

The application of orthopedic equipment in the form of orthoses in children suffering from cerebral palsy

Monika Stecko¹, Agata Wawryków¹, Katarzyna Korabiusz¹, Joanna Harasimowicz¹, Anna Fabian-Danielewska², Patrycja Piątek², Magdalena Żukowska², Agnieszka Kordek³

1. Pomeranian University of Medical Science, Doctoral Study of the Faculty of Health Sciences, Żołnierska 54, 71-210 Szczecin
2. Pomeranian University of Medical Science, Doctoral Study of the Faculty of Medicine, ul. Żołnierska 54, 71-210 Szczecin
3. Pomeranian University of Medical Science Neonatal Patology Clinic, Aleja Powstańców Wielkopolskich 72, 70-111 Szczecin
- 4.

Dane autora korespondencyjnego:

Monika Stecko

mjstecko@gmail.com

Abstract

Cerebral palsy is a broad term, including various, changing with age movement and postural disorders of cerebral origin [1]. Gait of children suffering from cerebral palsy is characterized by changeability. Observed gait abnormalities are caused by incorrect steering of movements of a child and they are the effects of brain damage and compensation mechanisms. The orthoses should be applied in children suffering from cerebral palsy to protect against deformations of lower limbs. An orthosis prevents the occurrence of articular contractures, probably as a result of inhibition of biomechanical changes in periarticular collagen caused by immobilization [9,10]. Selecting an appropriate orthosis is a key element of the process of treatment of diseases of musculoskeletal system. Orthosis should always be selected individually, depending on the needs and capabilities of

a patient. The following orthoses can be distinguished: ankle joint orthoses, dynamic foot orthosis and complex orthoses stabilizing ankle joint, knee joint and hip joint.

Selecting an appropriate orthopedic equipment is a very important aspect in complex rehabilitation of children suffering from cerebral palsy.

Key Words: cerebral palsy, orthosis, RING, AFO , KAFO, DAFO, GRAFO

Introduction

Cerebral palsy is a disorder syndrome caused by the damage to central nervous system in the early phase of its development [1]. Cerebral palsy is defined as permanent but non-progressive movement and postural disorder, caused by the damage of developing central nervous system in the period of pregnancy, childbirth or in initial period of life after birth. It is a syndrome of diverse aetiology and clinical picture [2]. Cerebral palsy is a broad term that includes various, changing with age, movement and postural disorders of cerebral origin [1]. The damage to structure of upper motor neuron in the period of its early development leads to occurrence of functional disorders of central system of movement control and as a consequence to impairment of child's functional development [3]. Its harmony is impaired – sequencing of occurring functional changes and further, centrally controlled motor activities [3]. General symptoms of damage to the so-called upper motor neuron are divided into negative such as coordination disorders and muscle weakness and released (translated directly as positive) that include muscle tonus disorders, occurring in various forms in early phases of development of pathology [3]. The consequences of damage to central system of movement control is muscle tonus disorder, among others, spasticity, occurrence of pathologic reflexes, muscle clonus, global movement patterns – the so-called synergy, muscle weakness, loss of selective movement control and as a consequence deformations and loss of physical fitness. As a result, these abnormalities impair proper child's functional development leading to recurring delays in remaining areas of development of its locomotion [3,4,5,6].

The application of orthoses in children suffering from cerebral palsy

Gait of children suffering from cerebral palsy is characterized by changeability. Observed gait abnormalities are caused by incorrect steering of movements of a child and they are the effects of brain damage and compensation mechanisms [7].

The lack of selectivity, the impact of primitive reflexes, weakness of equilibrium reactions, sensory disorders, incorrect distribution and size of postural tension and lack of muscular balance between activity of agonistic muscles and antagonistic factors is occurrence of abnormal power affecting musculoskeletal system, which leads to occurrence of secondary symptoms: contractures, bone deformations and dislocation or subluxation of joints [7]. The orthoses should be applied in children suffering from cerebral palsy to protect against deformations of lower limbs. Selecting an appropriate orthosis is a key element of the process of treatment of diseases of musculoskeletal system [8]. Orthosis should always be selected individually, adjusted to every little patient. In other words, orthosis is an apparatus for internal use, made of strong but light thermoplastic. There is also another term used in nomenclature - splints .

An orthosis prevents the occurrence of articular contractures, probably as a result of inhibition of biomechanical changes in periarticular collagen caused by immobilization [9,10]. The orthoses are also used to keep correct length of muscles, correct location of a foot, ankle joint and shank (better linearity), optimal pressure distribution, improve standing and gait function, consolidate the effects of therapy and to keep lowered muscle tonus after surgical procedure [11,12,13,14]. The orthosis users can make various modifications of splints: in the case of strong spastic tension, part of orthosis that includes calf can be additionally hardened to increase its strength, the fastenings in an orthosis may vary, velcro or shoe laces are applied for this purpose, internal surface of a splint is lined with a material, and in the centre, there is a bulge to correctly keep arch of the foot, the pads

under fingers can be adjusted to lower muscle tonus, the pads are also applied for better stabilization of calcaneal tuber and/or metatarsus [10].

The types of lower limb orthoses applied in cerebral palsy

RING orthosis - correction of lower ankle joint. It corrects deviation of a heel, releasing also forefoot.

AFO foot and ankle joint orthosis. There are many types of ankle-foot orthoses, selecting a proper one depends on the age of a child, intensity of muscle contractures and degree of joint dysfunction and foot deformations [10,15]. AFO orthosis includes foot, ankle joint and shank, blocks mobility of ankle joint, limits extension and plantar flexions. Ankle joint in neutral position. AFO orthosis has both day and night form. The benefits of application of AFO orthoses occur in biomechanical, energetic and above all functional aspect, expressed in improvement of gait and posture pattern [15,16].

