Effects of Noninvasive Skin Stimulation with Microcones on Constipation: A Double-Blinded Controlled Study

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ABSTRACT

Objective: The use of noninvasive skin stimulation with microcones for constipation is promising. However, no double-blinded study has assessed the effects of this approach on constipation. The goal of this research was to assess the effects on constipation when using noninvasive skin stimulation with microcones.

Materials and Methods: This double-blinded, controlled study included 44 subjects, each with a score of 5 points or higher on the Japanese version of the Constipation Assessment Scale (CAS-J). The subjects were randomly divided into 2 groups: (1) a stimulation group (skin-stimulation device with microcones; $n=23$; group S) and (2) a placebo group (identical device without microcones; $n=21$; group P). The subjects were required to attach the skin-stimulation devices to both cavum conchae with dedicated bandages every day for 2 months by themselves.

Main Outcome Measures: This study assessed the severity of constipation, total mood disturbance (TMD) score, and salivary amylase activity (SAA) in each subject. Measurements were obtained before, during, and after the intervention.

Results: With regard to the CAS-J score, significant differences were observed in both groups; however, no significant differences were observed between the groups. With regard to the TMD score, significant differences were observed in group S but not in group P. With regard to SAA, there were no significant differences in both groups; however, significant differences were noted after the intervention between the groups.

Conclusions: Noninvasive skin stimulation with microcones could relieve constipation and improve TMD scores and SAA activity. This procedure may be used as a self-care option.

Keywords: noninvasive skin stimulation, acupuncture, microcones, constipation

INTRODUCTION

BOWEL MOVEMENT IS AFFECTED by lifestyle factors (e.g., diet, physical activity, and sleep), stress, and other factors, and has been used as a health indicator for assessing quality of life (QoL).¹ Patients with functional bowel disorders, which predominantly manifest as abnormal bowel movements, abdominal discomfort, and other symptoms,

represent ~10%–15% of the general population. Functional bowel disorder has been suggested to occur more frequently in women than in men.² Constipation is associated with functional bowel disorder (e.g., recurrent abdominal pain, bloating, and abdominal distention) and is characterized by straining during defecation or difficult defecation. Constipation reduces QoL in patients experiencing these symptoms and has serious personal, medical, and social impacts.³

Moreover, because subjective complaints of constipation vary greatly among individuals, constipation is considered difficult to define in terms of frequency or volume of defecation.

However, since indicators for evaluating abnormal bowel movements were described in the Rome II criteria in 1988 and in the Rome III criteria in 2006,¹ an accumulation of studies on bowel movement was expected to occur. McMillan et al.⁴ presented the constipation assessment scale (CAS), developed for assessment of constipation, which is an inevitable adverse effect of opioids that are specifically used for cancer pain.

The recommended therapeutic options for constipation include exercise, fluid ingestion, fiber supplementation, laxatives, probiotics, antibiotics, spasmolytics, peppermint essence, psychotherapy, acupuncture, enema, sacral-root neuromodulation, and surgery. Among these approaches, acupuncture, which involves insertion of acupuncture needles into the body, is considered to possibly be effective for the symptoms of constipation if appropriate sites associated with constipation are stimulated.³ A systematic review on acupuncture in 1256 patients with chronic constipation reported that acupuncture increased the frequency of spontaneous bowel movements each week and was as effective as conventional drug therapy.⁵ Another study of 1075 patients with refractory constipation showed that electroacupuncture, in which an electric current is applied to acupuncture needles inserted into the body, was effective for treatment.⁶ The researchers noted that in previous studies on the effects of acupuncture, relatively intense stimulation was applied by inserting acupuncture needles (filiform needles) deep into the tissue up to the muscles.⁶ Acupuncture is only performed by physicians and acupuncturists. As acupuncture needles are inserted into the body, some patients show reluctance because of issues, such as pain, safety, and hygiene.

Hotta et al.⁷ reported that evoking an autonomic reflex with a noninvasive skin-stimulation device involving microcones, which do not penetrate into the body, might be as effective as acupuncture. This skin-stimulation device is an elastomer disk that is simply attached with a bandage to the body, and the skin can be continuously stimulated as long as the device remains attached. Focusing on this noninvasive skin-stimulation device with microcones, the current authors thought that, if the device could be used as a substitute for acupuncture, this disk might be considered as a simple, safe, and convenient self-care device that a patient can attach to his or her body. The amount of stimulation applied by acupuncture varies among practitioners according to the size of the acupuncture needles, the depth and duration of needle insertion, and other factors. In contrast, the skin-stimulation device enables application of a constant amount of stimulation to the body.

