



# Using Technology to Overcome Physical Barriers in Cerebral Palsy

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# Contents



Rehabilitation Technology



Rehabilitation / enablement in CP



Neurological System - Neuroplasticity



Musculo-skeletal system

# Neuroplasticity



Brain's ability to re-wire

Strengthen/weaken, create new/lose non-used



Optimised by type of training

Frequent, intensive, repetitive, varied,  
challenging, achievable, meaningful, task practice.

# Musculo-skeletal system



BONES, MUSCLES, TENDONS,  
JOINTS, LIGAMENTS.



TYPES OF TRAINING

# Effects of aging



Neurological System



Musculo-skeletal System

# Rehabilitation / enablement in CP

Specialist knowledge e.g. neurological physiotherapy



Individualised goals



Treatment – neuro or MSK focus



Patient empowerment (self efficacy)

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Weakness

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Stiffness & Spasticity

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Reduced co-ordination / balance

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Altered sensation

Common Physical Impairments in CP

Common  
Functional  
Problems in  
CP

Reduced  
mobility

Reduced arm &  
hand function



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Hemiplegic

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Diplegic

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Foot drop

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Knee flexion

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Hip flexion/adduction/medial rotation

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Pelvic tilt

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Reduced trunk control

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Reduced mobility – range of severity

Commonly  
used  
technologies

Ankle Foot Orthoses (AFOs)

Other orthotics (plastic/metal)

Walking aids

Wheelchairs

Technologies  
we need to  
use more



Functional Electrical Stimulation  
(F.E.S.)



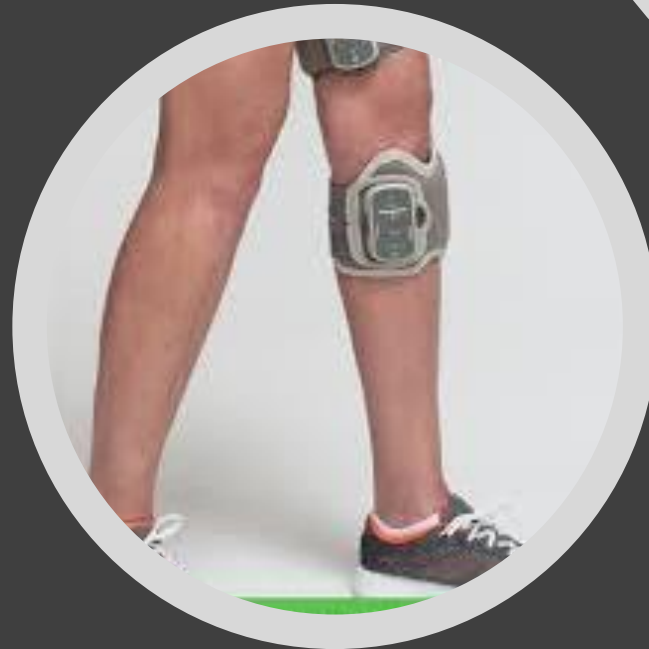
“Lycra Garments” / Sensory Dynamic  
Orthoses (S.D.O.s) / Dynamic  
Movement Orthoses / DEFOs



Dynamic Ankle Foot Orthoses  
(A.F.O.s)

# Functional electrical stimulation in CP

- Electrical impulses stimulate useful movement
- **Foot lift (dropped foot)**
- Calf stimulation (push off)
- Knee extension / hyperextension
- Hip flexion / stability





Sem Walk Aide

# Functional Electrical Stimulation



Compensatory effect – lifts foot to  
improve walking



Rehabilitation effect

# FES + CP: EVIDENCE

Increased speed

Reduced effort

Increased muscle strength

Improved selective muscle control

Reduced spasticity

Increased symmetry of step length

Push-off preserved

Well tolerated

# FES: Costs

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DEVICES £1,600 - £5,400



RUNNING COSTS –  
CONSUMABLES, MAINTENANCE



STUDIES SHOW COSTS  
COMPARABLE WITH AFOS (IN MS)



# FES or AFO?

- Clinical reasoning:
  - Complexity of walking problem
  - Comfort / compliance
- Practical application:
  - Cost
  - Availability



# FES Summary

FES can = improved mobility for mild/moderate walking problems.

FES has several potential benefits compared to AFOs.

Cost effective.

