ORIGINAL PAPERS

Dent. Med. Probl. 2008, **45**, 4, 361–368
ISSN 1644-387X

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Efficacy of Magnetic Stimulation in Adaptation to Dental Treatment of Cerebral Palsy Young Patients

Ocena skuteczności magnetostymulacji w przygotowaniu do leczenia stomatologicznego młodych pacjentów z mózgowym porażeniem dziecięcym

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Abstract

Background. The prevalence of infantile cerebral palsy in Poland and the world is about 2–3 cases per 1000 liveborn infants and it constantly grows. Treatment needs caused by dental caries, periodontal diseases and malocclusion in cerebral palsy children are greater than in healthy children. Applied in medicine, magnetic stimulation has an impact on various physiological processes in the organism, among them normalization of cellular membranes potentials and electro osmotic processes, improving in this way the action of nervous system.
Objectives. Evaluation of magnetic stimulation efficacy in adaptation of cerebral palsy children to outpatient dental treatment.
Material and Methods. The study comprised 44 cerebral palsy young patients of both sexes aged 2–20 years. In the subjects, the prevalence of 8 psychophysical and 12 emotional parameters during two visits were estimated. Before dental examination, all patients were adapted according to Addelson method „tell-show-do' and magnetic stimulation was performed. On the next visit, 23 patients were qualified with specific emotional and psychophysical criteria.
Results. In group I, after magnetic stimulation procedure, significantly decreased prevalence of 7 out of 8 considered psychophysical parameters was observed. However, standard adaptive procedures for developmental age patients seem not to influence significantly the improvement of psychophysical parameters and adaptation to dental treatment applied on the next visit (group II).
Conclusions. Magnetic stimulation can be useful in adaptation of patients with infantile cerebral palsy to dental treatment in outpatient conditions (**Dent. Med. Probl. 2008, 45, 4, 361–368**).

Key words: magnetic stimulation, cerebral palsy, dental treatment, psychophysical parameters**.**

Streszczenie

Wprowadzenie. Występowanie mózgowego porażenia dziecięcego w Polsce i na świecie wynosi około 2–3 przypadki na 1000 żywo urodzonych dzieci i ciągle wzrasta. Potrzeby lecznicze dzieci dotkniętych tym schorzeniem spowodowane przez próchnicę, choroby przyzębia oraz wady zgryzu są znacznie większe niż u zdrowych dzieci. Stosowana w medycynie, magnetostymulacja wywiera wpływ na różne procesy fizjologiczne w organizmie (tj. normalizacja potencjałów błon komórkowych lub procesy elektro-osmotyczne), poprawiając w ten sposób czynność układu nerwowego.
Cel pracy. Ocena skuteczności zabiegu magnetostymulacji w przygotowaniu do leczenia stomatologicznego w warunkach ambulatoryjnych dzieci z mózgowym porażeniem dziecięcym na podstawie wybranych cech psychofizycznych.
Materiał i metody. Przebadano 44 młodych pacjentów z mózgowym porażeniem dziecięcym obojga płci, w wieku od 2–20 lat. U wszystkich osób przed badaniem stomatologicznym przeprowadzono adaptację według Addelstona „powiedz-pokaż-zrób" oraz magnetostymulację. Do leczenia na następnej wizycie zakwalifikowano 23 osoby o określonych kryteriach emocjonalnych i psychofizycznych. Po drugim zabiegu magnetostymulacji podjęto u tych osób ambulatoryjne leczenie stomatologiczne. U wszystkich badanych oceniono częstość występowania 8 wybranych cech psychofizycznych i 12 cech emocjonalnych w czasie dwóch wizyt.

Wyniki. W grupie I (badanej) po zabiegu magnetostymulacji zaobserwowano istotne zmniejszenie częstości występowania 7 spośród 8 rozpatrywanych cech psychofizycznych. W grupie II (kontrolnej) postępowanie adaptacyjne nie wpłynęło istotnie na poprawę cech psychofizycznych, a tym samym na przygotowanie do leczenia stomatologicznego, które podejmowano na następnej wizycie.
Wnioski. Magnetostymulacja może być przydatna w adaptacji pacjentów z mózgowym porażeniem dziecięcym do leczenia stomatologicznego w warunkach ambulatoryjnych (**Dent. Med. Probl. 2008, 45, 4, 361–368**).

