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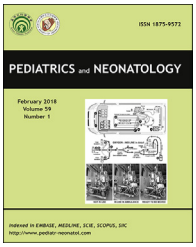

Original Article

The effects of reflexology on constipation and motor functions in children with cerebral palsy

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Key Words
cerebral palsy;
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Background: There is no evidence regarding the effects of reflexology on constipation and motor functions in children with cerebral palsy. This study was planned to investigate the effects of reflexology combined with neurodevelopmental therapy on constipation and motor functions in children with cerebral palsy.
Methods: Forty children between the ages of 3 and 15 years with cerebral palsy within levels 3/4/5 according to the Gross Motor Function Classification System (GMFCS) were included in the study. The participants were divided into two groups. While children in Group 1 received neurodevelopmental therapy, children in Group 2 also received reflexology. The therapy continued for two sessions per week for 8 weeks. Each session of neurodevelopmental therapy lasted for 45—60 min and reflexology took around 20 min. Motor performance of the children was evaluated with the Gross Motor Function Measure (GMFM) while constipation was assessed with the Modified Constipation Assessment Scale (MCAS).
Results: Both groups showed significant improvements in the GMFM scores after therapy (<0.001). In the group where neurodevelopmental therapy was applied together with reflexology, there was a decrease in MCAS scores (<0.001).
Conclusion: NGT improved motor performance in both groups and adding reflexology to therapy had a positive effect on constipation. We suggest applying reflexology to children with cerebral palsy who experience constipation problems.
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1. Introduction

Cerebral palsy (CP) is a chronic disease leading to disorders in movement, posture, and muscle tone.[1] Affected children experience secondary problems in addition to motor and sensorial ones. Frequently encountered problems are epilepsy, mental retardation, sensorial perception disorders, hearing and visual disturbances, pain, behavioral problems, and disorders related with other body systems. Gastrointestinal problems in particular have a deteriorating effect on the daily life of affected children. Different studies have demonstrated that brain injury may lead to problems in the gastrointestinal system. Dysphagia, disorders in eating patterns, vomiting, and chronic constipation have been reported in children with neurologic impairment.[2,3] The most frequently encountered gastrointestinal problem among children with CP is constipation.[4,5] Constipation is more prevalent among children with evident motor problems.[6] Although lifestyle and neurological factors have an important effect on constipation, factors such as insufficient nutrition, increased extensor muscle tone or general hypotonia, musculoskeletal system anomalies, decreased defecation and immobilization are also important risk factors leading to constipation in children with CP.[6–8] Neurodevelopmental therapy (NGT), which is widely used in the rehabilitation of children with CP, does not just address dysfunction of muscles but is a holistic approach that takes into account the quality of coordinated movement. Neurodevelopmental therapy evaluates the person as a whole, considering sensory-motor problems, cognitive skills, and emotional status as well as social, emotional, and functional problems of daily life.[9] Focusing on the importance of postural reactions, this treatment approach concentrates on facilitating automatic movements, supporting normal motor development and making it more functional. In addition to traditional treatment approaches such as NDT, families use complementary and alternative therapy modalities to improve the children's functionality and quality of life, reduce pain, and cope with secondary problems. One of the most commonly preferred methods in this regard is reflexology.[10] Reflexology is a massaging technique applied under certain rules, to the hands, soles of the feet and ears.

Fitzgerald examined the historical development of reflexology.[11–13] Fitzgerald observed that, pressure to certain areas in the hands and feet, resulted in an anesthetic effect in other parts of the body. Therefore, according to these results, he divided the body into 10 meridian regions with five on each side. These regions are limited at the ends of the fingers and toes. It has also been reported that, The Meridian regions are associated with the organs in that region of the body.[11–13] According to modern reflexology, reflexology and meridian regions do not coincide, but both are based on the assumption that the same energy blockages cause disease.[14]

It has been reported that the introduction of external stimuli affects the central nervous system leading to a state of wellness, improving homeostasis, regulating blood flow and ultimately resulting in relaxation and well-being.[15]

In Turkey, NDT methods have been used for many years in the rehabilitation of individuals with CP, and reflexology applications have also gained importance in the last few years due to the expectations and hopes of families. Despite the lack of data for this modality, many clinics in Turkey have added reflexology to their regimens to improve motor functions. However, despite widespread use, it should be noted that no study evaluated the effects of reflexology on motor functions and constipation. For this reason, this study planned to investigate the influence of reflexology applied together with neurodevelopmental therapy on constipation and motor functions in children with CP.

