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CADTH RAPID RESPONSE REPORT: REFERENCE LIST

Neuromuscular Electrical Stimulation for Lower Limb Ulcers, Edema, and Thrombosis: Clinical Effectiveness and Cost-Effectiveness

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Authors: Diksha Kumar, Monika Mierzwinski-Urban

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About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

Funding: CADTH receives funding from Canada's federal, provincial, and territorial governments, with the exception of Quebec.

Questions or requests for information about this report can be directed to **requests@cadth.ca**

Research Questions

1. What is the clinical effectiveness of neuromuscular electrical stimulation for the treatment of lower limb ulcers?
2. What is the clinical effectiveness of neuromuscular electrical stimulation for the treatment of lower limb edema?
3. What is the clinical effectiveness of neuromuscular electrical stimulation for the prevention of venous thromboembolism?
4. What is the comparative cost-effectiveness of neuromuscular electrical stimulation versus compression stockings for the treatment of lower limb ulcers?
5. What is the comparative cost-effectiveness of neuromuscular electrical stimulation versus compression stockings for the treatment of lower limb edema?
6. What is the comparative cost-effectiveness of neuromuscular electrical stimulation versus compression stockings for the prevention of venous thromboembolism?

Key Findings

One systematic review with meta-analysis and two randomized controlled trials were identified regarding the clinical effectiveness of neuromuscular electrical stimulation for the treatment of lower limb edema and the prevention of venous thromboembolism. No relevant economic evaluations were identified.

Methods

A limited literature search was conducted by an information specialist on key resources including MEDLINE All (1946-) via Ovid, the Cochrane Library, the University of York Centre for Reviews and Dissemination (CRD) databases, the websites of Canadian and major international health technology agencies, as well as a focused Internet search. The search strategy was comprised of both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. The main search concepts were neuromuscular electrical stimulation and lower limb ulcers, edema, and thrombosis. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2014 and August 22, 2019. Internet links were provided, where available.

Selection Criteria

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Q1 & Q4: Patients of all ages, in any setting with lower limb ulcers (e.g., venous leg ulcers, mixed etiology leg ulcers) Q2 & Q5: Patients of all ages, in any setting, with lower limb edema Q3 & Q6: Patients of all ages, in any setting, at risk of venous thromboembolism
Intervention	Q1-6: Neuromuscular electrical stimulation device (e.g., Geko)
Comparator	Q1-6: Graduated compression stockings Q1: Wound care (e.g., dressings, topical therapy)
Outcomes	Q1-3: Clinical effectiveness (e.g., hyperpigmentation, erythema, scaling, weeping, crusting, ulceration, wound size, edema, healing time, quality of life, discomfort, skin reactions, ischemic pain, muscle soreness, side effects, adverse events) Q4-6: Cost-effectiveness (e.g., incremental cost per health benefit gained, cost per quality adjusted life year, cost per patient adverse event avoided)
Study Designs	Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, and economic evaluations

Results

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials and economic evaluations.

One systematic review with meta-analysis[1] and two randomized controlled trials[2,3] were identified regarding the clinical effectiveness of neuromuscular electrical stimulation for the treatment of lower limb edema and the prevention of venous thromboembolism. No relevant health technology assessments or economic evaluations were identified.

Additional references of potential interest are provided in the appendix.

Health Technology Assessments

No literature identified.

Systematic Reviews and Meta-analyses

1. Hajibandeh S, Hajibandeh S, Antoniou GA, Scurr JR, Torella F. Neuromuscular electrical stimulation for the prevention of venous thromboembolism. *Cochrane Database Syst Rev*. 2017 11 21;11:CD011764.
PubMed: PM29161465

Randomized Controlled Trials

2. Benigni JP, Uhl JF, Balet F, Filori P, Chahim M. Evaluation of three different devices to reduce stasis edema in poorly mobile nursing home patients. *Int Angiol*. 2018 Aug;37(4):322-326.
PubMed: PM29521485

3. Yilmaz S, Calbiyik M, Yilmaz BK, Aksoy E. Potential role of electrostimulation in augmentation of venous blood flow after total knee replacement: a pilot study. *Phlebology*. 2016 May;31(4):251-256.
PubMed: PM25852131

Economic Evaluations

No literature identified.

Appendix — Further Information

Previous CADTH Reports

4. Low frequency nerve stimulation for leg ulcers: clinical effectiveness *(CADTH Rapid response report: reference list)*. Ottawa (ON): CADTH; 2017: https://www.cadth.ca/sites/default/files/pdf/htis/2017/RA0895%20Low%20Frequency%20Nerve%20Stimulation%20Final.pdf. Accessed 2019 Aug 26.

