Combined dropfoot treatment using dynamic splinting with FES: a case study

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Introduction

There are a number of problems associated with the use of FES for the treatment of dropfoot when used with children and young people. These include: daily accurate electrode positioning; hygiene and skin irritation; and potential developmental effects of inappropriate foot positioning. This paper describes a compound solution that has been developed to address these issues, by combining dynamic elastomeric splinting to provide passive ankle joint support with FES for additional active dorsiflexion. A further innovation is the use of a trans-conductive polymer developed (EPSRC funded). A polymer layer enables stimulation electrodes to be permanently placed externally on the splint, while the internal surface against the skin can be easily cleaned daily. The solution addresses the daily problems of accurate electrode positioning and skin hygiene. A final benefit is improved foot position at heel strike. Conventional dropfoot systems are normally setup to produce eversion of the foot along with dorsiflexion to ensure stability of the ankle at heel strike. This is opposite to normal gait where the foot lands partially inverted, rolling into eversion during stance. Landing on an everted foot produces abnormal loading on the inside of the knee joint and an abnormal gait pattern. By using dynamic elastomeric splinting to stabilise the ankle, the FES can produce dorsiflexion alone, promoting a more normal gait pattern with consequential benefits on developing limbs.

Method

A standard dorsiflexion sock made by DM Orthotics Ltd. was modified to include a panel of trans-conductive polymer. The material is inert against the skin but allows conduction of FES stimulation from the outer surface. The subject was a 17 y.o. female, CP with left-hemi. Measurements were taken during walking : without intervention; with the splint without FES; and with both splint and FES. Data were captured for 3 concurrent, timed 10m walks with the steps counted and the physiological cost index (PCI) calculated.

Results

Averaged over the 3 walks	Speed m/s	Stride cm	Cadence steps/min	PCI
No intervention	1.20	115	124.47	0.49
Splint alone	1.18	118	120.38	0.35
Splint + FES	1.21	123	118.59	0.30

Discussion

The intervention had little influence upon walking speed but improved stride length. From observation the additional dorsiflexion increased the step length on the affected side accounting for the 3cm improvement (splint alone) and a further 5cm with FES. The improved PCI indicated that changes to the gait (improved cadence) made a large difference to the effort required to walk, the subject reported at the time that she much preferred the ease of walking with the splint.

Conclusion

. This single case study has produced positive results that warrant further investigations into this combined intervention.