GRAFO orthosis includes shin in the area of calf and upper part of shinbone and foot. It blocks plantar flexions and extension of ankle joint. Ankle joint in neutral position, based on ground reaction force [10,17].

DAFO orthosis dynamic orthosis foot. Short orthosis that includes only ankle joint gives full mobility of upper ankle joint. It stabilizes tarsus and foot joints [10,17]. KAFO orthosis - correction of ankle joint and knee joint. Its task is to correct the whole lower limb, stabilize knee joint and ankle joint. Knee joint orthosis not only stabilize, but also support child in extension posture [10,15,16].

HKAFO orthosis – correction of ankle joint, knee joint and hip joint. Its basic task is to set lower limbs in abduction, and pelvis in anteversion in order to keep centre of gravity in support square to improve stability in standing or sitting position [10,15,16,18].

CONCLUSIONS

Selecting an appropriate orthosis is very important and it is a key aspect in complex rehabilitation of children suffering from cerebral palsy. The orthoses should be selected individually, depending on functional capabilities and needs of every patient suffering from cerebral palsy. It helps people function better in everyday life, allowing better psychomotor development protecting bone structure against deformations.

BIBLIOGRAPHY

1. Andruszczak B, Andzrejewska- Buraczyńska B., Krauss H., Potoczna - Jończyk K., Jacek Piątek J., Krzywicka A., Sobczak - Żukiewicz W., Krasowska E., Kozak M.: Wielopłaszczyznowa opieka nad dzieckiem z mózgowym porażeniem dziecięcym. *Medycyna Ogólna i Nauki o Zdrowiu*, 2012, Tom 18, Nr 4, 314-318.
2. Klimont L.: Założenia terapii neurorozwojowej NDT-Bobath w mózgowym porażeniu dziecięcym. *Ortopedia Traumatologia Rehabilitacja* 2001; 3(4): 527-530.
3. Manikowska F., Józwiak M., Idzior M.: Wpływ nasilenia spastyczności na możliwości funkcjonalne dziecka z mózgowym porażeniem. *Neurologia Dziecięca*, Vol. 18/009, nr 6: 31-35.
4. Borkowska M.: ABC Rehabilitacji dzieci. Pelikan, Warszawa 1989.
5. Borkowska M.: Uwarunkowania rozwoju ruchowego i jego zaburzenia w mózgowym porażeniu dziecięcym. Zaulek, Warszawa 2001.
6. Beker N., Yalcin S.: *The HELP Guide to Cerebral Palsy*. Global HELP– Publication, Istanbul 2005.

7. Dudek J., Chuchła M., Snela S., Szymczyk D., Drużbicki M.: Zaburzenia wzorca chodu u dzieci z mózgowym porażeniem. *Przegląd Medyczny Uniwersytetu Rzeszowskiego*, 2009, 3, 317–322.
8. Syczewska M., Świącicka A., Kalinowska M., Gaff K.: Zastosowanie ilościowej, obiektywnej analizy chodu do oceny doboru zaopatrzenia ortopedycznego u dzieci z mózgowym porażeniem dziecięcym (analiza chodu w doborze zaopatrzenia ortopedycznego w mpdz). *„Fizjoterapia Polska”* 2006, t. 4, vol. 4, s. 298- 303.
9. Bakheit A. M. O. Management of muscle spasticity. *Crit. Rev. Phys. Med. Rehabil.*, 1996, 8, 235-252.
10. Wojciechowska P., Starz A.: Zastosowanie ortez skokowo - goleniowych w zaburzeniach chodu dzieci z postacią spastyczną mózgowego porażenia. *Rehabilitacja w pediatrii.*, 2018, 6 , 36-41
11. Zwick E. B. i in. Ortopedyczna koncepcja poprawy sprawności motorycznej dzieci z zaburzeniami ruchu spowodowanymi spastycznością. *Rehabil. Med.*, 2000, 4, 40-44.
12. Steinborn B., Łuczak-Piechowiak A. Zastosowanie metod kinezyterapeutycznych w leczeniu spastyczności. *Pol. Prz. Nauk. Zdr.*, 2006, 1, 91-98.
13. Łuczak E. i in. Znaczenie zaopatrzenia ortotycznego w leczeniu mózgowego porażenia dziecięcego. *Post. Rehabil.*, 1996, 10, 82-8.
14. Kwolek A. i in. Rehabilitacja dzieci z porażeniem mózgowym - problemy, aktualne kierunki. *Ortop. Traumatol. Rehabil.*, 2001, 3, 499-507.\
15. Bartkowiak Z., Łuczak-Piechowiak A., Zgorzalewicz- Stachowiak M., Idzior M., Pajor J.: Metody zaopatrzenia ortopedycznego stosowane u dzieci z mózgowym porażeniem dziecięcym. *Fizjoterapia* 2008, 16, 4, 99-113
16. White H. i in. Clinically prescribed orthoses demonstrate an increase in velocity of gait in children with cerebral palsy: a retrospective study. *Dev. Med. Child. Neurol.* 2002, 44, 227-232
17. <https://www.vigo-ortho.pl/pl-PL/content/ortozy-konczyn-dolnych/85/>
18. Morris C. Orthotic management of children with cerebral palsy. *Dev. Med. Child. Neurol.*, 2007, 49, 791-796