Interventional studies on acupuncture have been considered difficult. However, the skin-stimulation device enables double-blinded clinical studies to be performed, and is potentially applicable to various study fields. There have been

no double-blinded studies assessing the effect of this skin-stimulation device on constipation. The availability of many therapeutic strategies for addressing constipation enables the selection of self-care programs appropriate for individual patients, and, consequently, their QoL might be improved, or more comprehensive medical services could be provided, with the addition of yet another modality.

Objective

The present double-blinded controlled study was conducted to assess the effects of noninvasive skin stimulation with microcones on constipation.

MATERIALS AND METHODS

Subjects and Study Design

Before the start of this study, eligible subjects were examined using the Japanese version of the CAS (CAS-J), which was derived from a partial modification applied by Fukai et al.^{8,9} to the scale developed by McMillan et al.⁴ The current study included 46 subjects, each with a score of 5 points or higher on the CAS-J, who were likely to have constipation problems and who were in nursing care. Patients who were receiving outpatient treatment for underlying diseases or drug therapy for constipation were excluded. The subjects were randomly divided (random numbers generated using Microsoft Excel) into the following 2 groups for comparison and analysis: (1) a stimulation group (skin-stimulation devices with microcones used; $n = 23$; group S) and (2) a placebo group (devices identical in appearance and material but without any microcones used; $n = 23$; group P).

In this double-blinded, controlled study, the subjects were randomly assigned to treatment and were stratified according to sex by investigators who were not involved in measurements or distribution of the skin-stimulation devices to the subjects. Each subject received a sufficient explanation about the study and provided written consent for participation. The study was conducted with the approval of the ethics committee of Tokoha University, Hamamatsu-shi, Shizuoka-ken, Japan (2016-012H).

Measurement Parameters

Constipation. Severity of constipation was measured using the CAS-J at the following three timepoints: (1) before (in the preceding 1 month); (2) during (1 month after baseline); and (3) after (2 months after baseline) the intervention. It was considered that the effects of the menstrual cycle (mainly progesterone) in women could be excluded with this approach. Fukai et al., who used the CAS-J to examine many patients, reported that those with scores of 5 points or higher were likely to have constipation problems in nursing care (Table 1).^{8,9}

TABLE 1. JAPANESE VERSION OF THE CONSTIPATION ASSESSMENT SCALE (CAS-J)

Item No.	"Question"	Options
1	The abdomen appears distended or swollen.	0. Never 1. Sometimes 2. Always
2	The amount of flatus	0. Normal or large 1. Sometimes small 2. Always small
3	The frequency of stools	0. Normal or high 1. Low 2. Very low
4	The rectum appears filled with feces	0. Never 1. Sometimes 2. Always
5	Pain at the anus during defecation	0. Never 1. Sometimes 2. Always
6	The amount of stool	0. Normal or large 1. Small 2. Very small
7	Easiness of defecation	0. Easy 1. Sometimes difficult 2. Always difficult
8	Diarrhea or watery stools	0. Never 1. Sometimes 2. Always

*Japanese translation of Profile of Mood States 2nd Edition-Adult Short (POMS2).*¹⁰ POMS2 is a questionnaire survey consisting of the following seven scales: (1) anger–hostility (AH); (2) confusion–bewilderment (CB); (3) depression–dejection (DD); (4) fatigue–inertia (FI); (5) tension–anxiety (TA); (6) vigor–activity (VA); (7) and friendliness (F). In the present study, POMS2 was conducted three times in each subject (i.e., before, during, and after the intervention) to obtain a total mood disturbance (TMD) score as a general indicator covering emotional or psychologic suffering and subjective euphoria. A higher TMD score is considered to indicate higher psychologic stress.¹⁰ In the present study, the score was used to evaluate psychologic stress as a factor for constipation.