Słowa kluczowe: magnetostymulacja, mózgowe porażenie dziecięce, leczenie stomatologiczne, cechy psychofizyczne.

Infantile cerebral palsy (also called Little's disease or infantile paralysis) is a syndrome defining variety of systemic disturbances resulting from brain permanent damage.

In relation to the time of action, the reasons for infantile cerebral palsy can be divided into pre-natal, peri-natal and post-natal. Cerebral palsy formation can be also favoured by mother's or father's risk factors as well as those concerning foetus or neonatal period. Organism disturbances do not undergo any changes along age. At early developmental stages, cerebral tissue damages can cause motor disorders (paresis, palsy, involuntary movements or in coordination), mental development disorders, allophasia and often epilepsy. Symptomatology largely depends on the cerebral damage location and can be related to pyramidal system (spastic form), extra pyramidal system (kinetic form) and cerebellar system (kinetic system disorders). The present form of mental impairment degree may vary in intensity and most often, it refers to the spastic form [1]. Cerebral damage usually occurs between 26th and 34th week of pregnancy. Disturbances may appear also in prematurely delivered babies and they are probable to be connected with the reason or consequence of premature delivery [1]. The prevalence of infantile cerebral palsy in Poland and the world is about 2–3 cases per 1000 live-born infants and it grows constantly [1].

Treatment needs caused by dental caries, periodontal diseases and malocclusion in cerebral palsy children are greater than in healthy children [2–10]. In cerebral palsy patients eruption of permanent teeth is delayed, bruxism and developmental defects of enamel may often appear [4, 9, 11]. Craniofacial specific disturbances most often related to changes of lingual and labial muscles motor activity, increased ability of chewing and mastication, increase of saliva out put make dental treatment at the outpatient unit [12] difficult and require use of anaesthesia or sedation.

Magnetic stimulation has been used to improve an effect of conventional dental treatment and the positive results encourage to wider application [13–18]. Magnetic stimulation has an impact on various processes in the organism, including normalization of cellular membranes potentials and electro osmotic physiological processes. After the application of magnetic field, enzymatic activity increases and ATP related oxidation-reduction processes increase which cause many vital processes stimulation at their cellular level [13, 19–23].

Depending on the size of the magnetic field induction, magnetic therapy (over 100 μT) and magnetic stimulation (below 100 μT) are distinguished. In the head area, magnetic stimulation of 2000–3000 Hz frequency and induction within the range of 1 pT to 100 μT is applied. Such a stimulation does not exceed the value of earth's magnetic field [13, 19– 22].

The aim of the study was to assess the use of magnetic stimulation with slow-change magnetic fields of low frequency in adaptation to dental outpatient treatment of cerebral palsy children basing on selected psychophysical features.

Materials and Methods

The study comprised 44 cerebral palsy children and adolescents of both sexes aged 2–20 years. Adaptation with Addelson's method "tell-show-do" was carried out in all subjects before the dental examination. Magnetic stimulation was performed in all the subjects before the oral clinical examination. The procedure was done with Viofor JPS device (Med.&Life) with the use of S point applicator producing pulsating, non homogeneous and directed magnetic field with exposure parameters adequate to age. The parameters were applied in accordance with manufacturer's recommendation for children and adolescents, "M2" program (changing intensity application), "P2" (prophylactic cyclotronic resonance) as well as intensity "I" depending on age (I-2 for children up to 12 and I-4 for children from 13 to 20 years). The procedure was performed twice and it lasted 12 minutes. During the second visit the S point applicator was applicated only on one face side where the tooth treatment was performed (on 3 neuromotorical points).

Type S applicator was applied extra-orally in the cranial area as a delicate massage in place of facial neuromotorical points similarly to Castillo-Morales method.

The applicator was applied in neuromotorical points as: wings of the nostrils, upper lip, angle of the mouth, mentum, oral cavity floor and masseter muscle [24].