2. Methods

Forty children between the ages of 3 and 15 years who were diagnosed with CP by an experienced specialist in pediatric neurology and referred to our clinic for physiotherapy rehabilitation were invited to participate in the study. Children with GMFCS levels of 3/4/5, without any open wounds in the reflexology application area of the foot were included in the study. However, children who received Botulinum injections within the last six months, who had undergone a surgical intervention in the lower extremities, who received reflexology or any other alternative medicine modality, and who had treatment-resistant epilepsy were excluded (Fig. 1). Referred children and parents were informed about the study and invited to join. Simple random sampling was used to separate the participants into two groups with 20 participants in each group. Ethical approval of the study was obtained from Gazi University Ethical Board for Clinical Studies (no: 25901600-1967). An informed consent form was signed by all parents after providing appropriate information to the patients and their parents (Fig. 1).

2.1. Data collection

Group 1 was selected as the control group where the patients received a neurodevelopmental treatment program with each session lasting for 45—60 min. The treatment program was commenced with intramuscular stretching and soft tissue mobilizations applied to spastic muscles in order to harmonize muscle tone and increase sensorial input. The session was continued with exercises improving protective balance and balance reactions and supporting the acquisition of postural tone. Position transitions such as turning from supine to prone or from prone to supine, from lying on their sides to sitting or from sitting to standing were facilitated according to the needs of the child. Special emphasis was placed on exercises used to strengthen the antagonists of spastic muscles. The stretching exercises were applied in a gentle manner without forcing the child to stretch or causing distress, with the active participation of the child whenever possible. The treatment continued for eight weeks with two sessions per week. Families continued to apply the exercises during the other days when they did not come to the clinic. The detailed home program was demonstrated to the family and updated regularly. The home programs were individualized for each child covering soft tissue mobilizations, facilitation of the position

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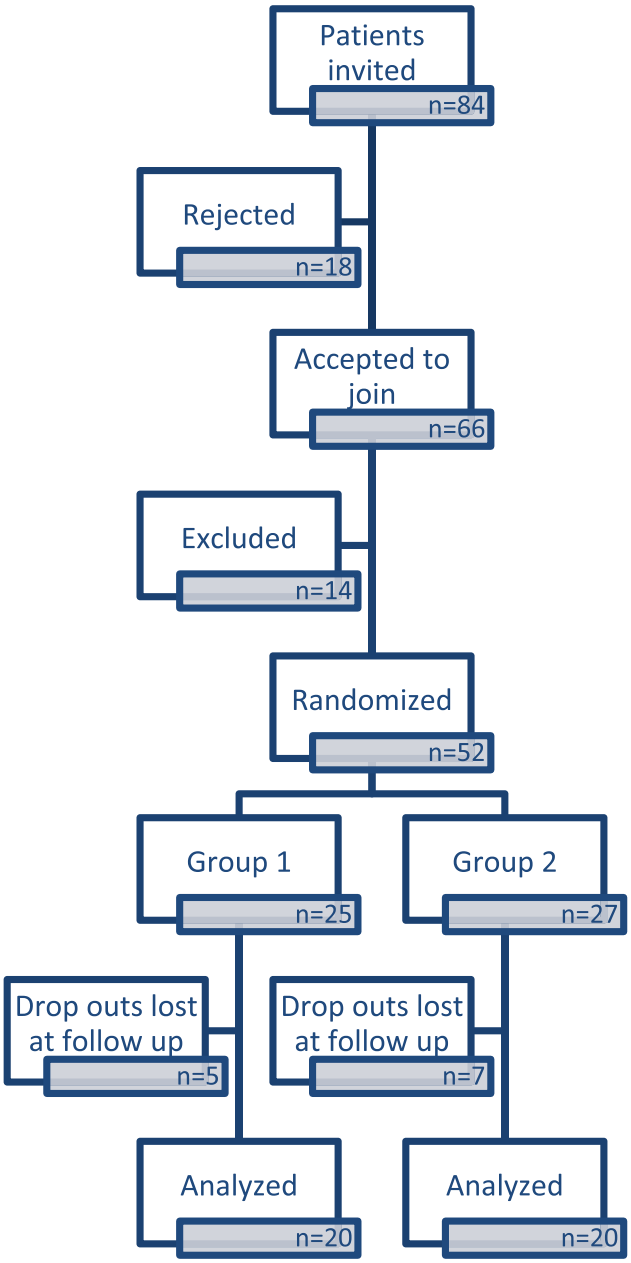

Figure 1 Patient flow diagram.

transitions, stretching and strengthening exercises as well as balance and weight shifting exercises.

