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Effect of visceral manipulation on children with refractory chronic functional constipation: a randomized controlled trial

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HIGHLIGHTS

- To evaluate the effect of visceral manipulation on children with chronic intractable functional constipation unresponsive to the standard treatment.
- Children with chronic interactable functional constipation were included in the study.
- The dose of oral laxatives in the visceral manipulation group decreased significantly.
- Visceral manipulation can be considered as a possible treatment without side effects besides standard medical treatment for the treatment of chronic functional constipation.

ABSTRACT – Background – Functional constipation (FC) is a common global high prevalence issue in children. **Objective** – The purpose of the present study is to evaluate the effect of visceral manipulation (VM) on children with chronic interacble FC unresponsive to the standard treatment. **Methods –** This study was conducted as a randomized, single-blind controlled trial. Fifty-two children with refractory chronic functional constipation unresponsive to the standard medical treatment were randomly allocated to two groups of 26 control (standard medical care (SMC)) and 26 intervention (SMC with VM) for 4 weeks. Abdominal pain, painful defecation, stool consistency, defecation frequency, and the dose of oral laxative were evaluated before and after the treatment period using the Pain Rating Scale, Bristol stool form scale, and patient/parents report. **Results** – At the end of treatment, except for the dose of oral laxative in the control group, all of the results showed a significant difference in both groups (P<0.05). The dose of oral laxative in the intervention group decreased significantly (P<0.05), however, no significant change was observed in the control group (P>0.05). In the intervention group comparison, statistically significant differences were found in all variables except the Bristol stool form scale (P<0.05). The Bristol stool form scale after treatments was not different when the groups were compared (P=0.32), but the number of subjects who had normal stool consistency was significantly increased in the intervention group than in the control group (P<0.05). **Conclusion –** VM can be considered as a possible treatment without side effects besides SMC for the management of chronic FC. Further studies are needed to investigate the long-term effect of VM.

Keywords – Constipation; functional constipation; physiotherapy; osteopathy; visceral manipulation.

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INTRODUCTION

Functional constipation (FC) is a common global issue in children with that prevalence ranging between 0.7–29.6% based on geographic regions[1]. FC is known as a symptom-based disorder, characterized by infrequent bowel movements, hard stool consistency, and painful evacuation with/without abdominal pain[1,2]. It is well known that the children's Health-related quality of life is compromised by FC. Their daily activities such as school and social participation are limited[3]. Moreover, children with FC impose a large economic burden on the healthcare system, with it has been reported to be approximately US$3.9 billion per year in the United States of America (USA). Furthermore, it accounts for 3% of general pediatrician visits and >25 % of pediatric gastroenterologist visits in the USA[4].

Although the FC pathophysiology in children is not clear and is considered a multifactorial problem as a result of each factor, bowel movements are disordered and stool Properties get affected[4,5]. Commonly FC treatments deviated into three groups; non-pharmacological, pharmacological, and surgical interventions. The first line of FC treatment is non-pharmacological interventions. The non-pharmacological treatment focused on education and lifestyle changes including fiber and fluid intake, increase physical activity, biofeedback therapy, toilet training, and behavior recommendations[5,6]. Pharmacological treatment refers to various forms of laxative agents such as Osmotic laxatives, Lubricants, and Stimulant laxatives. However, in a considerable proportion of children, these treatments do not seem to be effective, especially in the long term[5]. Whenever conventional treatments have failed and children's quality of life is significantly impaired by constipation, surgery has been chosen as the last treatment option[6].

Non-pharmacologic treatments were recommended for adult cases[7]. Recently used osteopathy method as one alternative treatment. Osteopathy is a holistic approach that uses a variety of manual treatments including stretches, mobilizations, and manipulations on musculoskeletal and visceral systems to promote and correct the structure and function of the body[8,9]. Visceral manipulation (VM) is an important part of the osteopathic method[10]. According to VM theory, all intra-abdominal organ has inherent motions (i.e., mobility and motility), whenever an organ's motions get disturbed (visceral dysfunction), its physiologic functions could be limited. Visceral dysfunction is considered as mobility and/or motility restriction in the viscera and its related structures include fascial, neural, skeletal, vascular, and lymphatic components[11,12]. VM is a gentle, specifically placed manual technique that aims to correct mechanical (mobility and motility), vascular, and neurological dysfunction in viscera[11,13].