In all the examined subjects, the prevalence of 8 psychophysical and 12 emotional parameters was assessed. The considered and dichotomously categorized parameters were psychophysical ones like sleepiness, reaction delay, hyper reactivity, raised and/or lowered muscular tension, relaxation and vocalization and emotional ones like fear, screaming, weeping, escape, aggressive behavior, riot, rejection of cooperation, emotional relaxation, satisfaction, smile, visual contact, verbal contact. These parameters were registrated before and after magnetic stimulation. No patient revealed any epileptic attacks. The patient psychophysical and emotional behavior were estimated on the basis of examiner's observation.

Basing on observation these psychophysical and emotional parameters appearing before and after 1 procedure of magnetic stimulation, all subjects were divided into two subgroups. Subgroup 1 (n=23) was provided by invasive and prophylaxis dental procedures and subgroup 2 (n = 21) wasn't treated because of their psychophysical and emotional condition, physical barriers (e.g. trismus) excluded capability of out-patient treatment.

The obtained data were statistically analysed using McNemar's and Fisher's tests at the significance level of $p < 0.05$.

Results

All patients (group A) after magnetic stimulation procedure (group B) revealed statistically significant changes in prevalence of psychophysical features as sleepiness, reaction delay, hyper reactivity, increases muscular tension, decreased muscular tension (Table 1). Magnetic stimulation favourably influenced the examined children in the form of decrease muscular tension, hyper reactivity de-

Table 1. The prevalence of selected psychophysical and emotional parameters for all subject (N = 44)

Table1. Częstość występowania cech psychofizycznych i emocjonalnych u wszystkich osób badanych (N = 44)

No	Psychophysical parameters	Before magnetic stimulation (A)		After magnetic stimulation (B)		Level of significance by Fisher's test
		n/N	%	n/N	%	
1	No/sleepiness	42/44	95.5	25/44	56.8	**0.001**
2	No/activity	39/44	88.6	37/44	94.9	NS
3	No/delayed reaction	38/44	86.4	25/44	56.8	**0.05**
4	No/hyper reactivity	23/44	52.3	1/44	2.2	**0.001**
5	Muscles increased tension	23/44	52.3	1/44	2.2	**0.001**
6	No muscles decreased tension	39/44	88.6	16/44	36.4	**0.001**
7	No relaxation	39/44	88.6	9/44	20.4	**0.001**
8	No vocalization	43/44	97.7	36/44	81.8	**0.05**
No	Emotional Parameters	Before magnetic stimulation (A)		After magnetic stimulation (B)		Level of significance by Fisher's test
		n/N	%	n/N	%	
1	Fear	24/44	54.5	2/44	4.5	**0.001**
2	Screaming	6/44	13.6	0/44	0.0	**0.01**
3	Weeping	10/44	22.7	3/44	6.8	**0.05**
4	Escape	19/44	43.2	1/44	2.3	**0.001**
5	Aggressive behavior	6/44	13.6	0/44	0.0	**0.01**
6	No autoaggressive behavior	43/44	97.7	43/44	97.7	NS
7	Riot, rejection of cooperation	13/44	29.5	0/44	0.0	**0.001**
8	No emotional relaxation	39/44	88.6	12/44	27.7	**0.001**
9	No satisfaction	37/44	84.1	10/44	22.7	**0.001**
10	No smile	40/44	90.9	25/44	56.8	**0.001**
11	No visual contact	18/44	40.9	4/44	9.1	**0.001**
12	No verbal contact	31/44	70.5	19/44	43.2	**0.01**

crease, reaction delay and sleepiness. Moreover, the improvement of emotional condition was found as a result of significant dropping in prevalence of fear, weeping, screaming, escape, riot, and rising in emotional relaxation, satisfaction, smile, visual and verbal contact (Table 1). At the second stage of our research, group 1 (n = 23) had dental treatment after treated with magnetic stimulation but group 2 (n = 21) was treated only by magnetic stimulation.

