

DEVELOPMENT OF A NEW ORTHOSIS FOR A CHILD WITH CEREBRAL PALSY, WITH A KNEE (HYPER) EXTENSION IN MIDSTANCE AND INTERNAL ROTATION OF LOWER LIMB PATTERN - A CASE STUDY

Ž. Boltežar¹, K. Groleger Sršen², I. Vrečar², I. Cikajlo², J. Krajnik², I. Tomšič², M. Humar Gorišek²

¹ Ortotika in protetika d.o.o., Ljubljana, Slovenia

² Institute for Rehabilitation, Ljubljana, Slovenia

Abstract

In conjunction with other interventions for children with cerebral palsy (CP), orthoses continue to play an important role in the physical management of children with CP. A case study was designed to provide a quantitative and qualitative analysis of gait pattern of a girl, who is using a specially designed twister hip-knee-ankle-foot orthosis (HKAFO). She was referred to our Institute at the age

of 4.5 years. She walked with pronounced hyperextension of knees in midstance and internal rotation of lower limbs. Clinical analysis after application of HKAFO showed better gait pattern without knee hyperextension in midstance, with lesser hip internal rotation and good foot position. She was slower, able to stop and to stand for a longer period. Kinesiology supported clinical findings. We expect a beneficial long term effect on gait pattern, but this has to be proved through a prospective study on a larger group of subjects.

INTRODUCTION

Cerebral palsy (CP) is a well-recognized neuro-developmental condition with frequent secondary impairments (1). For the function of ambulation, the Gross Motor Function Classification System (GMFCS) has been widely employed (2). Individuals in levels I and II are able to walk without any aid and those in levels III and IV need different types of orthoses, walker, crutches...

According to specific gait pattern, children with CP belong to one of five groups (3):

1. insufficient foot lift in swing,
2. knee (hyper)extension in midstance without heel rise,
3. knee (hyper)extension in midstance with heel rise,
4. knee flexion in midstance with heel rise and
5. knee flexion in midstance without heel rise.

In conjunction with other interventions, orthoses continue to play an important role in the physical management of children with CP. The aims of lower limb orthotic management of CP are to correct and/or prevent deformity, to provide a base of support, to facilitate training in skills and to improve the efficiency of gait (4).

Most frequently orthoses for ankle and foot (AFO) are used. There are 4 main types: a UCBL, a leaf-spring AFO, a rigid

AFO and a floor reaction AFO (5). Quite some studies are dealing with the effects of different types of AFO on the gait pattern, but there are just a few data on the influence of AFO on hip kinematics (6). Children with hyperextension of knee in the midstance and internal rotation of lower limb to our knowledge seem not to benefit enough from AFO.

METHODS AND SUBJECTS

The study was designed to provide a quantitative and qualitative analysis of gait pattern of a child with CP, who is using a specially designed twister hip-knee-ankle-foot orthosis (HKAFO). The orthosis consists of pelvic corset, knee orthosis and foot orthosis, connected by an adjustable spring. It provides prevention of internal hip rotation, correction of knee hyperextension in midstance and a good foot position. Based on individual analysis, compounds are chosen according to intensity of correction that is needed in a particular plane.

A girl was born after uneventful pregnancy 10 days after term: weight over 4 kg, height 54 cm, Apgar score unknown. She had broken collar bone and was vomiting amniotic fluid. Only at the age of one year she was referred to a physiotherapist because of a delayed motor development. She started to walk at the age of 18 months. Team at the regional

health-centre decided to apply inhibitory casting to prevent toe-walking at the age of 3 years. After that parents noticed, that her gait pattern worsened. She was walking very quickly, she was hardly able to stop in was falling frequently.

She was referred to our Institute at the age of 4.5 years. She was able to walk freely, but with difficulties: plantigrade in barefoot but compensating with pronounced hyperextension of both knees in the midstance and internal rotation of lower limbs. We decided to apply the twister HKAFO. Her gait pattern was analyzed clinically and kinesiologically (in the first week after application and again after period of 3 months).

RESULTS

Clinical analysis after application showed better gait pattern without knee hyperextension in midstance, with lesser hip internal rotation and good foot position. She was slower, able to stop and to stand for a longer period.

Kinesiology showed that the gait velocity with orthosis was lower (0.25m/s) and cadence was more variable. Gait pattern, which was based on moving the center of gravity forward and propulsion generation in hips, was changed in terms of propulsion generation and securing the stability; the hip power generation has decreased and pelvis was adjusted toward normal position and consequently moving the center of gravity backward. The spring was helpful in the swing phase, but not easy to overcome its force. At the same time it leaded to less power that was needed for walking. The HKAFO application also resulted in smaller pelvic tilt and abolished the undesired knee hyperextension.

Girl and her parents accepted the orthosis very well. Girl used the orthosis for several hours per day already in the period of adaptation, without any difficulties while committing to daily life activities.

DISCUSSION AND CONCLUSION

Gait patterns of children with CP differ significantly. One of possibilities is walking with knee (hyper) extension in

midstance and with pronounced internal rotation of hip. We developed a twister HKAFO to correct this gait pattern. Analysis is showing short-term improvement of gait pattern. It can be applied through all the day, without any functional limitation in performance of daily life activities, which is also very important for a child and its family.

There are some questions remaining to be answered. We expect that a long term effect will be beneficial, and that children will develop a better gait pattern that will persist also through a longer period without KHAFO. But this has to be proved through larger study within a longer period of observation.

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