For constipation has been thought that VM could be effective on constipation symptoms by improving the capacity of resilience in peritoneal structures surrounding organs. In other words, VM helps to restore motions in an environment of abdominal organs or within organs[9,14].

There have been published studies regarding the effect of osteopathy manual techniques on a patient suffering from constipation. Overall, the previous findings showed that osteopathy manual techniques could improve constipation symptoms[8,9,14-16]. However, most of these studies have been done as pilot studies and have a small sample size[8,9,15,16]. In addition, all of these studies except Pasin Neto H et al. used a range of manual techniques which caused uncertainty about the effectiveness of each technique[14]. To the best of our knowledge, no study has yet investigated the effect of VM on children with functional constipation.

Therefore, the purpose of the present study is to evaluate the effect of VM on children with chronic functional constipation. The researcher hypothesized that VM may improve refractory functional constipation symptoms and decrease the dose of oral laxative needed.

METHODS

Participants

The present study was designed and conducted as a randomized, single-blind controlled.

Inclusion criteria

The inclusion criteria for this study were included as follows:

1 - Age 5–18 years[17,18].

2 - The duration of constipation is at least 3 months[19].
3 - Functional constipation based on Rome IV criteria[1,20].
4 - There is no improvement following three months of treatment.
5 - Cooperative children and family.

Exclusion criteria

1 - Endocrine and metabolic disorders (eg, hypothyroidism, hypercalcemia, diabetes mellitus, diabetes insipidus).
2 - Neurologic and psychiatric disorders (spina bifida, cerebral palsy, anorexia nervosa, known autism spectrum disorders).
3 - Down's syndrome.
4 - Hirschsprung's disease.
5 - Secondary constipation to drug consumption.
6 - History of abdominal surgery[18].
7 - Fecal incontinency.

To sample homogenization, subjects with fecal incontinence were excluded from this study. All patients who enrolled in this study were examined and diagnosed by pediatricians before their enrollment.

Assessments

The following scales were used to assess patients: 1) Wong-Baker faces Pain Rating Scale (Wong-Baker FPRS) to evaluate abdominal and defecation pain 2) Bristol stool form scale (BSFS) to assess stool consistency. For statistical analysis, BSFS was calculated as a score[21]. 3) Defecation frequency (bowel movement per week) and 4) the dose of oral laxative (polyethylene glycol (PEG)) the patient needs.

Procedures

After obtaining informed consent, subjects were allocated to different groups (control or intervention) based on randomization maneuvers that will be explained below. Then information about age, sex, and anthropometric data (body mass and height) were recorded. Specific outcomes including abdominal and defecation pain, stool consistency, frequency of defecation, and laxative dose were measured for both groups in the first session and after four weeks. The dose of PEG was assessed after VM according to the stool consistency and abdominal pain during defecation.

Control group

The control group (CG) treatments included the standard medical care (SMC) and it consisted of children's and parents' education, the recommendation of fiber and fluid intake, and the prescribing laxatives (PEG)[18].

In the education section, information was given on the prevalence, symptoms, initiating and continuing factors, and the course of the FC. To facilitate defecation and use the benefit of the gastrocolic reflex after stomach distension, children were advised to sit on the toilet for at least 5 min after each meal and try to defecate. The importance of a comfortable posture during defecation was explained and they were recommended to use of footstool to support their feet when they were sitting on the toilet. The concept of withholding behavior was described and children were suggested to not hold their stools when they need to defecate[4,6].

In nutritional counseling on fiber and fluid intake, the patient was encouraged to consume more fluids (water, apple juice, pears, and plums) and fiber (cereals, vegetables, fruits, potatoes, and grains). According to the content and properties of fruits they were advised to eat Green kiwifruit, prune (dried plum), apples, and pears and also not to consume persimmons and bananas due to adverse effects[22].

The children's pediatricians were prescribed PEG for the patient (0.3–0.8 g/kg body weight per day). The patients were recommended to take PEG as needed. They were told that if their symptoms improved, they could reduce the PEG dose used, otherwise increased the dose.

Intervention group

The standard medical care package administered in the CG was also recommended for the intervention group (IG).

All subjects in the IG received VM techniques for eight sessions over 4 weeks (two sessions per week)[8,23].

Each session took 40 minutes. To general VM and abdominal relaxation, inhibitory techniques were performed on sphincters (gastroduodenal, oddi, duodenojejunal, and sigmoid colon) at the beginning of the session (FIGURE 1-4).

