

# Ocena wyników neurokinezyologicznego usprawniania metodą odruchowej lokomocji według Vojty, dzieci z zaburzeniami centralnej koordynacji nerwowej

*Evaluation of neurocinesiological improvement performance of reflexlocomotion method of Vojta on children at risk of central nervous coordination disorder*

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## Streszczenie:

**Wstęp.** W pracy przedstawiono ocenę rozwoju ruchowego wg 7 reakcji ułożeniowych Vojty i Monachijskiej Funkcjonalnej Diagnostyki Rozwojowej, oraz leczenie dzieci metodą Vojty ze stwierdzonymi zaburzeniami centralnej koordynacji nerwowej.

**Cel pracy.** Wykazanie skuteczności leczenia metodą Vojty, poprzez zastosowanie dwóch diagnostyk neurorozwojowych, oraz ich porównanie. Wskazanie znaczenia wczesnego rozpoznawania zaburzeń rozwojowych u dzieci i wprowadzenia wczesnego usprawniania leczniczego.

**Materiał i metody.** Badano 45 dzieci w wieku od 1-10 miesiąca życia, u których stwierdzono zaburzenia ośrodkowej koordynacji nerwowo-mięśniowej. Porównywano wyniki usprawniania metodą Vojty w 2 grupach dzieci: rozpoczynających terapię pomiędzy 2-4 m ż i 5-10 m ż. Oceny spontanicznej aktywności ruchowej dziecka, dokonywano według Monachijskiej Funkcjonalnej Diagnostyki Rozwojowej i oceny siedmiu reakcji ułożeniowych wg Vojty. Czas usprawniania wynosił 1-11 miesięcy, zależnie od poprawy stanu neurologicznego dziecka i motoryki spontanicznej.

**Wyniki.** Przed terapią ciężkie zaburzenia centralnej koordynacji nerwowej prezentowało 22 dzieci, średnio ciężkie ZCKN – 19 dzieci, lekkie – czyli 5 nieprawidłowych reakcji – 4 dzieci. Po terapii u wszystkich dzieci sytuacja ta zmieniła się.

**Wnioski.** Terapia metodą Vojty wpływa korzystnie na poprawę motoryki spontanicznej i stan neurologiczny dzieci z obniżonym ZCKN, a ocena obiema metodami daje równorzędne wyniki.

## Słowa kluczowe:

zaburzenia centralnej koordynacji nerwowej, metoda Vojty

## Abstract

**Introduction.** In the work there have been presented the assessment of 7 Vojta's child's spontaneous motor activity that was made according to Munich Functional Developmental Diagnostics and infant treatment with the stated central coordination disorders by Vojta's method.

**The subject of work.** To demonstrate the effectiveness of Vojta's treatment by applying two neurodevelopmental diagnostics and their comparison. A recommendation of early recognition of child's developmental problems and the introduction of early improvement.

**Materials and methods.** Children between 1-10 month, who were stated to have nerve and muscle coordination disorder were subjected. The effects of Vojta's method improving treatment were compared in groups: children beginning the therapy between 2-4 months of age, and 5-10 m. Assessment of child's spontaneous motor activity was made according to Munich Functional Developmental Diagnostics and Vojta's infant development. Improving treatment time was between 1-11 months, depending on improvement of child's neurological status and spontaneous motor activity.

**Results.** Before the therapy 22 children were suffering from hard, 19 children from medium, 4 children from light nervous system disorders. After the therapy, the situation of all children improved.

**Conclusions.** Therapy according to Vojta's method has a positive impact on improvement of spontaneous motor activity and on neurologic state of children with decreased nervous system disorders. Evaluation of the two methods give equivalent results.

## Key words:

central nervous coordination disorder, Vojta Method

## Introduction

The progress of modern medicine allows to effectively save more of the endangered pregnancies, and so raises the survival rate of the prematurely born infants. In consequence, there is a growing number of children with the early childhood developmental disorders. There is need, therefore, for the quick detection of the psychomotor disorders in children, and for the early implementation of the development improvement process (1).

The harmonious psychomotor development of a child goes on from the moment of birth, continuously and dynamically, according to the genetically programmed schedule, setting out the appropriate development, positioning and maintaining of the body posture, its verticalization and the purposeful movements of a child [2, 3, 4, 5, 6, 7]. Knowledge of this proper kinesthetic development allows to early detect any delays in the psychomotor skills acquisition and the abnormal posture patterns in a child, and makes it possible to sooner launch the stimulation supporting, and harmonizing, the further development stages [5, 8, 9].