The second group received reflexology to the sole of the foot in addition to neurodevelopmental therapy twice a week, with each session lasting for 20 min for a total duration of eight weeks. The reflexology sessions started with cleaning the feet, a relaxation massage with massage oil and preparation using ankle rotations. The session always started from the right foot. There are six different pressure application techniques in reflexology: caterpillar, birds' beak, tornado, butterfly, hooking, and tearing. The 6 different pressure techniques mentioned are varied according to the differences in using the practitioners' fingers. The caterpillar technique is applied with finger movements resembling worm movement. During treatment the thumb moves down and up with pressure applied to the tissue. The birds' beak technique is like the movement of a bird beak in which the thumb and index finger pinch together. A tornado is like the circular motion of water hose under pressure. Circular movements back and forth with the tip of the thumb are used in this technique. In the butterfly technique, the thumb is located on the flexed index finger and both fingers move together to resemble a butterfly's flap. The index finger is used as a supporting point. In the hooking technique, thumb and/or index finger are used as a hook for the end-point of the reflex point. The tearing technique uses the pressure of the thumb, applied from right—left and in an up-down direction with a tearing feeling. This technique gives the opportunity to stimulate broad and deep regions.

Selection of the technique depended on the area of application and the intensity of pressure. If the area was sensitive, we started with low-pressure application. The rule in reflexology massage is to make light, rapid, worm-hole activation with thumb or index finger instead of pressure applied to a fixed point to stimulate the activity of a weak organ and/or system. Sensitivity at the reflex point and surrounding tissues may occur; in this case, slight, rapid progress is required to produce a stimulation affect.

In order to stimulate gastrointestinal system activity, instead of fixed pressure to one certain point, light, fast, worm-like movements were applied with the thumb and index fingers. Strong and slow pressure was usually regarded as pain-relieving, while light, fast, moving movements were regarded as stimulating.

During application, the whole body systems represented on the soles of the feet were stimulated using appropriate techniques. In order to obtain improvements in constipation and motor functions, areas related to the gastrointestinal system, nervous system, and the musculoskeletal system on the soles of the feet were stimulated more frequently. Patients were given a glass of water after each session aiming to improve circulation and excretion and the families were advised to give patients plenty of water in order to eliminate toxins from the body.

2.2. Assessment

The name, age, sex, clinical type, order of birth, height, weight, and educational status of parents were recorded for each patient. Medications used by the child and the doses of these medications were recorded. Constipation was evaluated using the Modified Constipation Assessment Scale (MCAS) and motor evaluation was done with the Gross Motor Function Measure (GMFM).

2.2.1. Modified Constipation Assessment Scale (MCAS)

The Modified Constipation Assessment Scale was used to evaluate constipation status. This scale is a valid and reliable tool composed of nine self-rated questions in order to assess the presence and severity of constipation in children and adults.[16]

Scoring: severity is graded in three levels as 0 — no constipation; 1 — slight problem; and 2 — severe problem. The total score may vary from 0 (no constipation) to 18 (severe constipation). Although the MCAS is a self-rated

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scale, due to the age and intellectual capacity of children, it may also be answered by mothers and care givers.

2.2.2. Gross Motor Function Measure (GMFM)

The GMFM was used to evaluate motor functions of the participants. This measure is the most commonly administered classification tool to measure functional motor levels. It consists of five sub-sections including lying supine and prone, turning around, sitting, crawling and kneeling, standing, walking, running and jumping. The GMFM has 88 items related to motor performance. If desired, each dimension can be evaluated separately or as a total score. Results are presented as percentages. Scoring: 0 = Can not initiate; 1 = Partially initiates (<10%); 2 = Partially completes (10–100%); and 3 = Independently completes.[17]

2.3. Statistical analysis

Data were analyzed using the SPSS 21.0 statistical package software. For all analyses <0.05 was regarded as statistically significant. Continuous variables were presented as mean ± standard deviation while categorical variables were described as n and percentage. When the parametric test assumptions were met, the independent samples t test was used to compare means of independent variables; otherwise, the Mann–Whitney U test was used. When comparing mean values for paired variables, the paired samples t test was used if the parametric test assumptions were met; otherwise, we used the Wilcoxon signed rank test. Categorical variables were compared using the Chi Square test.

