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## SYSTEMATIC REVIEW

# Transcutaneous electrical nerve stimulation and interferential current demonstrate similar effects in relieving acute and chronic pain: a systematic review with meta-analysis

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### KEYWORDS

Electric stimulation therapy;  
Pain;  
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### Abstract

**Background:** Transcutaneous electrical nerve stimulation (TENS) and interferential current (IFC) have been widely used in clinical practice. However, a systematic review comparing their effects on pain relief has not yet been performed.

**Objectives:** To investigate the effects of TENS and IFC on acute and chronic pain.

**Methods:** We use Pubmed, Embase, LILACS, PEDro and Cochrane Central Register of Controlled Trials as data sources. Two independent reviewers that selected studies according to inclusion criteria, extracted information of interest and verified the methodological quality of the studies made study selection. The studies were selected if TENS and IFC were used as treatment and they had pain as the main outcome, as evaluated by a visual analog scale (VAS). Secondary outcomes were the Western Ontario Macmaster (WOMAC) and Rolland Morris Disability (RMD) questionnaires, which were added after data extraction.

**Results:** Eight studies with a pooled sample of 825 patients were included. The methodological quality of the selected studies was moderate, with an average of six on a 0-10 scale (PEDro). In general, both TENS and IFC improved pain and functional outcomes without a statistical difference between them.

**Conclusion:** TENS and IFC have similar effects on pain outcome. The low number of studies included in this meta-analysis indicates that new clinical trials are needed.

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## Introduction

The American Chronic Pain association (ACPA) defines chronic pain as “ongoing or persistent pain lasting beyond the usual course of an acute illness or injury, or pain that lasts 3–6 months or more, and which adversely affects the individual’s well-being” or simply “pain that continues when it should not”.<sup>1</sup> Due to its elevated economic cost, prevalence, and influence on the quality of life of individuals and their families, chronic pain is considered a global public health problem.<sup>2</sup> It is estimated that approximately 30% of the world’s population suffers from some type of chronic pain.<sup>3</sup>

Currently, pain management mainly consists in the use of pain medications, pain neuroscience education,<sup>4</sup> psychological counseling, exercises, manual therapy, and electrical stimulation (ES).<sup>1</sup> Regarding ES, interferential current (IFC) and transcutaneous electrical nerve stimulation (TENS) have been used to manage chronic pain.<sup>4</sup> TENS units, which typically deliver pulsed currents in the 1–200 Hz frequency range, with a pulse duration of 100–200  $\mu$ s,<sup>5</sup> are widely used due to their low cost and simple use and can be used as an independent method of treatment.<sup>6,7</sup> IFC delivers medium-frequency alternating currents which pass through the tissues simultaneously and cross with each other, producing interference and resulting in an amplitude-modulated frequency of 1–200 Hz.<sup>8</sup> It has been claimed that IFC decreases skin impedance, reducing the discomfort normally associated with low-frequency currents,<sup>5</sup> although this assertion has been challenged.<sup>9</sup> In fact, the differences between TENS and IFC for the management of pain remain unclear.<sup>10–12</sup>

IFCs added advantage of generating an amplitude-modulated frequency (AMF), which is a low-frequency current that is able to penetrate more deeply into the tissues, has been claimed as the main analgesic component of IFC.<sup>5</sup> Theoretically, the benefits of IFC stimulation could be achieved without the associated unpleasant side effects like pain, discomfort and skin irritation.<sup>13</sup> Unfortunately, IFC has been known to have these side effects. Nonetheless, Rutjes et al.<sup>14</sup> have observed significant effects of IFC for pain control. Despite presenting the theoretical advantages associated with the medium frequencies of IFC compared to TENS,<sup>6,10,11</sup> previous studies have found that IFC generated a similar effect to control pain and improve function over time compared to TENS (low frequency) in osteoarthritis (OA)<sup>15</sup> and in patients with chronic low back pain.<sup>15</sup>

In fact, the results of these studies do not present a clear consensus on which current type is the best for pain control. A narrative review has shown that IFC and TENS have similar effects on pain relief.<sup>12</sup> However, these authors reported numerous experimental biases resulting from sub-optimal designs (such as unblinded and non-randomized trials), results from healthy subjects using experimental pain (ischemic pain, cold pressure pain or mechanical pain), small sample sizes, and mainly the heterogeneity of IFC or TENS parameters, that could affect the main outcomes.<sup>12,13</sup>

According to these conflicting results, the clinical application of IFC and TENS to control pain and increase functional outcomes should be investigated in order to determine the best parameters to induce analgesic effects

with minimum discomfort. Therefore, a systematic review comparing IFC to TENS would thus be useful to help guide rehabilitation clinicians in the optimal use of ES. We conducted a systematic review of randomized controlled trials to compare the effects of IFC and TENS on pain control and functional outcomes.

## Methods

### Protocol and registration

The study selection process included screening of titles, reading of abstracts, checking for duplicated studies, evaluating inclusion criteria and full text reading. (PROSPERO Registration number: CRD42017056606, accessed at <https://www.crd.york.ac.uk/PROSPERO/>).

### Eligibility criteria

We included randomized controlled trials (RCTs) that compared the use of TENS and IFC on individuals with chronic or acute pain and that use a VAS (visual analog scale) for the main outcome. The secondary outcome assessed was specific questionnaires for functional outcome analysis such as the Western Ontario Macmaster (WOMAC) and the Roland Morris Disability Questionnaire for osteoarthritis and lower back pain, respectively. It is also important to emphasize that pain and function are considered core outcomes on chronic pain evaluation along with emotional function, life satisfaction, participant ratings of improvement and satisfaction with treatment, symptoms and adverse events, work ability, illness perception and participant’s disposition.<sup>17–19</sup>

### Information sources

A literature search was conducted from November of 2016 to April of 2017 on the following databases: Pubmed, Embase, LILACS, PEDro and Cochrane Central Register of Controlled Trials (CENTRAL). A manual search was conducted by checking the reference list of eligible articles. Contact with authors was made when additional data was required. Year of publication was not used as a limit.

### Search strategies

The search terms were selected according to the Medical Subject Headings (MeSH) of the United States National Library of Medicine (NLM) and were: “Interferential Current AND Transcutaneous Electrical Nerve Stimulation AND Pain”, “Interferential current AND transcutaneous Electrical Nerve Stimulation AND Chronic Pain”, “Interferential current AND transcutaneous Electrical Nerve Stimulation AND Analgesic Effects” and “Interferential current AND transcutaneous Electrical Nerve Stimulation AND rehabilitation”. In order to increase the effectiveness and encompass a greater number of articles, those terms were combined in each database and “Transcutaneous electrical nervous stimulation” was modified to “Transcutaneous nervous stimulation” during EMBASE searching.

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