Dental treatment was included one of following procedures such as ART method caries treatment (n = 10), fissure sealing (n = 10), endodontic treatment (n = 1), application of fluoride varnish (n = 1), prophylaxis (n = 1). In the subgroup of children treated by a dentist, after application of magnetic stimulation procedure (group 1A *vs.* group 1B) we observed significant decrease sleepiness, hyper reactivity, low muscular tension as well as relaxation and improvement of emotional state by fear reduction. We also observed more often emotional relaxation and satisfaction which was statistically confirmed (Table 2). It allowed us to perform dental treatment according to required curing procedures. In the patients who didn't receive dental treatment (subgroup 2A *vs.* subgroup 2B),e magnetic stimulation also caused benefit like decrease of hyper reactivity and muscular tension, relaxation as well as drop of fear and escape and increase of satisfaction and silence (Table 3). Before the magnetic stimulation procedure, in children who didn't receive dental treatment in

Table 2. The prevalence of selected psychophysical and emotional parameters before and after the second application of magnetic stimulation in patients receiving dental treatment (subgroup 1)

Table 2. Częstość występowania cech psychofizycznych i emocjonalnych przed i po drugiej magnetostymulacji u pacjentów poddanych leczeniu stomatologicznemu (podgrupa 1)

No	Psychophysical parameters	Before magnetic stimulation (A)			After magnetic stimulation (B)			Level of significance by McNemar's test
		No /Yes	n	%	No /Yes	n	%	p
1	Sleepiness	no	23	100.0	no	11	47.8	**0.01**
2	No activity	no	19	82.6	no	17	89.5	NS
3	Delayed reaction	no	18	78.3	no	11	61.1	NS
4	Hyper reactivity	yes	11	47.8	yes	0	0.0	**0.001**
5	Muscles increased tension	yes	11	47.8	yes	0	0.0	**0.01**
6	Muscles decreased tension	no	20	87.0	no	9	45.0	**0.05**
7	Relaxation	no	20	87.0	no	3	15.0	**0.001**
8	Vocalization	no	23	100.0	no	18	78.3	NS
No	Psychophysical parameters	Before magnetic stimulation (A)			After magnetic stimulation (B)			Level of significance by McNemar's test
		No/Yes	n	%	No/Yes	n	%	p
1	Fear	yes	10	43.5	yes	0	0.0	**0.001**
2	Screaming	yes	3	13.0	yes	0	0.0	**0.05**
3	Weeping	yes	4	17.4	yes	1	25.0	**0.05**
4	Escape	yes	8	34.8	yes	0	0.0	**0.01**
5	Aggressive behavior	yes	4	17.4	yes	0	0.0	**0.05**
6	Autoaggressive behavior	no	23	100.0	no	23	100.0	NS
7	Riot, rejection of cooperation	yes	6	26.1	yes	0	0.0	**0.01**
8	Emotional relaxation	no	19	82.6	no	5	26.3	**0.001**
9	Satisfaction	no	18	78.3	no	6	33.3	**0.01**
10	Smile	no	21	91.3	no	10	47.6	**0.01**
11	Visual contact	no	8	34.8	no	1	12.5	**0.05**
12	Verbal contact	no	14	60.9	no	6	42.9	**0.05**

comparison to those who did (subgroup 1A *vs*. subgroup 2A), we observed slight increase of activity, hyper reactivity, muscular tension and higher level of negative emotion i.e. escape, fear, weeping, riot, lack of visual and verbal contact (Table 4). However, both subgroups, after the magnetic stimulation procedure (1B *vs*. 2B), didn't show any important differences except for smile, visual and verbal contact (Table 4).

Discussion

For many years, conventional therapeutic methods have been supported with physical methods such as iontophoresis, electromagnetic field, laser therapy, ozone therapy or cryotherapy. Magnetic stimulation or magnetic therapy are used in many systemic diseases i.e. osteoarthritis, spastic condition, osseous and soft tissues damages, soft tissues rheumatism, leg ulceration, after surgical procedures and in rehabilitation. Some research on the efficacy of using the magnetic field in therapy of Parkinson's disease, peptic ulceration, multiple sclerosis, infantile cerebral palsy are still continued [13, 14, 20, 22, 23]. The procedures frequency and parameters depend on the patient's general condition. Most often, magnetic therapy is applied daily with weekend break [13, 14, 19–23]. More and more reports concerning its positive results in dental practice are noted [13–18]. Magnetic field is incorporated in dental practice to reduce pain, peri-

