



## Effect of transcutaneous abdominal electrical stimulation in people with constipation due to spinal cord injuries: a pilot study

Efeito da eletroestimulação abdominal transcutânea no quadro de constipação em pessoas com lesão medular: estudo piloto

Efecto de la electroestimulación abdominal transcutánea sobre el estreñimiento en personas con lesión de la médula espinal: estudio piloto

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### ABSTRACT

**Objective:** To evaluate the effect of abdominal electrical stimulation (EE) on bowel movement frequency and feces consistency and expelled amount in people with constipation due to spinal cord injuries (SCI). **Method:** This is an experimental, crossover, randomized pilot study with two treatment groups: conventional intestinal rehabilitation and conventional rehabilitation associated with EE via 8- and 20-Hz Functional Electrical Stimulation (FES) of the abdominal muscles. Both groups were followed for two weeks with daily 30-minute EE sessions. Participants were hospitalized in a rehabilitation institute in the municipality of São Paulo. Data were analyzed using descriptive and inferential statistics. **Results:** This study included 10 people with SCI, of which most were male (70%), with a mean age of 39 years (SD = 16.37). EE, associated with conventional treatment, was more effective in increasing defecation frequency ( $p = 0.029$ ) and amount of feces expelled ( $p = 0.031$ ). **Conclusion:** Abdominal EE, associated with conventional treatment, helped to increase defecation frequency and amount of feces expelled in people with constipation due to SCI. This pilot study will serve as the basis for a future clinical trial with greater sampling and statistical evidence.

### DESCRIPTORS

Spinal Cord Injuries; Constipation; Electric Stimulation; Abdominal Muscles; Enterostomal Therapy; Rehabilitation.

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## INTRODUCTION

Spinal cord injury (SCI) is a highly disabling instance which can lead not only to damage or loss of sensitivity and motor function but also to multiple organ dysfunctions, according to the caused impairment<sup>(1)</sup>. Thus, the estimated global incidence of SCI is 40 to 80 new cases per million a year, totaling 13,019 to 163,420 per million people<sup>(1)</sup>. Its estimated incidence in Brazil is 71 new cases per million inhabitants/year<sup>(2)</sup>.

Note that gastrointestinal complications ones stand out among SCI ones<sup>(3,4)</sup>. They cause neurogenic bowel dysfunction, which is characterized by colon or smooth muscle dysfunctions. Moreover, people with such lesions show motility, anorectal sensitivity, and sphincter control alterations, resulting in neurogenic constipation, a physical and psychological obstacle for these individuals which negatively impacts their quality of life<sup>(4)</sup>. A study with 291 participants found constipation and intestinal incontinence<sup>(3)</sup> as the most common complications after SCI.

The literature indicates that the most used self-care practices for proper bowel movement are nutritional control, the Rosing maneuver (an abdominal massage from right to left and from bottom to the top with slight compression for approximately 20 or 30 minutes after meals), digital stimulations, laxatives, anal irrigations, suppositories, manual extraction, and mineral oil use, all considered conventional treatments<sup>(5)</sup>. These practices are part of an intestinal training program developed by nurses who also consider food, cultural, and educational habits and defecation frequency prior to the injury. Although some evidence suggests that these practices improve constipation symptoms, results are inaccurate in measuring positive effects, which justifies the search for new alternatives<sup>(4,6)</sup>.

Among promising treatments are techniques which use electrical stimulation (EE), known as neuromodulations, which can be performed invasively, such as electrically stimulating implants; or non-invasively, with transcutaneous currents. Thus, the literature considers functional magnetic stimulation as a common noninvasive neuromodulatory treatment for neurogenic constipation and fecal incontinence, used to alter colon motility in people with SCI and other neurological diseases<sup>(6)</sup>.

Another studied approach is the functional EE of abdominal muscles via functional electrical stimulation (FES), directly activating the neural fiber of nerve endings, depolarizing them and contracting muscles, activating all motor units with the same stimulus intensity, providing greater tone to the musculature, increasing intra-abdominal pressure, and facilitating the propulsion of intestinal contents, leading to increased defecation frequency and directly affecting peristalsis<sup>(7)</sup>. This is because the intrinsic innervation of the intestine has many neurons which are disconnected from the central nervous system. Stimulating this innervation can generate impulses which propagate to the upper and lower part of the digestive tube, influencing the activity of smooth muscles and glands in the stomach and the functioning of enteric reflex arcs. Sensory neurons respond to several stimuli, including mechanic ones, thus initiating motor and secretory responses in the secretory endothelium, smooth muscles, endocrine cells, and blood vessels<sup>(8,9)</sup>.