Salivary amylase activity (SAA). SAA was measured with dedicated chips and a measuring device (Saliva Amylase Monitor, Nipro Co., Osaka, Japan). At the three measurement points (i.e., before, during, and after the intervention), saliva was collected with the chip placed under the tongue for 30 seconds, and, then, SAA was measured with the device. SAA, which highly correlates with plasma catecholamine concentrations, is used as an indicator for assessing various stresses.¹¹ The measurement procedure itself imposes little stress because only saliva is collected, and this noninvasive, short-lasting, simple measurement of

SAA is known to be useful for assessing stress.¹¹ Thus, in the present study, SAA was used as a criterion for evaluating physical stress as a factor for constipation.

Interventions Using the Skin Stimulation Device with Microcones and the Placebo Device

The noninvasive skin-stimulation device with microcones used in this study was a SOMARESON mini (Toyo Resin Co., Hamamatsu-shi, Shizuoka-ken, Japan), which is an elastomer disk on which 53 cylindrical microcones (tip diameter, 37 μm ; height, 300 μm) are arranged at intervals of 0.4 mm in an area having a diameter of 4 mm. Although the placebo skin stimulation device appeared to be the same as the SOMARESON mini, no microcones were attached to the placebo disk (Fig. 1). All skin-stimulation devices used in this study were stored in sealed packages, each of which contained 100 devices of the same type, and each device was numbered. The devices were distributed to the subjects by investigators who were not involved in measurements, and treatment assignments were not disclosed to either the investigators or the subjects during the study period. Consequently, the study interventions were applied, and neither the subjects nor the measuring investigators were aware of which skin-stimulation device was used.

According to previous studies, the subjects in the present study were, in principle, required to attach the skin stimulation devices to both cavum conchae,¹¹ with dedicated bandages (10 $\times$ 10 mm) every day for 2 months by themselves at home. In the explanatory meeting before the start of this study, an acupuncturist with specialized knowledge instructed the subjects directly on the method for attaching the devices and other aspects of the study, and distributed to each subject a 2-month supply of skin-stimulation devices, and a sheet illustrating how to attach the device and the location of the application site in the cavum concha (Fig. 2).

Questionnaire Concerning the Applied Skin Stimulation Devices

Using a self-completed questionnaire form, the current authors investigated whether the subjects were blinded properly. The subjects answered the question "[w]hich device do you think was applied, the skin stimulation device with or without microcones?" by selecting one of the following options: (1) "I attached the device with microcones"; (2) "I attached the device without microcones"; or (3) "I do not know."

Statistical Analysis

For continuous variables (i.e., age, body height, body weight, body fat percentage, blood pressure, and SAA), the Shapiro–Wilk test was performed to assess the normality of the distribution. Then, a parametric test was performed for data with a normal distribution, and a nonparametric test

FIG. 1. Noninvasive skin-stimulation devices. Group S: Skin-stimulation devices with elastomer microcones (SOMARESON mini, Toyo Resin Co.). Group P: Skin-stimulation devices composed of the same material without microcones. The active device is an elastomer disk on which 53 cylindrical microcones (tip diameter, 37 μm; height, 300 μm) are arranged at intervals of 0.4 mm in an area having a diameter of 4 mm. The placebo skin-stimulation device appeared to be the same as the SOMARESON mini, no microcones were attached to the placebo disk. This figure was modified from the website of Toyo Resin Co., Shizuoka, Japan, with permission from the company.

was performed for data without a normal distribution. For categorical variables (i.e., CAS-J and TMD scores), a non-parametric test was performed.

To compare groups S and P, data showing normality and homoscedasticity were analyzed using the unpaired *t*-test,

and data not showing normality or homoscedasticity were analyzed using the Mann–Whitney-*U* test.

To assess the effects of longitudinal changes in the CAS-J scores, TMD scores, SAA levels (before, during, and after the intervention), Friedman's test was performed separately

FIG. 2. How and where to attach the noninvasive skin-stimulation devices in 3 steps. An acupuncturist instructed the subjects directly about the method used to attach the devices and other aspects of the study. Each subject received a 2-month supply of skin-stimulation devices (SOMARESON minis or placebos that resembled the active devices without microcones) and a sheet illustrating how to attach the devices and the application site in the cavum concha. This figure was modified from the website of Toyo Resin Co., Shizuoka, Japan, with permission from the company.

in groups S and P. When significant differences were detected, the Wilcoxon signed rank test was performed as a *post hoc* test.

The answers to the question concerning the skin stimulation device were analyzed using Pearson's χ^2 test.

Data with a normal distribution were expressed as mean $\pm$ standard deviation, and data without a normal distribution were expressed as median (interquartile range).