Table 3. The prevalence of selected psychophysical and emotional parameters before and after the second application of magnetic stimulation in patients with no following dental treatment (subgroup 2)

Table 3. Częstość występowania cech psychofizycznych i emocjonalnych przed i po drugiej magnetostymulacji u pacjentów nieleczonych (podgrupa 2)

No	Psychophysical parameters	Before magnetic stimulation (A)			After magnetic stimulation (B)			Level of significance by McNemar's test
		No /Yes	n	%	No /Yes	n	%	p
1	Sleepiness	no	19	90.5	no	14	73.7	NS
2	No activity	no	20	95.2	no	20	100.0	**0.05**
3	Delayed reaction	no	20	95.2	no	14	70.0	NS
4	Hyper reactivity	yes	12	57.1	tak	1	8.3	**0.001**
5	Muscles increased tension	yes	12	57.1	yes	1	8.3	**0.001**
6	Muscles decreased tension	no	19	90.5	no	7	36.8	**0.05**
7	Relaxation	no	19	0.5	no	6	31.6	**0.001**
8	Vocalization	no	20	95.2	no	18	90.0	NS
No	Psychophysical parameters	Before magnetic stimulation (A)			After magnetic stimulation (B)			Level of significance by McNemar's test
		No/Yes	n	%	No/Yes	n	%	p
1	Fear	yes	14	66.7	yes	2	14.3	**0.001**
2	Screaming	yes	3	14.3	yes	0	0.0	**0.05**
3	Weeping	yes	6	28.6	yes	2	33.3	NS
4	Escape	yes	11	52.4	yes	1	9.1	**0.001**
5	Aggressive behavior	yes	2	9.5	yes	0	0.0	**0.05**
6	Autoaggressive behavior	no	20	95.2	no	20	100.0	NS
7	Riot, rejection of cooperation	yes	7	33.3	yes	0	0.0	**0.01**
8	Emotional relaxation	no	20	95.2	no	7	35.0	**0.001**
9	Satisfaction	no	19	90.5	no	4	21.1	**0.001**
10	Smile	no	19	90.5	no	15	78.9	NS
11	Visual contact	no	10	47.6	no	3	30.0	**0.05**
12	Verbal contact	no	17	81.0	no	13	76.5	NS

Table 4. Comparison the study parameters in subgroups 1 and 2 before and after magnetic stimulation procedure

Table 4. Częstość występowania cech psychofizycznych i emocjonalnych przed i po magnetostymulacji u pacjentów z 1 i z 2 podgrupy