Note that the literature is still studying the mechanism by which FES improves intestinal motility and its long-term effects. Although it fails to reverse immediate neurological damage, EE can contribute to converting type II muscle fibers (of rapid, white, and anaerobic contraction) back to type I fibers (of slow, red, and aerobic contraction). Due to their inactivity, the paralyzed limbs of people with SCI have proportionally more type II than type I fibers (which may also be atrophied), leading to muscle weakness.

Thus, studies suggest electrical stimulation exercises since they increase contraction and resistance to muscle fatigue as more fibers are converted to type-I ones<sup>(10)</sup>. This is due to low frequency action on the metabolic profile of muscle fibers, increasing their mitochondrial volume, changing oxidative enzymatic activity, and decreasing glycolytic activity<sup>(5,10)</sup>. No adverse effects have been described in the treatment with FES current, used to relieve constipation symptoms<sup>(7)</sup>, except for fatigue, which can be avoided via the management of the offered frequency and form of stimuli<sup>(9)</sup>.

Studies in people with constipation due to multiple sclerosis who were subjected to EE with FES in the oblique and transverse muscles of their abdomens have shown an increase in patients' bowel movement frequency<sup>(7)</sup>. Thus, these individuals show slow intestinal transit, weak abdominal and pelvic floor muscles, and reduced intestinal sensation and gastrocolic reflex, characteristics common to SCI.

Since the literature describes the positive effects of abdominal muscle stimulation, this study aimed to evaluate the effect of transcutaneous abdominal EE on the defecation frequency and consistency and amount of feces expelled in people with constipation due to SCI, characterize participants' defecation patterns before SCI, and detail their usual emptying techniques. Based on this, we hypothesize that stimulating abdominal skeletal muscles, responsible for the contraction of smooth muscles of the large intestine – mainly of ascending and descending colons – favors physiological peristaltic movement and possibly contributes to intestinal neuromodulation. It is likely that abdominal stimulation has an effect similar to that of invasive sacral EE techniques, modulating the autonomic system and optimizing defecation reflex mechanisms<sup>(9,11)</sup>, thus facilitating fecal displacement, improving colonic transit, and avoiding greater intestinal complications to individuals with SCI.

## METHOD

### DESIGN OF STUDY

This is a crossover experimental pilot study in which the order of the treatment participants received was randomized.

### LOCAL

This study was conducted at the Lucy Montoro Rehabilitation Institute, a reference center in the rehabilitation of individuals with physical disabilities. The institute is located in the municipality of São Paulo, SP, Brazil.

## POPULATION

The study population was composed by participants with SCI and constipation symptoms who were hospitalized for a physical rehabilitation program.

## SELECTION CRITERIA

Inclusion criteria consisted of all genders; age equal or above 18 years old; SCIs with an ASIA A, B, C and D classification<sup>(12)</sup>; paraplegia or tetraplegia; enrollment in the hospitalization rehabilitation program; and diagnosis of constipation whose complaint followed the SCI – according to the Bristol Scale to characterize fecal consistency– and the Rome III criteria<sup>(13)</sup> – to assess the characteristics of bowel movement and analyze intestinal emptying frequency.

Exclusion criteria included: chronic bowel diseases prior to SCI, contraindicated use of EE with FES current, such as due to pacemakers; pregnancy; hypertension; excessive abdominal adipose tissue, BMI values greater than or equal to 30.0 Kg/m<sup>2</sup>; adult obesity or BMI equal to or greater than 27.0 Kg/m<sup>2</sup>; overweight older adults<sup>(14)</sup> or those with signs of inflammation/infection in the abdominal region such as: pain, heat, flushing, edema or active infections in the skin at the site – with disruption of the epidermis, pustules, blisters, purulent secretion or allergic process; in addition to any irritation visible or reported by individuals; clinically instable vital signs; complaint of severe pain (regardless of intensity) or any discomfort in the abdomen in need of medication; soft or aqueous feces in at least 75% of bowel movements<sup>(13,15)</sup>.