Statistical analyses were performed using IBM SPSS version 24 (IBM Corp., Armonk, NY). A *P*-value of 5% was considered to indicate significance.

RESULTS

Subjects

Among all 46 randomized subjects, 2 from group P withdrew consent for participation after randomization. This study ultimately included 23 subjects (6 men and 17 women) in group S and 21 subjects (6 men and 15 women) in group P. No significant differences in the characteristics of the subjects were observed between the 2 groups (Table 2).

The Questionnaire Concerning the Applied Skin Stimulation Device

Table 3 shows the results of the self-completed questionnaire survey performed to examine whether the subjects were blinded properly.

The subjects were asked: "Which device do you think was applied, the skin stimulation device with or without microcones?" Of the 23 subjects in group S, 10 (43.5%) replied that the device with microcones was applied, 3 (13%) replied that the device without microcones was applied, and 10 (43.5%) did not know which device was applied. Of the 21 subjects in group P, 7 (33.6%) replied that the device with microcones was applied, 8 (38.1%) replied that the device without microcones was applied, and 6 (28.6%) did not know

TABLE 3. SENSATIONS ON ATTACHMENT OF THE SKIN-STIMULATION DEVICES WITH OR WITHOUT MICROCONES

Question: Which device do you think was attached, the skin stimulation device with or without microcones?

Groups	"With microcones"	"Without microcones"	"I do not know"	Totals
Group S (<i>n</i> = 23)	10	3	10	23
Group P (<i>n</i> = 21)	7	8	6	21
Total	17	11	16	44

No significant differences were observed in proportions of subjects (Pearson's χ^2 -test; *P* = 0.156).

which device was applied. There were no significant differences in the proportions of subjects between the groups (*P* = 0.156).

The Japanese Version of the Constipation Assessment Scale

Severity of constipation was measured with the CAS-J thrice (i.e., before, during, and after the intervention) and was analyzed using Friedman's test. Significant differences were observed in both groups S and P. The Mann-Whitney-*U* test was performed to compare groups S and P, and no significant differences were observed between the groups (Table 4).

Japanese Translation of Profile of Mood States, 2nd Edition—Adult Short

TMD was measured with the POMS2 thrice (i.e., before, during, and after the intervention) and was analyzed using Friedman's test. Significant differences were observed in group S (*P* < 0.05); however, no significant differences were observed in group P (Table 5).

TABLE 2. COMPARISON BETWEEN GROUPS S AND P BEFORE THE INTERVENTION

Characteristics	Group S (<i>n</i> = 23) (6 men & 17 women)	Group P (<i>n</i> = 21) (6 men & 15 women)
Age (years)	20.3 $\pm$ 1.1	20.5 $\pm$ 2.0
Height (cm)	161.1 $\pm$ 9.3	161.3 $\pm$ 8.0
Weight (kg)	56.3 $\pm$ 9.5	56.4 $\pm$ 8.8
Body fat percentage (%)	25.0 $\pm$ 8.6	25.1 $\pm$ 6.2
SBP (mmHg)	119.7 $\pm$ 12.5	121.2 $\pm$ 13.0
DBP (mmHg)	70.1 $\pm$ 10.1	68.4 $\pm$ 9.4

No significant differences were observed in all items between groups S and P before the intervention (unpaired *t*-test).

Data are expressed as mean $\pm$ standard deviation.

SBP, systolic blood pressure; DBP, diastolic blood pressure.

TABLE 4. CHANGES IN THE JAPANESE VERSION OF CONSTIPATION ASSESSMENT SCALE SCORES

Groups	Before	During	After
Group S** (<i>n</i> = 23)	7.0 (6.0–8.5)	5.0 (4.0–6.5) ^{##}	5.0 (3.5–6.0) ^{##}
Group P* (<i>n</i> = 21)	7.0 (6.0–8.0)	6.5 (4.0–8.0) [#]	5.5 (4.0–6.0) ^{##}

Friedman's test showed significant differences in both groups (***P* < 0.01 in group S and **P* < 0.05 in group P).

Comparison with scores before the intervention (^{##}*P* < 0.01 and [#]*P* < 0.05).

Mann-Whitney *U* test showed no significant differences between the groups.

Data are expressed as median (interquartile range).

