



Review Article

The role of interferential current electrical stimulation in pediatric urology: A systematic review of randomized controlled trials

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ABSTRACT

Background: In recent years, interferential current (IFC) electrical stimulation has been studied as a novel treatment for various lower urinary tract dysfunctions in children. As the findings of multiple studies may vary, we aimed to evaluate the current view on IFC in pediatric urology problems based on the findings of randomized clinical trials (RCTs).

Methods: We performed a systematic search in the Embase, Medline, and SCOPUS databases in accordance with the latest Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines. Eligible studies comprised studies evaluating IFC for lower urinary tract problems in children. The studies' quality was assessed using the Cochrane risk of bias (RoB) tool 2.

Results: A total of 125 articles were initially obtained, among which 40 articles were duplicates. There were six eligible RCTs with an overall low RoB. All subjects underwent 10–18 sessions of treatment. The outcomes measured consisted of the alleviation of symptoms and urodynamic parameters. The trials reported that 61–90% of patients responded positively to the treatment. Both IFC and transcutaneous electrical nerve stimulation generated improvements in the subjects. However, overall the IFC group showed better immediate and short-term improvement.

Conclusion: IFC is a promising therapy for bladder dysfunction and enuresis in children. More comparative RCTs are required in the future to quantitatively determine the superiority of IFC to other alternatives. The safety aspects of the treatment should also be studied further before it can be used in a clinical setting as the standard and protocol for children are still unclear.

Keywords: Bladder dysfunction, Interferential electrical stimulation, Pediatric urology

INTRODUCTION

Interferential current (IFC) was developed in the 1950s and this is readily observable as a recommended method of reeducating muscle activity.^[14] IFC produces two alternating currents of slightly differing medium frequency and is used widely not just to elicit muscle contraction but also to induce analgesia, modify the activity of the autonomic system, promote healing, and reduce edema. IFC machines typically use medium-frequency currents of approximately 4000–

5000 Hz.^[6] Alternating currents of medium frequency (1000–10000 Hz) have lower skin resistance than low-frequency currents (<1000 Hz) and as a result postulated that they penetrate tissue more easily (Huang *et al.*, 2011).^[7] With this benefit, electrical stimulation therapy has been expanded and extensively used for the treatment of urinary tract problems in adults and children.^[13]

These electrical currents, on the other hand, can affect sensory, motor, glandular, and secretory functions as well. Changes in neurotransmitter availability, reducing cholinergic activity, and increasing beta-adrenergic activity have also been reported as an effect of electrical stimulation therapy.^[4] Therefore, increasing the bladder capacity or compliance as well as the reduction in detrusor pressure can be caused by electrical currents.^[5]

The most common problem in the referral of children to pediatric urology clinics is lower urinary tract dysfunction (LUTD), including several different conditions such as dysfunctional voiding, urinary incontinence, overactive bladder, and underactive bladder (UAB). This condition requires treatment early in life to optimize a long-term outcome.^[2,3] The first-line treatment for this case is pelvic floor muscle (PFM) retraining and biofeedback therapy. In cases that are not successfully treated with PFM retraining and biofeedback therapy, electric stimulation can be an alternative solution by raising the capacity or compliance of the bladder or probably by pelvic floor relaxation as well as reducing detrusor pressure.^[11,15]

The widespread use of IFC as one of the alternative treatments for several urinary tract problems in children may become an interesting subject for further research. As the findings of multiple studies may vary, we aimed to evaluate the current view on IFC in pediatric urology problems based on the findings of randomized clinical trials (RCTs).

MATERIALS AND METHODS

The search was performed using databases from Embase, Medline, and Scopus by the latest Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines. Literature reviews were done by multiple investigators (IO, YPK, and BS), on three databases: Embase, Medline, and Scopus. The main keywords are (1) “Transcutaneous nerve stimulation or transcutaneous interferential electrical stimulation or transcutaneous electrical nerve stimulation” (TENS), and (2) “Enuresis or nocturnal enuresis,” “1 and 2.”

Randomized control trial studies were included. Identified articles from all databases were screened for duplication. Screening based on title and abstract was done and articles that fulfilled exclusion criteria were further excluded. In the end, eligible articles were included in a qualitative synthesis.

Eligible studies that were included in this systematic review are based on the following: Population, intervention, comparison, and outcome criteria. The defined population was children who had a lower urinary tract problem. The intervention was using IFC or another therapy and IFC as a choice. The comparison was using therapy other than IFC. The outcome was an improvement in the condition and complaints of pediatric patients who had a lower urinary tract problem. The study’s quality was assessed using the Cochrane risk of bias tool 2.

RESULTS

A total of 125 studies were identified at the beginning and after a thorough process, six studies were included in this study. Forty studies were excluded due to duplicate records, 78 studies were excluded after screening the title and abstract, and finally, one study was excluded for reasons [Figure 1].

