1. Influence of ankle-foot orthosis on postural control in children with cerebral palsy.

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1.1 Introduction:

Spasticity in the lower extremity, as a result of cerebral palsy (CP), disturbs commonly postural control in stance. Main causes for this condition are changes in two underlying systems for postural control: neurological changes affecting muscle activation patterns, disturbing proprioceptive and sensoric information as well as anticipation and adaptation mechanisms. Postural control is also influenced by age (maturity) and visual information (eyes open and eyes closed).

The use of an ankle-foot orthosis (AFO) is said to correct mal-alignment in the ankle joint and the knee joint and should therefore improve weight distribution and static postural control. Once static postural control is adequately achieved, the performance of a functional task such as reaching (dynamic postural control) can improve. The purpose of this study was to measure objective data of static and dynamic postural control in children with cerebral palsy when tested with and without AFO, and with eyes open and eyes closed. This in order to evaluate the influence of AFO.

1.2 Methodology:

Nine children (six boys-three girls), four-seventeen years old, with spastic diplegia or hemiplegia wearing an AFO were selected. As a control group, nine typically developing children (six boys-three girls) aged eight-thirteen years, underwent the same tests. All subjects attended one single test session.

For the static postural control test, the covered way of the center of pressure (COP) is measured, using a footscan 1m. pressure plate. The children were asked to stand as still as possible on this pressure platform. They stood in a comfortable position, the arms relaxed at their sides and the feet slightly spread. They performed three trials with eyes open and three trials with eyes closed. Each trial lasted ten seconds and verbal encouragement was allowed. The test was carried out at random barefoot and wearing AFO.

For the dynamic postural control test, the children were asked to stand in a comfortable way on the footscan plate and to reach with the dominant hand to a point in front of them at shoulder height and at 3/4 of their maximum reach. They performed 3 trials and with each trial they had to reach out three times in eight seconds. Verbal stimulation was allowed. The test was carried out at random barefoot and wearing an AFO.

3.3 Results:

Static postural control:

When standing barefoot, postural sway in children with cerebral palsy is significantly larger than typically developing children. This both in the condition eyes open and the condition eyes closed. Static postural control is less developed in children with cerebral palsy. Wearing an AFO, postural sway reduces significantly both in the conditions eyes open and eyes closed. This confirms the positive influence of an AFO on static postural control.

	eyes open (mm)normal	eyes closed (mm)normal	eyes open (mm)CP	eyes closed (mm)CP	eyes open (mm) CP AFO	eyes closed (mm) CP AFO
Mean	645.56	734.89	864.56	888.44	677.89	685.56
SD	180.02	179.01	220.29	390.86	164.88	208.02

Table 1 : covered way of the COP in mm

Dynamic postural control:

All children underwent a self-induced postural sway, reaching with the dominant hand to a point in front.

	barefoot controle	barefoot CP	Hemiplegia CP	Diplegia CP	Hemiplegia CP + AFO	Diplegia CP + AFO
Mean	2404.78	1605.22	2065.50	1237.00	2213.25	1210.00
SD	475.98	775.00	741.56	638.34	553.01	377.45

Table 2 : covered way of the COP in mm

In the barefoot condition, children with CP show a significantly smaller dynamic postural sway than normal children. This means they have less dynamic potentials. Within the group of children with CP, there is a remarkable difference between children with hemiplegia and diplegia. Hemiplegic children show a larger postural sway, thus a better dynamic postural control. In this group dynamic postural control shows more resemblance to the control group.

3.4 Discussion:

In the control group, postural sway is rather small (mean value 645/734 mm), which means less stability in stance with eyes closed. This indicates the influence of visual information on static postural control.
In children with cerebral palsy, the postural sway is significantly larger (mean value 864/888 mm) which means less stability, less postural control in stance.
Wearing an AFO reduces significantly (p=0.011) the postural sway in children with CP. As the AFO corrects the mal-alignation in ankle and knee joint, there must be an improvement of power generation. It takes less energy to keep the upright position. The AFO corrects also the position of the foot. So the base of support will improve and make standing easier. As a whole, we can conclude that wearing an AFO improves the static postural control significantly.
Children with CP have less dynamic postural control than the control group. As they often use spastic patterns to keep the upright position, little possibilities are left to perform a smooth movement. Poor static postural control influences dynamic postural control. Nevertheless, dynamic possibilities in children with hemiplegia seem to score better. Probably they are able to compensate movement strategies with the non involved side, where as children with diplegia are trapped in their spastic patterns. They need them to keep the standing position. Wearing an AFO gives a significant improvement in dynamic postural control (p=0.03) for the total group. Results on postural sway were more positive in the hemiplegic group. Again a better alignation and improved power generation, as well as a better base of support can be responsible for these results. In the diplegic group, results on postural sway were less positive. However there was an important improvement in posture and of the usage of strategies: less triple flexion, diminution of spastic pattern in the opposite arm, and more rotation of the trunk to the opposite side. All these findings suggest a better postural control.

3.5 References:

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