FIGURE 1. Treatment of sphincter oddi.

FIGURE 2. Pylorus (gastroduodenal) treatment.

FIGURE 3. Treatment of duodenojejunal flexure.

FIGURE 4. Mobilization of sigmoid colon.

To normalize organ mobility, VM techniques were applied to different parts of the large intestine (sigmoid mesocolon, descending colon, splenic flexure, hepatic flexure, ascending colon, toldt fascia, cecum) and mesentery (FIGURE 5).

FIGURE 5. Treatment of ileocecal valve.

At the end of the session, large colon motility was improved and corrected by induction technique[8,24,25]. Improvement in defecation and stool consistency and pain reduction are the evaluated by evaluation of bristol criteria.

Randomization and allocation

Fifty-two patients were randomly allocated to different study groups by block randomization. The block randomization was used to match the number of samples in the control and intervention groups. In the blocks, the letter A was assigned to the control group and the letter B to the intervention group. All patients were evaluated before their allocation. According to the order of the letters (A and B), the patients were allocated into the control or intervention group. The randomization process was performed by a person outside of the study, who was unaware of the process of study.

Blinding

The patient's evaluator and statistical analyzer were not involved in another aspect of the study. They were blinded to patients' allocation and treatment.

Statistical analysis

Statistical analyses were performed by the statistical analysis program Statistical Package for the Social Sciences (IBM SPSS Statistics 26). Numerical

data were presented as mean ± SD and categorical data were presented as frequency or percentage. The Kolmogorov-Smirnov test was used to check the normality of the data distribution. In normal data distribution, paired *t*-test was applied to calculate pre-and post-treatment differences, while the Wilcoxon rank-sum test was used in the non-normal data distribution. The independent-samples *t*-test was applied to the comparison between groups. The chi-square test was used in categorical data. A $P<0.05$ is considered a statistical significance level in all tests.

Statement of ethics trial

This study was approved by the ethics committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.REC.1398.293).

Clinical trial registration: The trial protocol was approved in the Iranian Registry of Clinical Trials (IRCT20190614043891N1, https://irct.behdasht.gov.ir/trial/40434).

RESULTS

A total of 59 children with functional constipation met the eligibility criteria. The four cases did not participate due to parental refusal. Fifty-five children were randomly allocated to two groups of 26 control and 29 intervention. We lost three cases in the intervention group due to the covid-19 pandemic and quarantine situation (FIGURE 6). There was no statistical difference in demographic characteristics (age, weight, and height) and sex between groups (TABLE 1).

Numbers in the Table are shown as N (%) and *P* values calculated from the chi-square test, **P*-value from Independent sample *t*-test.