If individuals showed soft or aqueous feces, their bowel movement frequency was observed after the first event and assessed according to the Rome III criterion.

## SAMPLE SIZE

Since this is a pilot study, no sample calculation was performed. Thus, a sample of 10 participants was defined by the project collaborators, which was divided into two groups of five volunteers each. The sample was chosen according to patients' admission to the Institute and our inclusion and exclusion criteria.

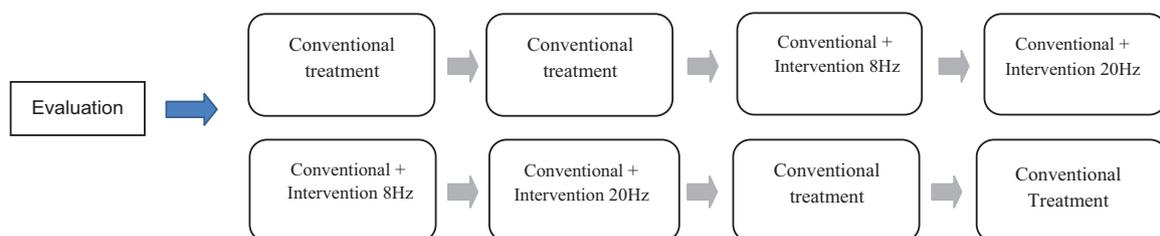
Treatment order was randomized via a website (*randomization.com*), which operated with a list containing treatment 1 – conventional; and treatment 2 – conventional plus abdominal EE with FES. In this process, five participants belonging to Group 1 and five, to Group 2 were used. This study lasted five weeks, corresponding to the length of hospital stay of individuals in the Institute.

In the first week, individuals were evaluated by a multi-disciplinary team and the research nurse via the instruments selected for this study. This assessment was considered as baseline. In the remaining four weeks, Group 1 was initially administered the conventional treatment, continuing to receive the same treatment in the following two weeks, but now associated with daily EE (8 Hz in the third week and 20 Hz in the fourth one). In Group 2, the protocol was the opposite (Figure 1). On weekends, individuals were discharged from therapy, returning to treatment on Mondays. It was impossible to establish a wash-out period as recommended in crossover studies since hospitalization at the Rehabilitation Institute lasts a maximum of six weeks. Thus, wash-out would have made complete data collection impossible since individuals would be discharged before the end of the treatment.

## DATA COLLECTION

Data collection was performed from July to October 2019 via the following instruments.

An instrument to assess socioeconomic, demographic, and clinical variables and investigate the occurrence of intestinal complications, taking as reference bowel movements before and after SCI. Among possible complications, volunteers were asked about fecal impaction, hemorrhoids, bleeding, fecal incontinence, constipation, diarrhea, and pain<sup>(16)</sup>. The classification scale of the American Spinal Injury Association (ASIA) evaluated by the medical physiatric team and described in electronic medical records: ASIA A (no motor or sensory function is preserved in the sacral segments S4–S5; ASIA B (sensory function preserved but not motor function is preserved below the neurological level and includes the sacral segments S4–S5; ASIA C (motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3; and ASIA D (motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more)<sup>(12)</sup>. Rome III criteria<sup>(13)</sup> were used to evaluate constipation. Participants were considered constipated if two or more of the following signs/symptoms were reported in the last three months before evaluation: defecation effort (in at least 25% of bowel movements); lumpy or hard stools (in at least 25% of bowel movements); sensation of incomplete defecation (in at least 25% of bowel movements); sensation of anorectal obstruction/fecal blockage (in at least 25% of bowel movements); need for manual maneuvers to facilitate defecation



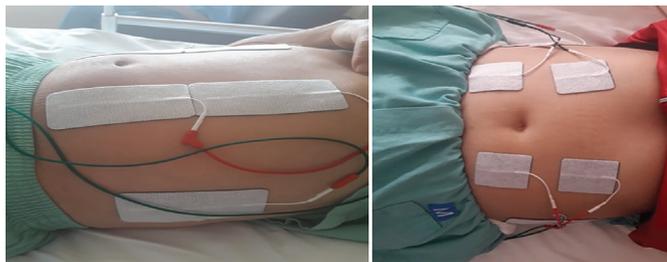
**Figure 1** – Experimental design to evaluate the effect of abdominal EE in participants admitted to the Lucy Montoro Rehabilitation Institute with SCI and constipation.