Of the six studies obtained, RCT was used as a research method. Three studies used IFC as the intervention group,^[1,8,16] and three other studies used IFC and other therapies (urotherapy and biofeedback).^[9,10,12] The therapy given to the control group used a placebo, desmopressin, urotherapy, biofeedback, and TENS. The length of time the intervention was carried out was between 3 weeks and 1 year. The age range of respondents in the study ranged from 3 years to 15 years. In these studies, the therapeutic targets used to reduce several complaints including primary nocturnal enuresis (three studies), neurogenic detrusor overactivity (one study), nonneuropathic UAB (one study), and nonneuropathic urinary incontinence (one study). The period for intervention ranged from 10 to 18 sessions, with varying frequency per week. Success parameters were measured subjectively and objectively, namely, incontinence, urodynamic study, the recurrence rate of bed-wetting, wet night, lower urinary tract symptoms, electromyography, post void residual, uroflowmetry, and pediatric incontinence questionnaire [Table 1].

DISCUSSION

IFC therapy is a challenging procedure, with a lack of published data on its efficacy, especially in children. From the six studies analyzed, a total of 149 children underwent IFC treatment (68 children receive combination therapy), with the youngest patients being 3 years old in Kajbafzadeh *et al.*’s report.^[8] This is the youngest patient who received IFC treatment compared to the other study and even the older literature that discussed IFC therapy (de Oliveira *et al.* (2013) and Sharifi-Rad *et al.*^[5,13] Early treatment of LUTD in children is necessary to ensure a good long-term outcome, with IFC as one of the promising therapy options at a

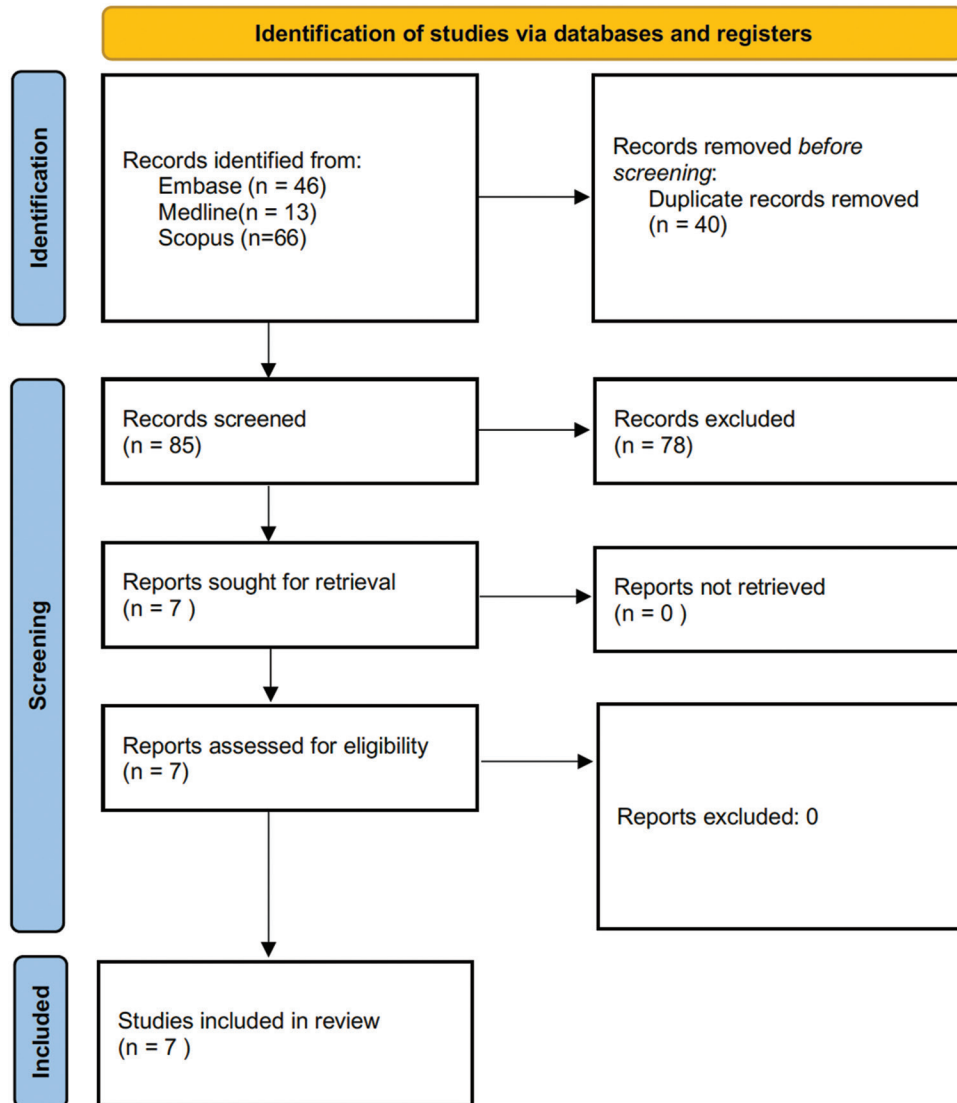


Figure 1: Diagram flow, n: number of articles.

young age. Although from some of the studies, response to treatment was better in older children (> 6 years old).^[5,12,16] This may be due to more development of the sphincter with an increase in age.^[16]

From the method and technique perspective, all of the authors mention similar duration, current frequency, and location of the therapy: 20 min session with 250 μ s for each shock and 6–6, 6 s of shock repetition, on a low-medium current frequency (4000–4500 Hz), and done in bladder and/or sphincter muscles. In addition, it is preferable to create a strong yet comfortable level of sensory stimulation for the patient during the procedure, without visible muscle contraction or pain complaint. Goats,^[6] as the oldest literature that explains the technique of IFC therapy, also mentions the same method used by all of the studies above.