3. Results

Results for 40 children were analyzed. Of the participants, 16 were females and 24 were males. There was no difference between the groups with regard to sex (>0.05; Table 1). Mean age of the participants was 5.85 ± 2.35 years and 5.1 ± 1.89 for Group 1 and Group 2, respectively. There was no difference in the groups with regard to age (>0.05). GMFCS levels of the groups were similar. In Group 1, 30% were level 3, 40% were level 4, and 30% were level 5. In Group 2, 30% were level 3, 30% were level 4, and 40% were level 5. Of the participants, 2.5% were hemiplegic spastic type CP, 35% were diplegic spastic type CP, and 62.5% were quadriplegic spastic type CP (Table 1). There was no difference in the GMFCS scores before and after treatment between the groups (>0.05). When compared within the groups however, both groups showed similar improvements after therapy (<0.05; Table 2). There was no significant difference in the MCAS scores before and after therapy (>0.05). According to within-group comparisons, there was a significant positive change in the neurodevelopmental therapy plus reflexology group after therapy (<0.05; Table 3).

4. Discussion

As the first and single study evaluating the effects of reflexology on motor development and constipation in children with CP, this study has demonstrated that neurodevelopmental therapy increases motor performance, and that adding reflexology to NDT has a positive effect on constipation. It was concluded that, in children with CP with constipation, adding reflexology to NDT may decrease constipation and that NDT may improve motor development.

Neurodevelopmental therapy approaches have been proven to have positive effect in children with CP.[18] Ezema et al. have reported positive effects of neurodevelopmental therapy in children with CP on the functional level.[19] Similarly, another study reported that NDT had an improving effect on gross motor functions and intensive therapy achieved better results compared to shorter therapies.[20] One study with a six-week NDT treatment period, reported that significant improvements were observed in gross motor functions. Additionally, it was noted self-care skills were observed to have increased and mobilization with less support.[21] In this study, we observed an increase in the GMFM scores before and after therapy in both groups. Neurodevelopmental therapy has been implemented worldwide for many years. It was adopted in this study because the method is well known by physiotherapists and it is a functional and family-focused approach. Having applied this method to both groups, we observed positive outcomes in motor development for both groups in accordance with the literature.

Table 1 Demographic data.

	Group 1	Group 2	Total	p
Age (mean ± SD)	5.85 ± 2.35	5.1 ± 1.89	5.45 ± 2.14	0.389 α (z = −0.879)
GMFCS (mean ± SD)	4 ± 0.79	4.1 ± 0.85	4.05 ± 0.81	0.718 α (z = −0.402)
Sex (n %)				
Female	9	7	16 (40%)	
Male	11	13	24 (60%)	0.519φ (χ^2 = 0.417)
Type of CP (n %)				
Hemiplegia	1	0	1 (2.5%)	
Diplegia	7	7	14 (35%)	0.595φ (χ^2 = 1.040)
Quadriplegia	12	13	25 (62.5%)	

CP: Cerebral Palsy; SD: Standard Deviation; α: Mann–Whitney U test; φ: Chi-Square Analysis; χ^2: Test statistics for Chi-Square; z: Test statistics for Mann–Whitney U Test.

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Table 2 Results of the Gross Motor Function Measure.

		Before	After	p1	p2	p3
Group 1	(mean ± SD)	63.25 ± 42.31	66.6 ± 42.57	0.620 α	0.947 α	0.0001 γ
	Median (min–max)	55.5 (15–135)	56.5 (17–138)	z = −0.501	z = −0.081	z = −3.528
Group 2	(mean ± SD)	59.25 ± 43.99	66.15 ± 44			0.0001 δ
	Median (min–max)	52 (15–130)	58.5 (19–149)			t = −7.521

SD: Standard Deviation; Min–max: Minimum and maximum values; p1: difference between Group 1 and Group 2 before therapy; p2: difference between Group 1 and Group 2 after therapy; p3: difference in each group before and after therapy; β: Independent Samples t test; α: Mann–Whitney U test; γ: Wilcoxon signed rank test; δ: Paired Samples t test; z: Test statistics for Mann–Whitney U and Wilcoxon Signed Rank Test; t: Test statistics for Independent samples t test and paired samples t test.

Table 3 Results of Modified Constipation Assessment Scale.