(in at least 25% of bowel movements); and fewer than three bowel movements a week<sup>(13)</sup>. A defecation frequency with three or more bowel movements a week and a maximum of three bowel movements a day was the parameter to establish normal intestinal pattern, in addition to other incorporated factors, such as: defecation effort, feces consistency, and rectal emptying<sup>(17)</sup>. The Bristol Stool Form Scale belongs to Rome III criteria. It assesses functional constipation by evaluating fecal content shape by a chart representing seven types of stools according to form and consistency, including two which are characteristic of constipation: type 1 and 2<sup>(17)</sup>. The daily defecation record filled out by participants or with the help of their caregivers during intervention contained information on weekly defecation frequency, fecal consistency (according to the Bristol Scale), and information on defecation effort and/or use of another resource (laxatives, enemas, digital anal stimulation or manual extraction), and amount expelled, according to participants' perception, evaluated as small, medium, and large<sup>(7)</sup>.

In the week in which conventional treatment was administered together with EE by FES current, a frequency of 8 Hz/10 mA<sup>(5)</sup> was used to desensitize abdominal muscles in five sessions. In the following week, a frequency of 20 Hz/10 mA was also used in five sessions, both lasting 30 minutes each<sup>(7)</sup>. Due to the change in sensitivity after SCI, intensity was increased every five minutes until visible muscle contraction was observed or 80 mA was reached, according to the safety assessment from a study with people in critical condition<sup>(18)</sup>. Participants were instructed that intensity units (mA) should be achieved without discomfort, burning sensation or pain<sup>(15)</sup>. Note that the 20 Hz frequency was selected due to its action on type I muscle fibers<sup>(19)</sup>.

Before starting EE, skin antiseptics of the abdominal region was performed with a 70% liquid alcohol solution. After the skin was completely dry, two individual self-adhesive electrodes were linearly positioned on participants' oblique muscles below their last rib until the bilateral anterior superior iliac crest and on the transverse musculature of their lateral abdomen. For this, standard 5 × 9 cm or 4 × 4 cm electrodes were used as they were better suited to individuals' abdomen. During EE treatment and at the end of each session, participants' skin was inspected, questions were asked about pain or discomfort, changes in spasm pattern were observed, and any other signs or symptoms reported by participants or by the nursing team after electrical therapy were verified.

For a better understanding, see the illustrative figure of the positioning of the electrodes on the abdominal muscles during the application of EE by FES current (Figure 2).



**Figure 2** – Positioning of transcutaneous electrodes on transverse and abdominal oblique muscles.

We should mention that all participants received therapy in the rehabilitation program. Within its activities, the conventional treatment performed by the rehabilitative nurses in the institution involved daily guidance on the functioning of the digestive system after SCI, intestinal emptying maneuvers (Rosing maneuver, toilet use positioning, and rectal examination), intestinal regulatory medications (lactulose and SIMBIOFLORA<sup>®</sup>), and a standardized laxative diet for all according to the evaluation and indication of the nutrition service.

## DATA ANALYSIS AND TREATMENT

Data were stored in Microsoft Excel version 2013 and their analysis was performed in Stata. Thus, the data obtained were analyzed using descriptive statistics, with absolute and relative frequencies for categorical and mean variables and standard deviation for numerical ones. For the comparative statistical analysis between defecation frequency (DF) and fecal amount (FA) within the evaluation periods (baseline, conventional treatment, and conventional treatment associated with EE), the Wilcoxon Signed-rank test was used. Moreover, this test also evaluated loading effect between the offered treatments due to the absence of intervals between them, i.e., if the first treatment interfered with the second one.

The FA variable was evaluated quantitatively, in which 1 = small, 2 = medium, and 3 = large quantity. The Fisher's exact test was used to compare the group with conventional treatment and the group with both treatments (conventional and EE) in the analysis of stool consistency (SC). For this, each individual's mean frequency – corresponding to two weeks of conventional treatment and two weeks of conventional treatment plus EE – was calculated and subtracted from baseline defecation frequency.

A 5% significance level was considered for the statistical tests.