No	Psychophysical Parameters	Treated	Before magnetic stimulation A			Level of significance by Fisher's test	After magnetic stimulation B			Level of significance by Fisher's test
		subgroup 1 *vs* subgroup 2	No /Yes	n	%	p	No /Yes	n	%	p
1	Sleepiness	1 2	no no	23/23 19/21	100.0 90.5	NS	no no	11/23 14/21	47.8 73.7	NS
2	No reactivity	1 2	no no	19/23 20/21	82.6 95.2	0.05	no no	17/23 20/21	89.5 100.0	NS
3	Delayed reaction	1 2	no no	18/23 20/21	78.3 95.2	NS	no no	11/23 14/21	61.1 70.0	NS
4	Hyper reactivity	1 2	yes yes	11/23 12/21	47.8 57.1	0.05	yes yes	0/23 1/21	0.0 8.3	NS
5	Muscles increased tension	1 2	yes yes	11/23 12/21	47.8 57.1	0.05	yes yes	0/23 1/21	0.0 8.3	NS
6	Muscles decreased tension	1 2	no no	20/23 19/21	87.0 90.5	NS	no no	9/23 7/21	45.0 36.8	NS
7	Relaxation	1 2	no no	20/23 19/21	87.0 90.5	NS	no no	3/23 6/21	15.0 31.6	NS
8	Vocalization	1 2	no no	23/23 20/21	100.0 95.2	NS	no no	18/23 18/21	78.3 90.0	NS
No	Emotional Parameters	subgroup 1 *vs* subgroup 2	Before magnetic stimulation A			Level of significance by Fisher's test	After magnetic stimulation B			Level of significance by Fisher's test
			No /Yes	n	%	p	No /Yes	n	%	p
1	Fear	1 2	yes yes	10/23 14/21	43.5 66.7	0.01	yes yes	0/23 2/21	0.0 14.3	NS
2	Screaming	1 2	yes yes	3/23 3/21	13.0 14.3	NS	yes yes	0/23 0/21	0.0 0.0	NS
3	Weeping	1 2	yes yes	4/23 6/21	17.4 28.6	NS	yes yes	1/23 2/21	25.0 33.3	NS
4	Escape	1 2	yes yes	8/23 11/21	34.8 52.4	0.05	yes yes	0/23 1/21	0.0 9.1	NS
5	Aggressive behavior	1 2	yes yes	4/23 2/21	17.4 9.5	NS	yes yes	0/23 0/21	0.0 0.0	NS
6	Autoaggressive behavior	1 2	no no	23/23 20/21	100.0 95.2	NS	yes yes	23/23 20/21	100.0 100.0	NS
7	Riot, rejection of cooperation	1 2	yes yes	6/23 7/21	26.1 33.3	0.05	yes yes	0/23 0/21	0.0 0.0	NS
8	Emotional relaxation	1 2	no no	19/23 20/21	82.6 95.2	NS	no no	5/23 7/21	26.3 35.0	NS
9	Satisfaction	1 2	no no	18/23 19/21	78.3 90.5	NS	no no	6/23 4/21	33.3 21.1	NS
10	Smile	1 2	no no	21/23 19/21	91.3 90.5	NS	no no	10/23 15/21	47.6 78.9	0.05
11	Visual contact	1 2	no no	8/23 10/21	34.8 47.6	0.05	no no	1/23 3/21	12.5 30.0	0.05
12	Verbal Contact	1 2	no no	14/23 17/21	60.9 81.0	0.05	no no	6/23 13/21	42.9 76.5	0.01

pheral nerves damages reconstruction, osseous regeneration processes stimulation in periapical area, after extraction procedures, in endodontic treatment complications, after anaesthesia and surgical procedures [13–18]. Magnetic stimulation and magnetic therapy are more and more often used in periodontology, orthodontics and maxillofacial surgery. In dental practice there are no data concerning electromagnetic field negative activity in the head area [17, 18, 23, 25]. Also, it has been proved that magnetic therapy influences brain bioelectric activity and does not evoke its deep structures so it is quite safe in an epileptic patient [15, 25].

Infantile cerebral palsy constitutes an important problem in dental treatment and most often, the only choice is to perform dental treatment under general anaesthesia due to no verbal or eye contact, muscular spasm and oral motor disturbances [1–11].

The obtained data showed possibility of magnetic stimulation use in adaptation of cerebral palsy children to outpatient treatment by reaching relaxation or so called motor silence condition. Castillo-Morales [24] defines motor silence as the condition in which a child feels easy, safe and he/she is relaxed which enables verbal or eye contact to perform treatment procedures in labiofacial area. It seems of great importance as the standard 'tell-show-do' method is not efficient in cerebral palsy children and dental procedures cannot be carried on. Our studies revealed that performed of magnetic stimulation allow not only for non-invasive treatment but also invasive one. In this study the application of magnetic stimulation was performed once a week and showed out a significant relaxation result. Other authors have obtained positive results due to more frequent magnetic stimulation procedure applications (10–20 applications applied day after day) comparing our study [13–22]. However, presented authors were using the mat type applicator for the therapy. In our research, the S point applicator was used, and it had two hundred-fold greater power of performance. In such a case even the single procedure of the magnetic stimulation allows the patient to obtain the physiological state of relaxation causing the psychical relaxation [26].

However, further studies should be carried on to establish magnetic stimulation efficacy in adaptation of palsy children for dental treatment in outpatient conditions.

The Authors concluded that magnetic stimulation can be useful in adaptation of patients with infantile cerebral palsy to dental treatment in outpatient conditions.

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Received: 22.12.2008
Revised: 19.01.2009
Accepted: 19.01.2009

Praca wpłynęła do Redakcji: 22.12.2008 r.
Po recenzji: 19.01.2009 r.
Zaakceptowano do druku: 19.01.2009 r.