Systematic Reviews and Meta-analyses

Condition not Specified

5. Ashrafi M, Alonso-Rasgado T, Baguneid M, Bayat A. The efficacy of electrical stimulation in lower extremity cutaneous wound healing: a systematic review. *Exp Dermatol*. 2017 02;26(2):171-178.
PubMed: PM27576070

Alternative Comparators

6. Burgess LC, Immins T, Swain I, Wainwright TW. Effectiveness of neuromuscular electrical stimulation for reducing oedema: a systematic review. *J Rehabil Med*. 2019 Apr 01;51(4):237-243.
PubMed: PM30834452

7. Ravikumar R, Williams KJ, Babber A, et al. Neuromuscular electrical stimulation for the prevention of venous thromboembolism. *Phlebology*. 2018 Jul;33(6):367-378.
PubMed: PM28610546

8. Hajibandeh S, Hajibandeh S, Antoniou GA, Scurr JR, Torella F. Neuromuscular electrical stimulation for thromboprophylaxis: a systematic review. *Phlebology*. 2015 Oct;30(9):589-602.
PubMed: PM25567877

Randomized Controlled Trials

Alternative Comparators

9. Kadi MR, Hepguler S, Atamaz FC, et al. Is interferential current effective in the management of pain, range of motion, and edema following total knee arthroplasty surgery? A randomized double-blind controlled trial. *Clin Rehabil*. 2019 Jun;33(6):1027-1034.
PubMed: PM30764635

10. Wainwright TW, Burgess LC, Middleton RG. Does neuromuscular electrical stimulation improve recovery following acute ankle sprain? A pilot randomised controlled trial. *Clinical Med Insights Arthritis Musculoskelet Disord*. 2019;12:1179544119849024.
PubMed: PM31205428

11. Miller C, McGuiness W, Wilson S, et al. Concordance and acceptability of electric stimulation therapy: a randomised controlled trial. *J Wound Care*. 2017 08 02;26(8):508-513.
PubMed: PM28795880

12. Miller C, McGuiness W, Wilson S, et al. Venous leg ulcer healing with electric stimulation therapy: a pilot randomised controlled trial. *J Wound Care*. 2017 Mar 02;26(3):88-98.
PubMed: PM28277996

13. Ojima M, Takegawa R, Hirose T, Ohnishi M, Shiozaki T, Shimazu T. Hemodynamic effects of electrical muscle stimulation in the prophylaxis of deep vein thrombosis for intensive care unit patients: a randomized trial. *J Intensive Care*. 2017;5:9.
PubMed: PM28101364

14. Choi YD, Lee JH. Edema and pain reduction using transcutaneous electrical nerve stimulation treatment. *J Phys Ther Sci*. 2016 Nov;28(11):3084-3087.
PubMed: PM27942125

15. Izumi M, Ikeuchi M, Aso K, et al. Less deep vein thrombosis due to transcutaneous fibular nerve stimulation in total knee arthroplasty: a randomized controlled trial. *Knee Surg Sports Traumatol Arthrosc*. 2015 Nov;23(11):3317-3323.
PubMed: PM24957913

16. Liani M, Trabassi E, Cusaro C, et al. Effects of a pulsatile electrostatic field on ischemic injury to the diabetic foot: evaluation of refractory ulcers. *Prim Care Diabetes*. 2014 Oct;8(3):244-249.
PubMed: PM24434128

Non-Randomized Studies

17. Bogachev VY, Lobanov VN, Golovanova OV, Kuznetsov AN, Yershov PV. Electrical muscle stimulation with Veinoplus® device in the treatment of venous ulcers. *Int Angiol*. 2015 Jun;34(3):257-262.
PubMed: PM25719401

Review Articles

18. Williams KJ, Ravikumar R, Gaweesh AS, et al. A Review of the evidence to support neuromuscular electrical stimulation in the prevention and management of venous disease. *Adv Exp Med Biol*. 2017;906:377-386.
PubMed: PM27620314

19. Orsted HL, O'Sullivan-Drombolis D, Haley J, LeBlanc K, Prarsons L. The effects of low frequency nerve stimulation to support the healing of venous leg ulcers. North York (ON): Wound Care Canada; 2016:
https://www.woundscanada.ca/docman/public/health-care-professional/bpr-workshop/70-bpr-lfns-final-110316/file. Accessed 2019 Aug 26.

20. Thakral G, La Fontaine J, Kim P, Najafi B, Nichols A, Lavery LA. Treatment options for venous leg ulcers: effectiveness of vascular surgery, bioengineered tissue, and electrical stimulation. *Adv Skin Wound Care*. 2015 Apr;28(4):164-172.
PubMed: PM25775200

21. Yazdanpanah L, Nasiri M, Adarvishi S. Literature review on the management of diabetic foot ulcer. *World J Diabetes*. 2015 Feb 15;6(1):37-53.
PubMed: PM25685277

22. Mulder G, Tenenhaus M, D'Souza GF. Reduction of diabetic foot ulcer healing times through use of advanced treatment modalities. *Int J Low Extrem Wounds*. 2014

Dec;13(4):335-346.
PubMed: PM25384916