## ETHICAL ASPECTS

This study was evaluated and approved by the Research Ethics Committee with opinion 3.402.561/2019. Informed consent was obtained from all participants, according to resolution 466/2012, which refers to research conducted with human beings.

## RESULTS

Overall, seven men aged between 23 and 63 years old and three women aged between 19 and 59 years old participated in this study. Mean male age was 37.7 years (SD = 15.91) and the female one, 42 (SD = 20.66). Individuals' mean age was 39 years (SD = 16.37). Regarding educational attainment, seven (70%) had completed high school; two (20%), elementary school; and one (10%) was illiterate. Regarding marital status, five (50%) were married; two (20%), single; two (20%), separated; and one, (10%) widowed.

In total, four (40%) suffered from SCI due to traffic accidents with bicycles, motorcycles, and cars; three (30%), to undescribed traumas; two (20%); to falls; and one (10%); to a gunshot wound. Regarding time living with SCI until the beginning of the rehabilitation program at admission, eight (80%) had lived with it for less than two years and two (20%); for more.

Overall, six participants showed tetraplegia between C2 and C7 medullary levels; three (30%), incomplete lesions and three

(30%), complete ones; whereas four had paraplegia covering T4 to L3 medullary levels; three (30%), incomplete lesions; and one (10%), a complete lesion. Individuals showed lesions from ASIA A to C.

Defecation frequency before SCI was daily in six (60%) individuals and every two days in four (40%). No participant reported previous bowel movement difficulties. Defecation frequency after SCI ranged from every four or five days for four (40%) participants, every three days for three (30%), every seven or 10 days for one (10%), on alternate days for one (10%), and daily for one (10%). We characterized participants with daily movement and on alternate days as constipated due to other classification factors, e.g., hardened feces, defecation effort, and incomplete defecation sensation.

Of the six participants with cervical lesions, all needed caregivers' help for conventional intestinal rehabilitation treatment. Overall, five defecated every three days or more and only one did every other day, expelling type 1 and 2 hardened and dry feces (according to the Bristol scale). Constipation signs and symptoms returned when caregivers were unable to perform intestinal rehabilitation care. Table 1 shows participants' bowel emptying strategies.

All participants were prescribed a laxative diet. Regarding the medication used to favor bowel movement, lactulose was prescribed for nine (90%) individuals, and only one (10%) use another medication. Administered dosages remained unchanged from baseline until the end of the protocol since participants already used the medication prior to intensive rehabilitation at admission, according to the responsible psychiatric physician's prescription.

No participant reported discomfort, pain, burning sensation or discomfort during or after EE. Applicability was made possible during participants' hospitalization without any prejudice to the fulfillment of the remaining prescribed therapies.

**Table 1** – Participants' strategies for bowel movement during treatments (conventional and EE) – São Paulo, SP, Brazil, 2019.

Strategy	N	%
Daily abdominal massage	5	50
Rectal examination or manual extraction	2	20
Bowel movements only after bowel irrigation	1	10
Rectal examination, abdominal massage, and the Valsalva maneuver	1	10
Abdominal massage and forward tilt	1	10
<b>Total</b>	<b>10</b>	<b>100</b>

**Table 2** – Defecation frequency of individuals with SCI, according to evaluation periods in conventional treatment, conventional treatment with EE, and baseline – São Paulo, SP, Brazil, 2019.

Defecation Frequency	Mean (SD)	Median	*P-value
<b>Conventional</b>	2.5 (0.86)	2.25	0.029
<b>Conventional + Electrical stimulation</b>	3.0 (0.90)	3.25	
<b>Baseline</b>	2.25 (0.88)	2.5	0.029
<b>Conventional + Electrical stimulation</b>	3.0 (0.90)	3.25	
<b>Baseline</b>	2.25 (0.88)	2.5	0.273
<b>Conventional</b>	2.5 (0.86)	2.25	

\* Wilcoxon Signed-rank test

We excluded only two participants from the analysis of defecation frequency since they moved their bowels three or more times a week, according to the Rome III criteria. Thus, Table 2 shows the results of the treatments offered were compared with the values obtained from the first week of hospitalization (baseline).

In total, nine (90%) participants' defecation frequency increased to three or five weekly episodes. Only one participant showed no alterations in their defecation frequency. They had complete thoracic (T4) SCI (ASIA A) and evacuated every seven to ten days since the injury four years ago.