The most commonly used neurokinesiological method for the assessment of a child's motor development, is the 7 provoked postures examination according to Vojta, which evaluates the ability of the central nervous system (CNS) to quickly and adequately respond to the change in the child's body position in space [10, 11, 12, 13, 14]. During the child's first year, the response to the provoked posture is a typical reaction, which is changing along with the CNS development, and any deviations from this ideal patterns Vaclav Vojta had called the Central Nervous Coordination Disorder (CNCD) [2, 4, 15].

In assessing the spontaneous motor activity of a child, the other well recognized diagnostic method may be used – the World Health Organization (WHO) approved: Munich Functional Developmental Diagnostics by Hellbrügge (MFDD) [16]. It is based on the thorough knowledge and evaluation of the child development, and allows for the early recognition of the motor dysfunctions.

Timely rehabilitation of children with the central nervous coordination disorders, based on the neurophysiological methods and on the plasticity of the brain principle, offers the chance for the brain's proper development, and the correction or limitation of the disorders [17, 18].

In this study we have examined the 7 posture reactions, according to the Vojta method, in children with the perinatal risk factors and the shortened gestational age, and we have done the quantitative and qualitative evaluation of the children motor patterns, according to the MFDD method.

## Research Goals

The purpose of this study has been to demonstrate the effectiveness of the Vojta reflex locomotion treatment method in children, by applying the two neurodevelopmental diagnostic methods, and by their comparison. The indication of importance

of the early diagnosis in the developmental disorders in children, and the early implementation of the rehabilitation procedures.

### Materials and Method

The research has been carried out in the Rehabilitation-Educational Center for Children and Youth in Szczytno, on 45 children, aged 1 to 10 months (16 girls and 29 boys). The examined children had been born between the 28th and 41st week of pregnancy, and 8 of them were born prematurely (28-36 week of pregnancy). The study group has been divided into subgroups, depending on the age at which the Vojta method rehabilitation began. In the children born prematurely, the age have been corrected by subtracting from the child's age the weeks missing from the proper duration of pregnancy [11,18,7].

A – children beginning the rehabilitation between 2 to 4 months of age – 32 children (71 %)

B – children beginning the rehabilitation between 5 to 10 months of age – 13 children (29%)

Within the study group, we have made the qualitative and quantitative assessment of the spontaneous motor activity of a child – both, with the baby laying on its belly and on its back – and we have compared the movement accomplishments of the children, at the given development stage, to the standards described in the MFDD.

The first assessment of the spontaneous motor activity of a child had been done before the rehabilitation therapy, and the further assessments were being performed every 4-6 weeks, during the entire duration of the treatment. These assessments had been carried out on the basis of the physiological development tables for infants by Hellbrügge and Pechstein (MFDD), they were being recorded using the deficit in moths to the spontaneous motor activity ideal standard pattern, individually for each of the children. The study group children had also been examined, in the same time intervals, with the 7 posture reactions method according to Vojta, i.e., we were verifying the ability of the children to automatically respond to a change in their body position in space [4,10].

The children showed the abnormal muscle tone (of hypo or hypertonia type), the asymmetric alignment of the body and head, and we also diagnosed them with the Vojta's central nervous coordination disorder (CNCD), confirming the moderate or severe disorders in the functioning of the central nervous system.

The Central Nervous Coordination Disorder may be categorized as:

- minimal (1-3 incorrect reactions),
- light (4-5 incorrect reactions),
- medium severe (6-7 incorrect reactions),
- severe (7 incorrect reactions with the concomitant disorder of the muscle tone) [3,19].

All the examinations took place in a surgery, under exactly same conditions, in a quiet and warm environment, and all the children

were held by their limbs and torsos using the same, specific grip techniques. The pattern observed in a patient was being compared to the standardized dynamics of the development of a healthy infant tables, during the four quarters of the first year of the infant's life (10, 20). The children who had shown dysfunctions of movement patterns in the spontaneous motor activity, and disorders during the postural reactivity examination, had been subjected to the Vojta method therapy, twice a week by a therapist and 4 times a day by their parents at home. The time of the rehabilitation process ranged from 1.5 months to 11 months, depending on the improvement in the neurological status and the spontaneous motor activity of a child. The type of the exercises and the way they were done, i.e. the choice of stimulation zones, as well as the order in which the exercises had been implemented – with the patient lying on his/her back, on one side or on the belly – had always been individually adjusted to the current problems and the needs of the particular child (figure 1-5). With the treatment time passing, and the certain effects emerging, the children rehabilitation program was being modified and further developed.