The results of pre-and post-intervention are

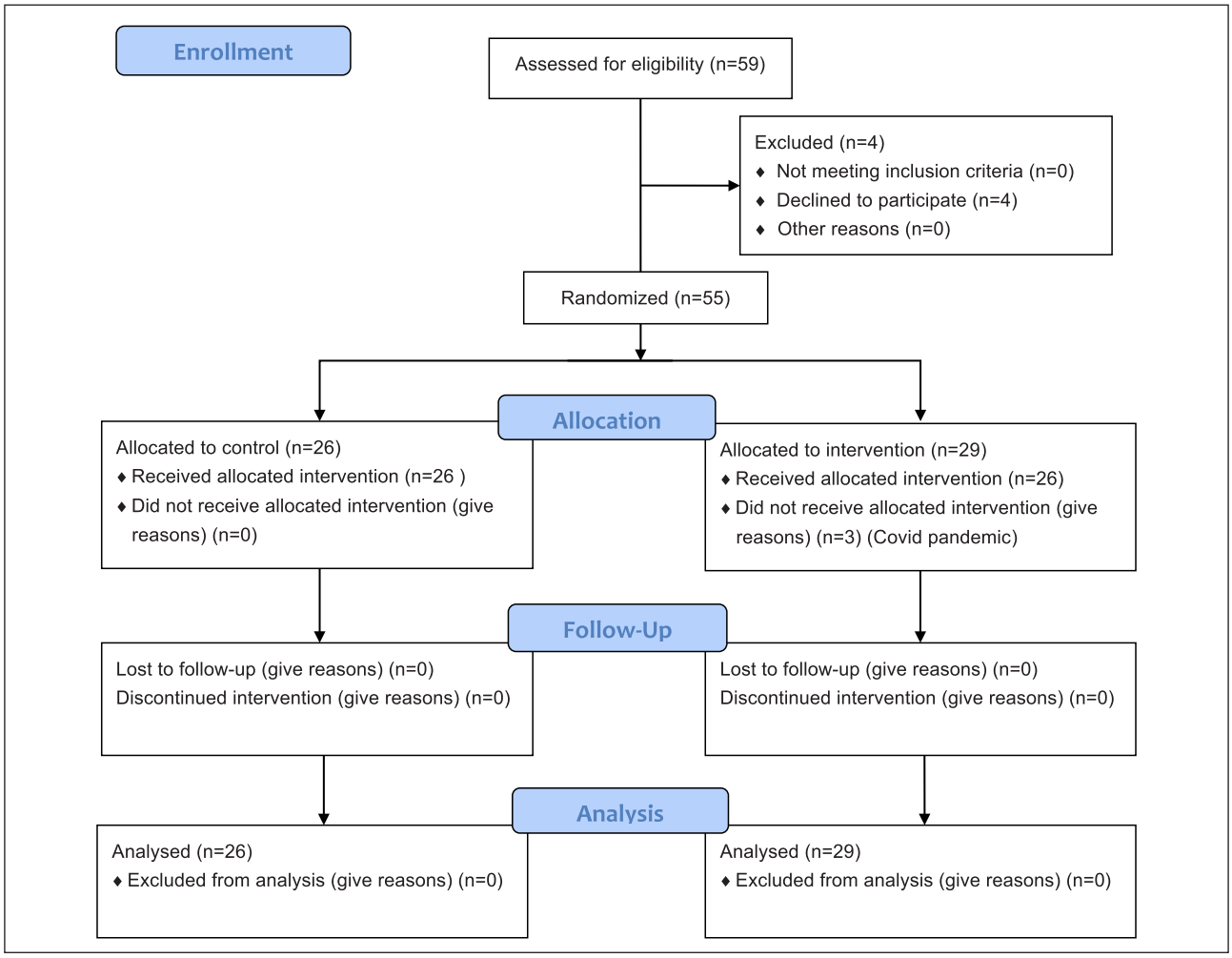

FIGURE 6. CONSORT flow diagram.

TABLE 1. Baseline characteristics of children allocated to groups.

	Control group (mean ± SD)	Intervention (mean ± SD)	*P* value
Age (years)	7.46±3.12	7.8±2.68	0.42
Weight (kg)	24.67±8.5	24.82±8.5	0.06
Height (cm)	119.81±17.02	122.35±16.79	0.54
Sex	N (%)	N (%)	
Boys	15 (57.7)	12 (46.2)	0.4
Girls	11 (42.3)	14 (53.8)	

shown in TABLE 2. No difference was found between groups at the baseline. All of the continuous data distribution had a normal distribution.

Defecation pain

The result of intragroup analysis (paired-samples *t*-test) showed significant improvement in both groups in terms of defecation pain (IG: $P<0.0001$; CG: $P<0.0001$). Statistically significant differences (samples *t*-test) were seen between groups after the treatment ($P=0.002$). (TABLE 2).

Abdominal pain

A statistically significant decrease was found through the paired-samples *t*-test in both groups (IG: $P<0.0001$; CG: $P=0.026$). Samples *t*-test indicated statistically significant differences between groups after treatment ($P=0.002$).

Stool consistency

Analysis (paired-samples *t*-test) of changes in stool consistency after applying treatment revealed statistically significant differences in both groups (IG: $P=0.01$; CG: $P=0.002$). There was no difference between groups in terms of stool consistency ($P=0.32$). (TABLE 2)

In another way, the results of chi-squared analysis showed that there were no statistically significant differences in the number of patients with normal stool consistency between groups at the baseline ($P=0.5$) but after treatment, the statistically significant differences was confirmed (IG: 88.5%; CG: 50%; $P=0.003$) (TABLE 2).

Defecation frequency

The result of statistical analysis (paired-samples *t*-test) showed defecation frequency increased in both groups after treatment (IG: $P<0.0001$; CG: $P<0.0001$). At the end of treatment, as compared with CG, the defecation frequency in IG was increased significantly ($P=0.001$) (TABLE 2).