TABLE 5. CHANGES IN TOTAL MOOD DISTURBANCE SCORES FROM THE JAPANESE TRANSLATION OF PROFILE OF MOOD STATES, 2ND EDITION—ADULT SHORT

Groups	Before	During	After
Group S* (<i>n</i> = 23)	15.0 (5.0–27.5)	9.0 (2.0–24.0)	9.0 (–3.0 to 32.5)
Group P (<i>n</i> = 21)	20.0 (10.0–34.0)	12.0 (6.0–24.0)	17.0 (7.0–29.0)

Friedman's test showed significant differences in group S (* $P < 0.05$). Data are expressed as median (interquartile range).

Salivary Amylase Activity

SAA was measured thrice (i.e., before, during, and after the intervention) to determine differences between the measurement points and were analyzed using the Friedman test. There were no significant differences in both groups S and P. However, the Mann–Whitney U test showed significant differences in the values after the intervention between groups S and P ($P < 0.05$; Table 6).

ADDITIONAL NOTE

All subjects completed all scheduled tasks, and no particular health-related problems were reported throughout the study period.

DISCUSSION

With regard to the question concerning the attachment of noninvasive skin-stimulation devices, no differences were observed in the proportions of subjects between groups S and P, indicating that the subjects had been blinded properly. The current authors assumed that the interventions in this study were performed under a double-blinded condition. In addition, the noninvasive skin-stimulation device with microcones used in this study was suggested to be a device that enables the performance of double-blinded controlled studies.

In both group S (in which the skin stimulation device with microcones was attached) and group P (in which the device without microcones was attached), CAS-J scores regarding

constipation significantly decreased during the study period. However, because no statistically significant differences were observed between the 2 groups, this study did not detect any differences in the effects between the devices with and without microcones.

However, the CAS-J score after the intervention in group S was 5.0 (range: 3.5–6.0), which was lower than that of the 5.5 score (range: 4.0–6.0) in group P. It is considered that individuals with a CAS-J score of 5 points or higher are likely to have constipation problems in nursing care.^{8,9} According to the scores observed in the present study, it is expected that noninvasive skin stimulation with microcones might resolve the tendency to have constipation problems in nursing care. Previous studies reported that noninvasive gentle stimulation applied to the perineal skin of anesthetized rats with an elastomer roller without microcones was effective for inhibiting micturition contractions, whereas stimulation applied with a polystyrene roller having a hard surface was ineffective.^{12,13} In the future, more-detailed studies need to be conducted with various skin-stimulation devices to assess the effects of the presence or absence of microcones, the size and sturdiness of the device, the materials used in the device, and other factors.

In the present study, the skin-stimulation devices were attached to both cavum conchae.¹⁴ Because the cavum conchae are controlled by the vagus nerves, stimulation applied to the cavum conchae is considered to be involved in the control of autonomic function.^{14,15} Depending on the methods and sites of insertion of acupuncture needles, such stimulation is expected to affect bowel movement via the somatic-autonomic reflex pathway.¹⁶

In addition, the beneficial effects of trigeminal nerve stimulation on several neurologic disorders have been increasingly acknowledged. Hypothesized mechanisms include the modulation of excitability in networks involved by the disease, and its main site of action has been recently reported at brainstem level.¹⁷

The skin-stimulation devices to both cavum conchae reach the center of the autonomic nerve of the brainstem through the trigeminal nerve. Because there is a vagus nerve nucleus that dominates the stomach and the intestines, it was thought that the stimulation reached the large intestine via the vagus nerve, which promoted the bowel movement.

Hotta et al.⁷ previously reported that autonomic function can be controlled by skin stimulation applied, using a device with microcones similar to the device used in the present study. The Hotta et al. study⁷ demonstrated that the effects of skin stimulation with microcones were similar to the effects of stimulation with acupuncture needles. Specifically, skin stimulation with acupuncture needles inhibited the somatic-autonomic reflex and induced excitation of low-threshold cutaneous mechanoreceptive fibers. Consequently, nociceptive transmission conveyed by primary afferent C fibers was inhibited via the release of both opioid and nonopioid inhibitory mediators.

TABLE 6. CHANGES IN SALIVARY AMYLASE ACTIVITY LEVELS

Groups	Before	During	After*
Group S (<i>n</i> = 23)	0.0	0.0 (–10.0 to 5.0)	–5.0 (–11.5 to 1.0)
Group P (<i>n</i> = 21)	0.0	0.0 (–7.0 to 2.0)	1.0 (–2.0 to 5.0)

Friedman's test showed no significant differences in groups S and P. Mann–Whitney-U test showed significant differences after the intervention between the groups (* $P < 0.05$).