**Fig. 1. The first reflex turning phase according to Vojta (photographs by authors)**



**Fig. 2. The second reflex turning phase according to Vojta (photographs by authors)**



**Fig. 3. The third reflex turning phase according to Vojta (photographs by authors)**





**Fig. 4. The classic reflex creeping according to Vojta (photographs by authors)**

**Fig. 5. The reflex creeping on the bent facial leg, according to Vojta (photographs by authors)**



### Results and Discussion of the Results

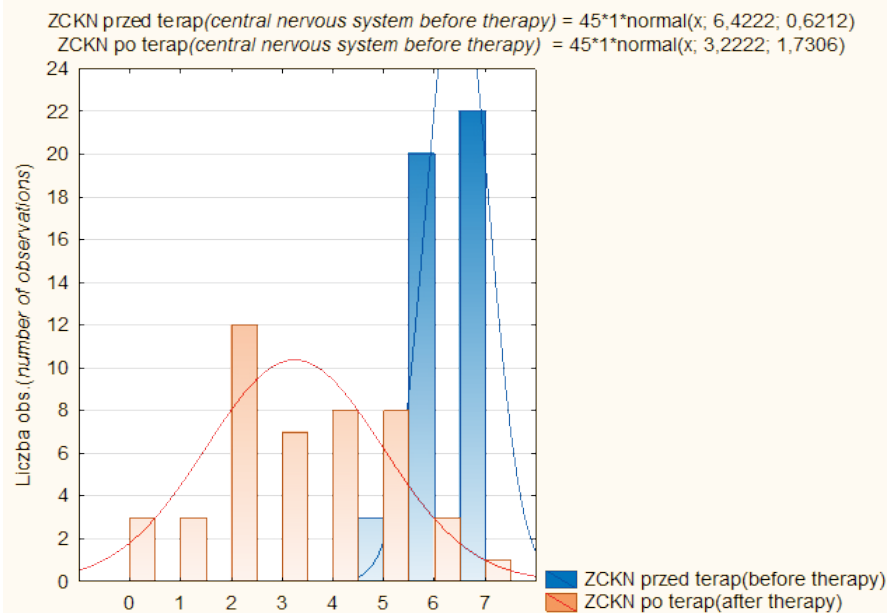
Within the study group, before the therapy, there were diagnosed severe central nervous coordination disorders in 22 children (49%) -7 incorrect reactions; medium severe CNCD was found in 19 children (42%); and 4 children (9%) had 5 incorrect reactions, i.e., the light disorder – during the initial examination.

The figure 6. illustrates the impact of the reflex locomotion therapy on the central nervous system development. The diagnostic examination performed after the period of treatment has shown the decrease in numbers of the incorrect reflexes, and the severe disorder has been found – in 1 child; the medium severe – in 3 children (7%); while the light disorder – in 16 children (36%); and the minimal one – in 25 children (56%).

The changing values of the incorrect reflex reactions, according to Vojta, are also presented for the subgroups listed in here (Table 1).

To demonstrate the significant correlation between the changes of the central nervous coordination disorder and the presented spontaneous motor activity skills, we have evaluated the motor development of a child quantitatively and qualitatively. The main criterion for the assessment were the child development stages, according to the infant physiological development tables by Hellbrügge and Pechstein, in the Munich Functional Movement Screen. The groups examined have not been evaluated for speech development, since this evaluation can be done only in children older than 6 months. The examination results were being recorded in numbers, showing the accumulated deficit in months – from the ideal pattern standard, individually for each of the children.

The obtained evaluation values are shown in the Table 2.



**Fig 6. Rehabilitation outcome for the children in the study groups of 7 postural reactions according to Vojta**

**Table 1. Evaluation of 7 postural reactions according to Vojta (central nervous system disorders) in subjected groups before and after conducting the therapy**

Group of children	N	Degree of ZCKN before therapy				Degree of ZCKN after therapy			
		hard	medium hard	light	lightest	hard	medium hard	light	lightest
Group A	32	16	16	-	-	1	1	13	17
Group B	13	6	4	3	-	-	2	3	8

Group A:

Children starting improving treatment in age 2-4 months

Group B:

Children starting improving treatment in age 5-10 months

**Table 2. Evaluation of psychomotor functions before and after Vojta therapy**

Group of children	Evaluation	N	Mean number of moths deficite	SD	Min	Max
Group A	Before therapy	32	0.89	1.09	-2	3.5
	After therapy	32	0.50	1.54	-2	3
Group B	Before therapy	13	1.73	1.96	-1	6
	After therapy	13	1.57	2.53	-2	7
Total	Before therapy	45	1.13	1.43	-2	6
	After therapy	45	0.78	1.77	-2	5

Group A:

Children starting improving treatment in age 2-4 months

Group B:

Children starting improving treatment in age 5-10 months

When analyzing the results obtained in the examined groups, we have noted that in the children reaching the subsequent motor development stages, there was a reduction of the measured in months deficit from the ideal pattern (the situation is illustrated in the summary of the averages of the deficit calculated, in Table 2). This means, that despite of the initial delays in the spontaneous motor activity in children, after the treatment with the Vojta method, along with the children getting older there occurred the successive movement and behavioral patterns, adequate to the child's age or only slightly delayed.

In the column MIN of the Table 2, we can see the negative deficit values, which indicate that the child, at the time of the examination, presented the psychomotor functioning patterns above the standard for his/her age. This situation occurred in the children born prematurely, after the correction of the child's age by subtracting the weeks "missing" from the proper pregnancy term.

For rehabilitation of children with the central nervous coordination disorders, the time when the therapy begins is extremely important. In young children, if the therapy begins too late, the loss of time becomes irreversible due to the development of the so-called alternative movement patterns [10, 21]. This is being confirmed by the summary of examination results presented in the Table 2, which shows that the deficit (in months) from the proper development stage has been reduced quicker in the younger children. In the group of children who have began the rehabilitation between the 2-4 months of age, the developmental deficit has decreased by 44%, if compared to the starting point, whereas in the group of the older children, 5-10 months of age, the deficit has decreased by only 9%. This correlation has been calculated according to the following formula, defining the relative percentage ratio of the deficit decrease:

$$\frac{\text{deficit before therapy} - \text{deficit after therapy}}{\text{deficit before therapy}} \times 100\%$$

Duration of the therapy in the defined groups has been vary similar and amounted to:

- in the Group A an average of 4.09 months (min: 2 months, max: 11 months).
- in the Group B an average of 3.92 months (min: 1.5 months, max: 10 months).

This allows to draw the conclusion, that the children engaged in the therapy at a younger age do achieve – within the similar time period of the therapy – the quicker normalization of the spontaneous motor activity patterns and the significantly reduced central nervous coordination disorder, than the children who are several months older.

Our experiences regarding the two methods for the evaluation of the psychomotor development in children show, that the examination results of both, the Vojta method and the MFDD method, are consistent at the various levels of the development

and rehabilitation of the young children (up to 1 year of age). Examination with the Vojta method has shown that 25 children, representing 56% of the whole study population, have achieved the minimum CNCD status, while the examination with the MFDD method has shown that 27 children, which constitutes 60 % of the whole population, have reduced the deficit (in months) to the ideal pattern to the level of 0-1.

These methods then, do complement each other by providing the comprehensive and accurate assessment of the psychomotor development of a child, and thanks to the numerical recording of the results for both methods, one can easily track the rehabilitation and the development progress in children with the central nervous coordination disorders.

### Discussion

The presented materials have demonstrated, that the Vojta therapy in children with the CNCD has a beneficial effect, leading to the improvement of their spontaneous motor activity and of their neurological condition.

The implementation of development diagnostics according to Vojta and to the Munich Development Diagnostics methods, allows for the early detection of the nervous system deficits in infants and for the identification of children with the risk of the abnormal motor development pattern [5, 7, 17, 14]. This, in turn, makes it possible to launch the rehabilitation early and to reduce the central nervous coordination disorder. On the basis of the above mentioned examination techniques, one can separate those children with only the minimal disorders, from those whose proper development is being seriously threatened. This way, we can identify the posture disorders which in themselves do not constitute a threat of the cerebral palsy, but as a result of the abnormal child motor development may contribute to the posture defects, sensorimotor integration disorder symptoms, attention deficit hyperactivity disorder, dyslexia and dysgraphia [11].

The therapeutic Vojta method allows to counteract the abnormal development of the spontaneous motor activity in children and, if undertaken early enough, prevents consolidation of the improper movement patterns [22].