The dose of oral laxative

In comparison with pre-treatment values, the dose of oral laxatives used in patients was a statistical analysis (paired-samples *t*-test) of the dose of oral laxative showed a statistical decrease ($P=0.002$) in the IG. No significant change was identified in the CG ($P=0.77$). Moreover, after treatment the dose of oral laxative in the IG was significantly was less than CG ($P<0.0001$) (TABLE 2).

DISCUSSION

This study was conducted to evaluate the effect of VM compared with SMC in children with chronic FC. Our results showed that both treatments make considerable improvement in defecation and abdominal pain, stool consistency, and defecation frequency but VM addition to SMC is more effective than SMC. Moreover, the VM reduces the laxative needed in these patients.

Although there are few studies in terms of the

TABLE 2. The effect of treatment on defecation pain, abdominal pain, stool consistency, defecation frequency, and dosage of oral laxative.

Variables	IC			CG			*P*-value IC vs CG
	Before Tx	After Tx	*P*-value	Before Tx	After Tx	*P*-value	
Defecation pain (Wong Baker)	4.88±2.48	1.08±1.87	<0.001	5.85±2.31	3.65±2.48	*P*<0.001	0.002
Abdominal pain (Wong Baker)	3.54±3.28	1.27±1.95	<0.001	3.85±2.61	3.27±2.40	*P*=0.026	*P*=0.002
Stool consistency (BSFS Criteria)	2.69±1.85	3.58±0.85	0.01	2.46±1.98	3.96±1.70	*P*=0.002	0.32
Defecation frequency (number/wk)	2.57±2.36	5.65±2.91	<0.0001	1.81±1.38	3.31±1.7	*P*<0.0001	0.001
The dose of oral laxative (g)	22.88±16.92	11.53±2.36	0.002	23.65±10.25	23.07±11.83	*P*=0.77	*P*<0.0001

SD: standard deviation; Tx: treatment, IC: intervention group, CG: control group. *Significant at $P<0.05$.

effect of VM on gastrointestinal problems, some of the current studies confirm the results obtained in this study. The significant improvement in defecation and abdominal pain were found through Wong-Baker FPRS in both groups with statistically significant differences between groups after treatment. These findings are consistent with the previous studies[14,16].

It may be because of decreases in lumen changes through the increase in defecation frequency[26,27].

An RCT conducted by Neto et al. showed that the VM significantly decrease defecation and abdominal pain in stroke survivors with constipation[14]. Belvaux et al. demonstrated that the osteopathic manipulative treatment including VM and some other techniques significantly improves constipation symptoms[16].

Stool consistency is an important component to evaluate bowel habits and it referred to colon transit time and stool water content. The BSFS is the current scale that is used to classify stool consistency[28]. Based on the BSFS, stool consistency is classified in seven points that it rated from hard stool (type 1 and 2) to lose and liquid (type 6 and 7). Type 3–5 is considered normal consistency. Hard stools represent slow colon transit while fast colon transit results in liquid or loose stools[29]. Our results showed that stool consistency significantly improved in both groups. Although there was no statistically significant difference in BSFS as a numeric scale between groups, the result of some other calculations indicated that several patients with normal stools consistency (ie, type 3–5) were significantly more in the intervention group (88.5%) than the control group (50%). PEG is an osmotic laxative. The osmotic laxative mechanism is based on fluid retention by creating an osmotic gradient in the lumen of the colon that results in to increase in stools' water content[30]. A previous study showed that 50% of children with functional constipation that visited by pediatric gastroenterologists still need laxatives after 12 months, while 40% of them deal with constipation symptoms yet[31]. In addition, the laxative agent has side effects such as abdominal pain, diarrhea, incontinence, nausea, and act[8,15]. Some published studies showed that manual therapy including visceral manipulation with/without some other osteopathic techniques significantly improves stool consistency and/or defecation frequency[14-16]. These results confirm our findings regard to stool consistency and defecation frequency.

The effect of VM on constipation symptoms improvement is more confirmed through a reduction in laxative use in this patient. The finding of the present study and some literature shows that VM with/without other treatments could decrease laxative use in patients with constipation[8,16].

There are several hypotheses about osteopathic manual therapy (ie, VM and other techniques) effect mechanisms that are based on neurological, tissue, and neuroendocrine agents[32]. The results of previous studies have shown that this hypothesis could be logical and reasonable.