However, what varies among these study are frequency of IFC repetition therapy conducted during each of their study lengths. Yazdanpanah *et al.*'s study^[16] is the most frequently conducted IFC: five times in 3 weeks study length; while the others varied from 1 \times to 3 \times a month. There is no literature that conveys the recommended frequency for IFC therapy in children, but it could be assumed that 5 times a session in 3 weeks can be done safely based on Yazdanpanah *et al.*'s study.^[16]

For the IFC result, there was a significant response between IFC therapy and other therapies in treating pediatric patients with lower urinary tract disorders. From these studies, children who were treated using IFC had significantly better results than those who used other therapies. The trials reported that 61–90% of patients responded positively to

Table 1: Table of data.

Author	Trial type	Control group	Total Groups (n)	Study length	Range age years old	Male (%)	Female (%)	Target	Sessions	Placement	Parameters
Kajbafzadeh <i>et al</i> (2009)	RCT	Placebo	IFC : 20	6-36 months	3-12.5 (5.62.7)	38	62	NDO	18	Symphysis pubic - ischial tuberosity	Incontinency UDS
Yazdanpanah <i>et al</i> (2012)	RCT	Desmopressin	IFC : 36	3 weeks	5-15	40	60	PNE	15	Below inguinal ligament - the upper sides of inner thighs	Wetting night Recurrence rate
Kajbafzadeh <i>et al</i> (2015)	RCT	Urotherapy	Urotherapy+IFC : 27	1 year	6-14 (8.72.5)	57	43	PNE	15	Symphysis pubic - ischial tuberosity	Wet night
Kajbafzadeh <i>et al</i> (2016)	RCT	Urotherapy	Urotherapy+IFC : 18	1 year	5-13 (8.92.6)	42	58	Non-neuropathic UAB	15	Symphysis pubic - ischial tuberosity	LUTS EMG PVR
Seyedian <i>et al</i> (2019)	RCT	Biofeedback therapy	biofeedback therapy+IFC : 23	1 year	5-13 (8.42.2)	20	80	Non-neuropathic urinary incontinence	10	Symphysis pubic - ischial tuberosity	Daytime time incontinence Urgency Nighttime wetting Uroflowmetry PVR
Sharifi-Rad <i>et al</i> (2020)	Retrospective	Trazosin (alpha blocker treatment)	IFC	7.5 weeks	5 - 13 (7.7)	83	17	PNBD	15	Symphysis pubic - ischial tuberosity	LUTS EMG lag time
Abdelhalim and Ibrahim (2020)	RCT	TENS	IFC : 26	6 months	7-14 (10.6 1.9)	63	37	PNE	18	Symphysis pubic - ischial tuberosity	Wet nights PinQ

RCT: Randomized control trial, IFC: Interferential current, NDO: Neurogenic detrusor overactivity, UDS: Urodynamic study, PNE: Primary nocturnal enuresis, PinQ: Pediatric incontinence questionnaire, TENS: Transcutaneous electrical nerve stimulation, PNBD: Primary bladder neck dysfunction, PVR: Post void residual, EMG: Electromyography, LUT: Lower urinary tract symptoms, UAB: Underactive bladder

the therapy. Both IFC and TENS produced improvements in the subjects. However, overall the IFC group showed better improvement in the short-and long-term compared to the TENS group.^[1] Desmopressin proved to be more effective than IFC based on the higher mean response of the groups, but the IFC group had a lower relapse rate.^[16] In all studies, there were no side effects reported in the control group or intervention group.

Only half of the studies discussed about complications and safety of the therapy, and most of them stated that no side effects occurred.^[1,9,10] This may be due to the low current frequency and time limit of each session. Goats^[2,6] recommends that the current start from low Hz until the patients feel the sensory stimulation without arousing pain. In addition, the skin around the attached electrode must be clean and dry to avoid linear electrical resistance.^[6] This safety topic was not discussed in all of the studies, especially for children is still unclear.

CONCLUSION

IFC is a promising therapy for bladder dysfunction and enuresis in children. More comparative RCTs are required in the future to quantitatively determine the superiority of IFC to other alternatives through a meta-analysis. The safety aspect of the treatment should also be studied further before it can be used in a clinical setting as the standard and protocol for children are still unclear.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author(s) confirms that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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