Regarding fecal consistency, we classified our results in binary categories (normal: Bristol 3 and 4; and hardened: Bristol 1 and 2). We excluded from analysis a participant who showed normal fecal consistency at baseline. Another important factor is the statistically insignificant difference between the week of conventional treatment and that of conventional treatment with EE ( $p = 0.21$ ). Table 3 shows our results regarding participants' perception of the amount of feces they eliminated.

During data collection, participants and/or caregivers reported the changes they perceived to bowel movement characteristics during treatment associated with EE, of which five (50%) stated decreased defecation effort; three (30%), increased defecation desire; and two (20%), increased defecation desire and disappearance of flatulence.

We emphasize that, in all these tests, results failed to show statistical significance during the assessment of loading effect between the groups (Table 4).

The non-statistical significance of the comparison between the sums of the offered therapeutic sequences implies the absence of cumulative interferences between treatments, even without the wash-out period (interval) recommended for crossover studies.

**Table 3** – Amount of feces expelled from individuals with SCI, according to the evaluation periods in conventional treatment, conventional treatment with EE, and baseline – São Paulo, SP, Brazil, 2019.

Amount of feces expelled	Mean (SD)	Median	*P-value
<b>Conventional</b>	1.95 (0.43)	2	0.031
<b>Conventional + Electrical stimulation</b>	2.35 (0.41)	2.25	
<b>Baseline</b>	1.7 (0.67)	2	0.023
<b>Conventional + Electrical stimulation</b>	2.35 (0.41)	2.25	
<b>Baseline</b>	1.7 (0.67)	2	0.205
<b>Conventional</b>	1.95 (0.43)	2	

\* Wilcoxon Signed-rank test

**Table 4** – Comparison between the sum of treatment sequences of groups 1 and 2, considering the analyzed variables – São Paulo, SP, Brazil, 2019.

Characteristic	Mean (SD)		Sum of the medians		*p
	Group 1	Group 2	Group 1	Group 2	
<b>DF</b>	6.0±2.17	5.5±1.03	6.0	5.5	0.625
<b>FC</b>	5.1±1.98	5.5±1.22	6.0	5.5	1.000
<b>FA</b>	4.2±1.03	4.4±0.22	4.0	4.5	0.690

DF (defecation frequency); FC (Fecal consistency); FA (Fecal amount expelled); \*Wilcoxon Signed-rank test

## DISCUSSION

Robust reviews have discussed the efficacy and safety of EE in treating neurogenic bowel dysfunction, highlighting their positive outcomes, such as increased defecation frequency and reduced difficulty in people with mild to moderate constipation<sup>(5-6)</sup>. Note that few studies evaluated how abdominal EE improves bowel movement, especially in people with SCI. However, we found that associating EE with conventional intestinal rehabilitation increased defecation frequency to a satisfactory pattern, i.e., one within the recommendations of the Rome III criteria, with at least three bowel movements a week and an increase in individuals' perception of the amount of expelled feces.

Moreover, a systematic review found that, most studies addressing EE methods to treat neurogenic bowel dysfunction after SCI mentioned transcutaneous EE, using 20 to 25Hz frequencies, achieving efficacy and safety positive results<sup>(5,9)</sup>. Thus, our results corroborate another study which targeted people with multiple sclerosis who were subjected to abdominal EE, finding increased defecation frequency after bowel daily log analysis<sup>(7)</sup>. This study found that EE enhanced conventional treatment.

Another study, conducted with 18 participants with slow transit intestinal constipation, found that percutaneous EE of the tibial nerve, administered between three to six times a week in protocols which lasted up to 12 weeks, alleviated constipation severity by improving parasympathetic impulses, increasing defecation frequency ( $p = 0.048$ ), and decreasing laxative use ( $p = 0.025$ )<sup>(20)</sup>. However, we should consider that comorbidities which cause milder colon dysfunction may respond better to distal neuromodulation than more severe diseases<sup>(21)</sup>. Thus, the efficacy of distal neuromodulation, either transcutaneously or percutaneously, can be improved with the careful selection of participants' SCI clinical profile<sup>(22)</sup>.