The contemporary authors and researchers, including inter alia: Sadowska L. (2001) [11] and Banaszek G. (2004, 2010) [10, 23], encourage the application of the Vojta diagnostic and therapy method, considering it one of the most effective ways for treatment of children with the central nervous coordination disorder and the cerebral palsy symptoms. Similar proposals are also to be found in the international literature on the subject. Yasuyuki Futagi, Yasuchisa Toribie and Yasuhiro Suzuki (2009) [12], in their work on diagnostics of the primitive reflexes, highlight the suitability of the Vojta postural reactions for the early detection of the cerebral palsy in children.

After carrying out tests on a group of infants, Barczyk K.,



Wojtowicz D. et al. (2009), have confirmed that the Vojta therapy method, applied in infants with the CNCD, contributes to the improvement of a neurological condition: reduces the threat of the abnormal development, normalizes the status of nervous reflexes and stabilizes the muscle tension in children [20].

Also the team of researchers from Zgorzelec: Daljewska-Starykow A., Śliwiński Z., Różyło W. (2002), have shown in their research on the motor development in infants, that the neurokinesiology based, development diagnostics according to Vojta make it possible to quickly identify any abnormalities in the psychomotor development of a child, and that the earlier the therapeutic procedures have been implemented, the greater are chances for the child's proper development [24].

A study on the neurological status of the infant twins with the CNCD, rehabilitated using the Vojta method, has also been carried out by Pyzio M., Wojtowicz D., i Skrzek A. (2007). The study included the quantitative and qualitative evaluation according to the standards developed by Prof. V. Vojta, postural reactions evaluation, as well as the assessment of the neurological reflexes. Subsequently, the infants have undergone a six-months rehabilitation program, according to the Vojta method. There had been some neurological differences observed between the twins – prior to the therapy. During the therapy, the differences between the twins were getting smaller and smaller. Upon the completion of the rehabilitation program, majority of the examined twins with the greater neurological deficits, have managed to “catch up” to their siblings, presenting the improved neurokinesiological condition [25].

The problem of the selection of the diagnostic methods, and their usefulness for the early detection of the central nervous coordination disorder in children, has also been studied by the team based in the Medical Academy in Poznan, including Gajewska E., Sobieska M., Samborski W. (2006) [6, 5]. On the basis of their research, the team has demonstrated that the both development diagnostic methods, according to Vojta and to MFDD, are sensitive ways for the early detection of CNS disorders and that they can be used interchangeably.

The functional tests constitute the basis for the planning of the rehabilitation process [26], and the evaluation of the postural development in infants is quite difficult, due to their immature nervous system, which at that time is able to show the brain damages only in a limited way. Therefore, it is advisable to use the broad range of the diagnostic techniques, consisting of more than one way to evaluate a child, to be able to diagnose the abnormal development pattern as early as possible.

### Conclusions

1. The applied Vojta therapy has shown its high efficiency in the process of rehabilitation, the positive impact on the spontaneous motor activity improvement and on the condition of the central nervous system in children with the CNCD.

2. The Munich Functional Diagnostics and the Vojta Development Diagnostics are the equivalent methods for evaluation of the central nervous coordination disorders in children.

3. For the therapy effects, the child's age at which the rehabilitation therapy begins is of major importance, therefore the sooner the CNCD is diagnosed and the treatment starts, the better are chances for the child's proper psychomotor development.

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## Piśmiennictwo/ References

