults: Fourth edition. Cephalalgia. May 2019; 39(6): 687-710. PMID 30806518
97. Chou DE, Shnayderman Yugrakh M, Winegarner D, et al. Acute migraine therapy with external trigeminal neurostimulation (ACME): A randomized controlled trial. Cephalalgia. Jan 2019; 39(1): 3-14. PMID 30449151
98. Hokenek NM, Erdogan MO, Hokenek UD, et al. Treatment of migraine attacks by transcutaneous electrical nerve stimulation in emergency department: A randomize controlled trial. Am J Emerg Med. Jan 2021; 39: 80-85. PMID 31983598
99. Domingues FS, Gayoso MV, Sikandar S, et al. Analgesic efficacy of a portable, disposable, and self-applied transcutaneous electrical nerve stimulation device during migraine attacks: A real-life randomized controlled trial. Pain Pract. Nov 2021; 21(8): 850-858. PMID 34013542
100. Schoenen J, Vandersmissen B, Jeangette S, et al. Migraine prevention with a supraorbital transcutaneous stimulator: a randomized controlled trial. Neurology. Feb 19 2013; 80(8): 697-704. PMID 23390177
101. Qaseem A, Wilt TJ, McLean RM, et al. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians. Ann Intern Med. Apr 04 2017; 166(7): 514-530. PMID 28192789
102. American Congress of Obstetricians and Gynecologists (ACOG) Committee Opinion Number 766 on Approaches to Limit Intervention During Labor and Birth. February 2019. https://www.acog.org/Clinical-Guidance-and-Publications/Committee-Opinions/Committee-on-Obstetric-Practice/Approaches-to-Limit-Intervention-During-Labor-and-Birth. Accessed September 27, 2023.

103. Benzon HT, Connis RT, De Leon-Casasola OA, et al. Practice guidelines for chronic pain management: an updated report by the American Society of Anesthesiologists Task Force on Chronic Pain Management and the American Society of Regional Anesthesia and Pain Medicine. Anesthesiology. Apr 2010; 112(4): 810-33. PMID 20124882
104. National Cancer Institute. Pain (PDQ)-Health Professional Version. 2022. https://www.cancer.gov/about-cancer/treatment/side-effects/pain/pain-hp-pdq#_3. Accessed September 27, 2023.
105. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Adult Cancer Pain. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/pain.pdf. Accessed September 27, 2023.
106. National Institute for Health and Care Excellence (NICE). Low back pain and sciatica in over 16s: assessment and management [NG59]. 2016 (last updated 2020); https://www.nice.org.uk/guidance/NG59. Accessed September 25, 2023.
107. National Institute for Health and Care Excellence (NICE). Osteoarthritis in over 16s: diagnosis and management [NG226]. 2022. https://www.nice.org.uk/guidance/ng226. Accessed September 26, 2023.
108. National Institute for Health and Care Excellence (NICE). Intrapartum care for healthy women and babies [CG190]. 2014 (last updated 2022); https://www.nice.org.uk/guidance/cg190. Accessed September 27, 2023.
109. North American Spine Society. Diagnosis and Treatment of Low Back Pain. 2020. https://www.spine.org/Portals/0/assets/downloads/ResearchClinicalCare/Guidelines/LowBackPain.pdf. Accessed September 27, 2023.
110. Bono CM, Ghiselli G, Gilbert TJ, et al. An evidence-based clinical guideline for the diagnosis and treatment of cervical radiculopathy from degenerative disorders. Spine J. Jan 2011; 11(1): 64-72. PMID 21168100
111. McAlindon TE, Bannuru RR, Sullivan MC, et al. OARSI guidelines for the non-surgical management of knee osteoarthritis. Osteoarthritis Cartilage. Mar 2014; 22(3): 363-88. PMID 24462672
112. Bannuru RR, Osani MC, Vaysbrot EE, et al. OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. Osteoarthritis Cartilage. Nov 2019; 27(11): 1578-1589. PMID 31278997
113. Centers for Medicare & Medicaid. National Coverage Determination (NCD) for Transcutaneous Electrical Nerve Stimulators (TENS) (280.13). 2012; https://www.cms.gov/medicare-coverage-database/view/ncd.aspx?NCDId=354&. Accessed September 26, 2023.
114. Centers for Medicare & Medicaid. Decision Memo for Transcutaneous Electrical Nerve Stimulation for Chronic Low Back Pain (160.27). 2012; https://www.cms.gov/medicare-coverage-database/details/nca-details.aspx?NCAId=256&DocID=CAG-00429N&NCDId=63&ncdver=2&bc=gAAAABAAAAAA&d. Accessed September 27, 2023.
115. Centers for Medicare and Medicaid. National Coverage Determination (NCD) for Assessing Patient's Suitability for Electrical Nerve Stimulation Therapy (160.7.1). 2006; https://www.cms.gov/medicare-coverage-database/details/ncd-details.aspx?NCDId=63&ncdver=2&DocID=160.7.1&bc=gAAAABAAAAAA&. Accessed September 25, 2023.