Transcutaneous EE consists of a noninvasive intervention which offers clinical and safety benefits, in addition to its low cost and the possibility of application in outpatient or domestic regimes without the need for surgeries, an advantage in restoring bowel movement<sup>(5-6)</sup>.

In this study, participants with complete SCI – and especially cervical ones – showed positive changes in the analyzed variables and individuals' perceptions but maintained a regular need for caregivers' assistance. The different causes and neurological levels of SCI may influence EE effects and outcomes. Thus, a study conducted with 33 participants with SCI, divided into two groups according to neurological lesion level (above T9 and from T9 to L2), found an increase in rectoanal pressure after four weeks of transcutaneous EE treatment in sacral dermatomes and, consequently, improvement of intestinal emptying in participants with SCI from T9 to L2. Thus, neurogenic bowel dysfunction treatment produced better results in participants with incomplete SCIs<sup>(5)</sup>.

Due to its small sample size, this study was unable to evaluate the degree of improvement in the different types of SCI but found that participants with lower and incomplete lesions adhered more to conventional therapy due to the greater functionality of their upper limbs, which dispensed with caregivers' help to perform the care of conventional guided treatment, thus producing more positive results, according to their reports. In total, nine cases (90%) received a medical prescription for oral

laxative medication to aid with constipation symptoms, illustrating that adding EE fails to exclude individuality and the need for continuous conventional treatments.

We should highlight that the participants in this study were assisted by a nursing team trained to provide conventional treatment, guiding them on intestinal rehabilitation. However, the comparison of baseline values with conventional treatment showed no significant improvement in the DF, FA, and FC variables, which may suggest that this outcome relates to the association of individuals and caregivers to the offered behavioral guidance.

The conventional and EE treatments in the offered protocols failed to help only a single participant, who maintained their emptying pattern since they depended on weekly bowel irrigation to defecate. The medical team suspected structural alterations in the intestinal musculature but was unable to confirm via imaging tests in time for the outcome of this study. A radiological study in participants with SCI found that 74% had megacolons (with a colonic diameter greater than 6cm) and 55%, moderate to severe retention in all intestinal segments. Note that the risk factors for megacolon include advanced age, long injury time, symptoms of abdominal distension, radiological constipation, and laxative and anticholinergic use<sup>(23)</sup>, factors present in this participant, in addition to their verbal report of insufficient access to the offered behavioral guidance.

This study found no significant alterations to fecal consistency after EE association. The Bristol scale shows that the shape of feces also correlates with intestinal transit time and water intake<sup>(17)</sup>. Even with increasing EE, the literature still needs more studies with larger populations.

Most publications on SCI complications mainly focus on bladder function, less systematically and conclusively describing bowel movement ones. Still, neurostimulation results are promising for the future treatment of neurogenic bowel dysfunction. Thus, patients with intestinal dysfunctions which are secondary to neurological lesions or diseases are an extremely heterogeneous group, and future treatment with EE is likely to reflect underlying pathologies. This requires a better understanding of the action mechanisms for each EE type<sup>(24)</sup> since these therapies aim to modulate neuronal pathways, requiring further development of the literature on residual effects. Thus, people with neurogenic bowel dysfunction are, in fact, the most logical group to benefit from these treatments<sup>(25)</sup>. EE protocols perform a scheduled number of sessions and, due to their short periods of stimulation, some treatments assume effects which last beyond that<sup>(24)</sup>.

We conclude that the more the literature knows about electrical signal modulation, the more control it can obtain over bladder function, bowel movements, and other systems. Thus, despite the potential of noninvasive neuromodulation to improve clinical outcomes in people with SCI, its characteristics are nonspecific and efficacy reviews scarce<sup>(6)</sup>.

## PERSPECTIVES

Together with the conventional self-care techniques necessary for defecation in individuals with SCI — performed by patients or caregivers — we hope that EE will improve fecal elimination and reduce spent time and effort to positively improve these individuals' constipation symptoms and quality of life.

FES current is an easily applicable, low-cost, demonstrably safe, and noninvasive method which can even be administered by individuals and caregivers at home<sup>(7)</sup>. Moreover, the literature indicates the consistent results in daily EE use but the effects of outpatient application in health services are possibilities to be studied (such as the number of days of viable application) both for assessing practical reality and for obtaining satisfactory and cost-effective results as users acquire portable devices<sup>(9)</sup>.