Regarding neurological effects, there is some evidence about the impact of VM on the autonomic nervous system. Studies conducted by Silva et al. and McSweeney et al. showed that VM decreases pain perception in spine[33,34]. Silva et al. study indicated that VM could increase the amplitude of the EMG signal of the upper trapezius muscle in patients with non-specific neck pain and functional dyspepsia[33]. According to another study performed by Attali et al., VM could reduce rectal hypersensitivity through action on sensory nerve fibers[35].

One of the basic hypotheses behind VM and other manual techniques states that all body structures and tissues need to have free and unimpaired physiologic motion to keep their health and/or recovery potency from diseases[36]. A study by Tozzi P et al. realized kidney mobility has less range of motion in patients with non-specific low back pain than the healthy subject as well as visceral manipulation/mobilization significantly improved kidney mobility and low back pain[37]. In an RCT study, Eguaras N et al. reported that VM in the epigastric area improved gastroesophageal reflux disease. Accordingly, it seems reasonable that visceral manipulation could improve visceral function by altering visceral motion.

Limitations and further research

There is limited published research about VM and constipation in healthy appearance children. So we have limitation to compare our data. Another limitation is the lack of standard criteria for the interactable constipation and dose of visceral manipulation.

Other limitation was the lack of follow-up to evaluate the persistence of effects. Second, we did not same VM to rule out the placebo effects on patients. Ho-

wever, the results indicated that VM could ameliorate constipation symptoms and decrease laxative needs in these patients. Therefore, randomized controlled short and long-term follow-up trials with same procedures are needed to be conducted to make good body evidence about VM and its effect on constipation.

CONCLUSION

The results of this RCT have shown that VM can impact positive effects on children with chronic FC, such as improvement in abdominal and defecation pain, stool consistency, defecation frequency, and laxative need. So VM can be considered as a possible treatment without side effects besides SMC for the management of chronic FC. Further studies are needed to investigate the long-term effect of VM.

Authors' contribution

Zakaryaei SA: writing proposal, data collection, and data analysis. Shaterzadeh-Yazdi MJ: writing proposal, data collection, revision of the manuscript. Javaherizadeh H: main idea, revision of the manuscript, and data collection. Hakimzadeh M: data collection, revision of the proposal, and literature review. Ravanbakhsh M: supervision, data collection, and data analysis. All authors read and approved the manuscript.

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RESUMO – Contexto – A constipação funcional (CF) é um problema comum de alta prevalência global em crianças. **Objetivo** – O objetivo do presente estudo é avaliar o efeito da manipulação visceral (MV) em crianças com CF crônica intratável, não responsiva ao tratamento padrão. **Métodos** – Este estudo foi conduzido como um ensaio clínico randomizado, controlado e cego. Cinquenta e duas crianças com CF crônica refratária, não responsivas ao tratamento médico padrão, foram randomicamente alocadas em dois grupos de 26 controle (cuidados médicos padrão (CMP)) e 26 intervenção (CMP com MV) por 4 semanas. Dor abdominal, defecação dolorosa, consistência das fezes, frequência de defecação e dose de laxante oral foram avaliadas antes e após o período de tratamento usando a Escala de Avaliação da Dor, Escala de Forma das Fezes de Bristol e relato do paciente/pais. **Resultados** – No final do tratamento, exceto pela dose de laxante oral no grupo controle, todos os resultados mostraram uma diferença significativa em ambos os grupos (P<0,05). A dose de laxante oral no grupo de intervenção diminuiu significativamente (P<0,05), entretanto, nenhuma mudança significativa foi observada no grupo controle (P>0,05). Na comparação do grupo de intervenção, diferenças estatisticamente significativas foram encontradas em todas as variáveis, exceto na Escala de Forma das Fezes de Bristol (P<0,05). A Escala de Forma das Fezes de Bristol após os tratamentos não foi diferente quando os grupos foram comparados (P=0,32), mas o número de indivíduos com consistência fecal normal aumentou significativamente no grupo de intervenção em comparação com o grupo controle (P<0,05). **Conclusão** – A MV pode ser considerada como um possível tratamento sem efeitos colaterais além dos CMP para o manejo da CF crônica. Mais estudos são necessários para investigar o efeito de longo prazo da MV.

Palavras-chave – Constipação; constipação funcional; fisioterapia; osteopatia; manipulação visceral.

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