		Before	After	p1	p2	p3
Group 1	Mean ± SD	5.2 ± 5.51	5.75 ± 5.9	0.192 α	0.602 α	0.670 γ
	Median (min–max)	2.5 (0–18)	4.5 (0–18)	z = −1.322	z = −0.546	z = −0.426
Group 2	Mean ± SD	6.85 ± 3.8	3.8 ± 2.63			0.0001 δ
	Median (min–max)	7 (0–12)	3.5 (0–8)			t = 5.406

SD: Standard Deviation; Min–max: Minimum and maximum values; p1: difference between Group 1 and Group 2 before therapy; p2: difference between Group 1 and Group 2 after therapy; p3: difference in each group before and after therapy; β: Independent Samples t test; α: Mann–Whitney U test; γ: Wilcoxon signed rank test; δ: Paired Samples t test; z: Test statistics for Mann–Whitney U and Wilcoxon Signed Rank Test; t: Test statistics for Independent samples t test and paired samples t test.

Reflexology is a massaging method applied to the sole. Although it can be considered that massaging to the sole may affect motor development by interfering with the central nervous system, reflexology showed no additional benefit to motor functions. Thus, it should be kept in mind that NDT can always be included in the rehabilitation programs of children with CP in order to support motor development, and adding reflexology to the treatment programs for this purpose may lead to time-wasting and inappropriate consequences with regard to the expectations of the child as well as parents.

Bishop et al. applied six sessions of reflexology each lasting 30 min to 48 children and demonstrated that there was an increase in intestinal function.[22] Woodward et al. investigated the effects of reflexology on constipation applying reflexology to 19 women referred to the biofeedback service for duration of six weeks. Ninety-five percent of the participants experienced decrease in constipation, flatulence, and drug usage together with an increase in the frequency of defecation after six sessions.[23]

It is interesting to observe that no study examined the effects of reflexology in children with CP. Although Bishop et al. and Woodward et al. conducted their studies in different groups, it was identified that due to similar mechanisms of action, reflexology had positive outcomes on the constipation in children with CP. On the other hand, when we reviewed the effects of reflexology on body systems, we found that the most important mechanism of action was via the autonomous nervous system. It is thought that applications to the sole affect body systems by increasing parasympathetic system activity. Many studies have reported that reflexology stimulates the autonomic nervous system. Heart rate and blood pressure values were assessed in healthy adults in order to investigate the effect of reflexology on the autonomic nervous system. It was emphasized that the reflexology induced changes in the body by stimulating the autonomic nervous system.[24] This assertion is supported by a study which shows that the effect of reflexology on the circulatory system relies on the change in the heart rate and baroreceptor reflex which are controlled by the autonomic system of the body.[25] The influence of reflexology on the autonomic nervous system supports the 'nerve theory'. A stimulus done on the sensory fibers in the soles of the feet stimulates A beta, A delta and C fibers. The sensory nervous system is in contact and organization with the high centers in the brain such as hypothalamus, cortex and amygdala. Since these centers also include nuclei that affect the central nervous system, blood pressure, heart rate and the baroreceptor reflex may change. In another study, using an electrocardiogram that provided objective data about the state of the heart, the heart was monitored during the reflexology stimuli. As a result, changes in the state of the heart during reflexology massage were revealed by the effect of reflexology on the autonomic nervous system.[26–29] It has been also reported that reflexology massage reduces stress and anxiety in studies conducted in different populations. This affect also occurs via regulation of the autonomic nervous system.[3–6]

In patients with CP, constipation is not solely the result of motor response and immobilization. Especially in conditions with dominant sympathetic activity, applications to certain areas in the sole of the foot may facilitate parasympathetic activity, increasing motility and ultimately facilitating defecation. In addition, this may lead to a general relaxation in the body, decreasing the pressure in the abdominal area and activating parasympathetic activity of the body, thus assisting faster operation of the digestive system. We postulated that activation of the parasympathetic system as a result of bodily relaxation in addition to stimulation of the intestinal reflex points

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contributed to the increase of intestinal functions. Furthermore, by balancing homeostasis and wellness, changes in the nutrition and tone of the children may have contributed to intestinal functions.

4.1. Limitations of the study

Nutritional behaviors of the participants could be a confounding factor. Providing nutritional training could influence some of the outcomes. Due to the short time period of the study, some of the children had Botox Injection after the treatment, so it was impossible for us to see the long-term effects of reflexology. We are still in the follow up process for the children who did not have and/or need any other additional invasive treatment over the long term.

4.2. Conclusion

We conclude that reflexology applied with NDT in treatment of children with CP may be an effective method to deal with constipation but that this treatment has a conflicting effect on the motor development. It may also be warranted to have a group with reflexology massage alone, to see if there is any additional effect on motor development but this poses ethical problem. We suggest children with CP may benefit from NDT for their motor development and reflexology may be considered as additional treatment for patients with constipation problems.

Conflicts of interest

The authors declare no conflicts of interest with respect to the research, authorship, and/or publication of this article.

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