### STUDY LIMITATIONS

This study ignored possible differences between individuals with tetraplegia and paraplegia and with complete and incomplete lesions due to its reduced sample size. If these individuals were to be separated into homogeneous groups, results could indicate which group would benefit most from treatment.

Also, the time participants took to start rehabilitation after SCI varied. Thus, individuals with lesions of varying ages participated in this study, which also failed to evaluate participants' previous knowledge of conventional treatment.

This study failed to suspend laxative medication at baseline before starting interventions. Although dose maintenance throughout the protocol minimized the influence of medications, its absence could contribute to a better understanding of EE effects.

### CONCLUSION

In light of the experiments and analyses performed, this pilot study showed that abdominal EE, together with conventional treatment for intestinal rehabilitation of people suffering from constipation after SCI, improved bowel movement frequency and the amount of feces expelled compared to baseline. However, we must emphasize that the literature still needs further development and a greater and better theoretical basis, with studies involving larger samples and more weeks of daily EE, enabling more robust analyses. Thus, this pilot study will serve as the basis for a future clinical trial with greater sampling and statistical evidence.

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### RESUMO

**Objetivo:** Avaliar o efeito da eletroestimulação (EE) abdominal sobre a frequência de evacuações, a consistência e a quantidade de fezes em pessoas com constipação decorrente da lesão medular (LM). **Método:** Estudo piloto experimental do tipo *crossover*-randomizado em dois grupos de tratamento: convencional de reabilitação intestinal e convencional associado à EE com *Functional Electrical Stimulation* (FES) de 8 e 20 Hz aplicados na musculatura abdominal. Ambos os grupos em seguimento por duas semanas, com 30 minutos de sessão diária de EE. Os participantes estavam internados em um instituto de reabilitação da cidade de São Paulo. Os dados foram analisados por meio de estatística descritiva e inferencial. **Resultados:** Participaram do estudo 10 pessoas com LM, a maioria do sexo masculino (70%), com média de idade de 39 anos (DP = 16,37). A EE, associada ao tratamento convencional, mostrou-se mais eficaz no aumento da frequência evacuatória ( $p = 0,029$ ) e na quantidade de fezes ( $p = 0,031$ ). **Conclusão:** A EE abdominal associada ao tratamento convencional auxiliou no aumento da frequência evacuatória e na quantidade de fezes no quadro de constipação em pessoas com LM. Este estudo piloto servirá como base para um futuro ensaio clínico com maior amostragem e comprovação estatística.

### DESCRITORES

Traumatismos da Medula Espinhal; Constipação Intestinal; Estimulação Elétrica; Músculos Abdominais; Estomaterapia; Reabilitação.

### RESUMEN

**Objetivo:** Evaluar el efecto de la electroestimulación abdominal (EE) sobre la frecuencia de las evacuaciones, la consistencia y la cantidad de heces en personas con estreñimiento debido a una lesión de la médula espinal (LME). **Método:** Estudio piloto experimental de tipo *crossover*-aleatorizado en dos grupos de tratamiento: convencional rehabilitación intestinal y convencional asociado a EE con *Functional Electrical Stimulation* (FES) de 8 y 20 Hz aplicados a los músculos abdominales. Se realizó un seguimiento de ambos grupos durante dos semanas con 30 minutos de sesión diaria de EE. Los participantes estaban hospitalizados en un instituto de rehabilitación de la ciudad de São Paulo. Los datos se analizaron mediante estadística descriptiva e inferencial. **Resultados:** Diez personas con LME participaron en el estudio, la mayoría hombres (70%) con una edad media de 39 años (DE = 16,37). La EE asociada al tratamiento convencional demostró ser más eficaz en el aumento de la frecuencia de evacuación ( $p = 0,029$ ) y la cantidad de heces ( $p = 0,031$ ). **Conclusión:** La EE abdominal asociada al tratamiento convencional ayudó a aumentar la frecuencia de evacuación y la cantidad de heces en el contexto de estreñimiento en personas con LME. Este estudio piloto servirá de base para futuros ensayos clínicos con mayor muestreo y evidencia estadística.

### DESCRIPTORES

Traumatismos de la Médula Espinal; Estreñimiento; Estimulación Eléctrica; Músculos Abdominales; Estomaterapia; Rehabilitación.

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