1. Dołyk B. Diagnostyka i terapia metodą Vojty we wczesnej interwencji, zaburzenia ośrodkowej koordynacji nerwowej. W: Cytowska B, Winczur B. Wczesna interwencja i wspomaganie rozwoju małego dziecka. I wyd. Kraków: Impuls; 2006. str. 209-220.
2. Vojta V. Die zerebralen Bewegungsstörungen im Säuglingsalter. Hipokrates Verlag GmbH, Stuttgart 2000.
3. Matyja M, Domagalska M. Podstawy usprawniania neurorozwojowego wg Berty i Karela Bobathów. Katowice: Śląska AM; 1998.
4. Vojta V, Schweitzer E. Die Entdeckung der idealen Motorik. Pflaum Verlag 2009.
5. Gajewska E, Sobieska M, Samborski W. Correlates between Munich Functional Development Diagnostics and postural reactivity findings based on seven provoked postural reactions modus Vojta during the first period of child's life. Annales Academiae Medicae Stetinensis 2006; 52 (3): 67-70.
6. Gajewska E, Samborski W. Zastosowanie diagnostyki według Vojty dla wczesnego wykrycia zaburzeń w rozwoju oraz wpływ czynników takich jak punkcja w skali według Apgar oraz asymetria ułożenia u dzieci z bardzo małą masą ciała. Annales Academiae Medicae Stetinensis 2006; 52 (2): 101-4.
7. Zajkiewicz K, Pop T, Korab D, Lewicka K, Śmigiel A. Ocena rozwoju psychoruchowego dzieci w pierwszym roku życia urodzonych z niską punkcją w skali Agar. Fizjoterapia Polska 2005; 5 (4): 417-422.
8. Patel DR. Therapeutic interventions in cerebral palsy. Indian Journal of Pediatrics 2005; 72 (11): 979-83.
9. Meholfić-Fetahović A. Importance of early rehabilitation using the Vojta method in symptomatic high risk infants. Medicinski Arhiv. 2005; 59 (4): 224-6.
10. Banaszek G. Rozwój niemowląt i jego zaburzenia a rehabilitacja metodą Vojty. Wyd II. Bielsko Biala: Medica Press; 2004. str. 69-85.
11. Sadowska Ludwika. Neurokinezyologiczna koncepcja diagnostyki i terapii dzieci z zaburzeniami rozwoju motorycznego opracowana przez Vojtę. Ortopedia Traumatologia Rehabilitacja 2001; 3 (4): 519-526.
12. Yasuyuki Futagi, Yasuhisa Torbie, Yasuhiro Suzuki. Neurological Assessment of Early Infants. Current Pediatric Reviews 2009; 5: 65-70.
13. Olszewska A, Wagner W. Asymetria ułożenia głowy u niemowląt – wpływ na globalny rozwój ruchowy. Przegląd pediatryczny 2009; 39 (2): 122-125.
14. Kiebzak W, Szmugiel Cz. Ocena efektów wczesnego usprawniania leczniczego niemowląt urodzonych z niską masą ciała neurologiczną metodą Vojty przy pomocy skali T1. Postępy Rehabilitacji 1996; Suplement II
15. Vojta V. Frühbehandlung der CP-Risikokinder Analyse der Endresultate. Mschr. Kinderheilk 1973; 121: 271-273.
16. Vojta V, Peters A. Das Vojta prinzip. Berlin: Springer-Verlag; 2007.
17. Zajkiewicz K, Pop T, Śmigiel A. Wpływ czynników ryzyka okołoporodowego na rozwój ruchowy dzieci urodzonych przedwcześnie. Przegląd Medyczny Uniwersytetu Rzeszowskiego 2003; 4: 392-397.
18. Rodan T, Janusz M, Trzcińska M. Wczesna diagnostyka dziecięca jako istotny element procesu fizjoterapii. Postępy Rehabilitacji 2009, tom 23, 140-141
19. Vojta V. Frühdiagnose und Frühtherapie der cerebralen Bewegungsstörungen im Kindesalter. Z. Orthop. 1972; 110: 450-457.
20. Barczyk K, Wojtowicz D, Hawrylak A, Mraz M. Zaburzenia ośrodkowej koordynacji mięśniowej (ZOKN), a ruchomość stawów biodrowych u niemowląt. Przegląd pediatryczny 2009; 39 (2): 110-116.
21. Vojta V. Metoda Vojty – gry mięśniowe w odruchowej lokomocji i w ontogenezie ruchu. Warszawa: Fundacja Promyk Słońca; 2006. str. 36-41
22. Streck B. Das Vojta-Prinzip Ein anderer Blickwinkel in der Rehabilitation Unfallverletzter. Trauma Berufskrankh 2011; 13: 29-35.
23. Banaszek G. Vojta's method as the early neurodevelopmental diagnosis and therapy concept. Przegląd Lekarski 2010; 67 (1): 67-76.
24. Daljewska-Starykow A, Śliwiński Z, Różyło W. Ocena rozwoju motorycznego niemowląt według Vojty z uwzględnieniem czynników ryzyka w materiale ośrodka rehabilitacji dzieci z mózgowym porażeniem dziecięcym. Fizjoterapia Polska 2002; 2 (3): 216-228.
25. Pyzio M, Wojtowicz D, Skrzek A. Stan neurologiczny niemowląt-bliźniąt, z zaburzeniami ośrodkowej koordynacji nerwowej, usprawnianych metodą Vojty. VI Międzynarodowe Dni Fizjoterapii; Fizjoterapia 2007; 15 (1): 34.
26. Nowotny J, Nowotny-Czupryna O, Czupryna K. Problemy badań funkcjonalnych w fizjoterapii. Fizjoterapia Polska 2009; 3(4): Vol.9, 245-257.