Data are expressed as median (interquartile range).

A previous study,¹⁸ in which the current authors were involved, suggested that skin stimulation with microcones applied around the middle portion of the anterior tibial muscle improved blood flow. This stimulation also reduced cardiac sympathetic nervous activity via the somatic–autonomic reflex, which could have accelerated a decrease in the levels of physical function and metabolites from levels elevated by exercise to levels in the resting state. Another report indicated that acupuncture applied to acupoints on the upper and lower limbs increased bowel movements in rats with constipation.¹⁹ Thus, the current authors believe that studies comparing stimulation at different sites are needed in the future.

Based on the action mechanisms shown in the aforementioned studies, it is assumed that the phenomena observed in the present study also reflected some effect exerted on constipation through the mechanism of the somatic–autonomic reflex, similar to stimulation with acupuncture needles.

Because the digestive organs are easily affected by psychologic stress, the stress–brain–gut axis—which involves brain–gut interactions—is regarded as an important pathologic feature of constipation.²⁰ Abdominal pain and abnormal bowel movements caused, or aggravated, by psychologic stress are considered to be characteristic features of typical gastrointestinal disorders.²¹ Thus, TMD scores obtained from POMS2 were used to assess changes in psychologic states associated with constipation. According to Friedman’s test, the POMS2 scores changed significantly in group S, whereas group P did not show any significant changes.

Because changes in psychologic states can comprise a cause and not a consequence of abnormal bowel movements, no generalization can be made. However, the present study suggested that skin stimulation with microcones applied to the cavum concha might alleviate psychologic stress. Because CAS-J scores decreased with improved TMD scores obtained from POMS2, the present study suggested that these psychologic stresses might have been involved in skin stimulation with microcones. However, it appears necessary to understand the background factors causing constipation in individuals. In the future, the current authors plan to analyze the effects of skin stimulation with microcones further, with consideration of lifestyle, QoL, and other factors affecting subjects.

The Mann–Whitney–U test showed that differences in SAA after the intervention differed significantly between groups S and P. Yet, there was no significant difference shown in Friedman’s test. This might be due to individual differences over time and the fact that there were few subjects. In future research, the current authors would like to revise the measurement method and increase the number of subjects. In the present study, measurement of SAA enabled simple and rapid assessment of physical stress experienced by subjects who were likely to have constipation. Patients with irritable bowel syndrome (IBS) accompanied by constipation have been reported to show overreactions of the gastrointestinal tract to stress. For instance, intravenous administration of corticotropin-releasing hormone, a com-

mon mediator of stress reactions, induces excessive secretion of adrenocorticotrophic hormone and simultaneously causes enhanced or abnormal bowel movement accompanied by abdominal pain in patients with IBS, compared with healthy individuals.²²

It is assumed that skin stimulation with microcones exerted some effect through the mechanism of the somatic–autonomic reflex, similar to stimulation with acupuncture needles.⁷ However, because autonomic nervous activity was not measured in the present study, the mechanism for the effects of skin stimulation with microcones could not be determined according to the methods and results of the present study. This mechanism should be assessed in a future study.

There were subjects who showed constipation relief and those who showed no change in the condition or an increase in the CAS-J score. Thus, it appears important to understand the characteristics of the responses of subjects. The limitations of this study included the small sample size and selection bias with respect to age and sex. Based on these limitations, the current authors believe that the effects of skin stimulation need to be reexamined under different conditions with regard to selection of subjects, sample size, intervention periods, and other factors. With simultaneous measurement of autonomic-nerve activity and other indicators, the current authors intend to enhance the objectivity of the current study further. During the present study, the subjects reported no particular health-related problems. Because only noninvasive microcones were applied without any drugs, this skin-stimulation device is expected to be simple and safe for self-care of constipation, and can be used even when no advanced medical devices are available.

CONCLUSIONS

The findings of this study suggest that noninvasive skin stimulation with microcones could relieve constipation and improve TMD scores and SAA levels. This procedure may be used particularly as a self-care option.

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AUTHOR DISCLOSURE STATEMENT

The authors of this article have no conflicts of interest to declare.

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