Under-used option.

**FES should be offered as a matter of routine to children with CP with mild to moderate walking problems aged 7+.**

# Making the case for funding



[https://www.odstockmedical.com/sites/default/files/paediatric\\_evidence\\_karen\\_hodgkinson.pdf](https://www.odstockmedical.com/sites/default/files/paediatric_evidence_karen_hodgkinson.pdf)



[https://www.odstockmedical.com/sites/default/files/abstract\\_paediatric\\_making\\_the\\_case\\_for\\_funding.pdf](https://www.odstockmedical.com/sites/default/files/abstract_paediatric_making_the_case_for_funding.pdf)

# Sensory Dynamic Orthoses (SDOs)

- Compression garments
- Continuous sensory feedback
- Regulate muscle spasticity
- Structural support
- Improve posture
- Improve quality of movement









## “Support where I feel unstable”

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- “It provides me with support in areas where I feel most unstable, which for me is my lower back and pelvis.”
- “It helps me stand or walk outdoors for longer.”
- “My posture feels better; more upright; I’m more aware.”
- *Kathleen, Diplegic CP*

# Kathleen's Treatment

## Flexibility

- Stretches
- Positioning

## Strength

- Exercises

## Endurance

- Cycling
- Graded increase in walking distance

## Balance

## Co-ordination

Rehabilitation  
technology to  
augment

Sensory Dynamic Orthosis

Bambach saddle seat

Custom in-soles + shoe mod

Walking poles

FES



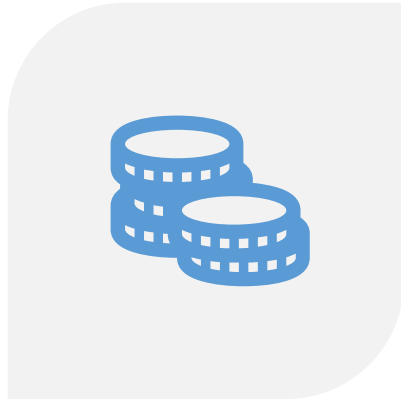
# SDOs: The Evidence

High quality evidence – children with CP, trunk & arm.

Lower quality evidence - children with CP, walking

References: <https://www.dmorthotics.com/wp-content/uploads/2019/04/Appendix-A-Hierarchy-of-Evidence-2019.pdf>

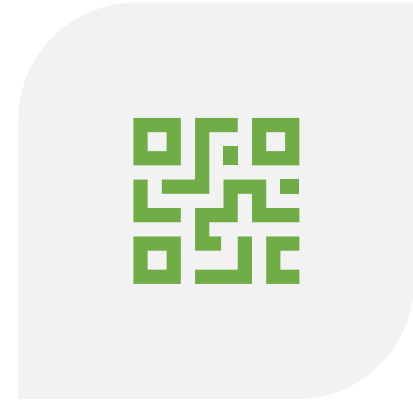
# SDOs Costs



£15 - £1,500



MORE STOCK  
PRODUCTS



NEW SCANNING  
TECHNIQUES

# SDOs Summary

Consider use for trunk or hand and arm.

May also benefit leg and foot function.

Practical considerations – comfort, toilet

Under-used option

SDOs should be considered as a potential adjunct to treatment for children & adults with CP

# Dynamic Ankle Foot Orthoses

- Lots of different manufacturers
- WalkOn range – carbon fibre
- Step-On range – spring loaded
- Turbomed - attaches to shoe





Flexible or rigid custom AFO?

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# Flexible AFO: potential benefits



Comfort



Normal shoe size



Dynamic

SDO/FES/Flexible AFO --> Custom AFO, mix



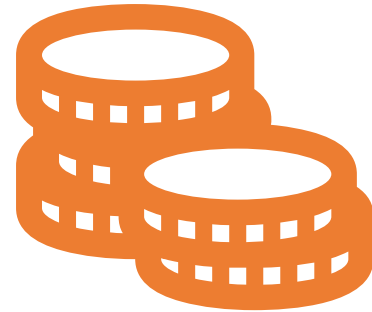
*“My physio advised me to try on an flexible walking splint, which I initially used to wear for an hour to get my muscles used to it, but now I can wear it for 8 hours a day. It never has given me blisters and I do not need anyone with me when I wear it.”*

*Abbey, hemiplegic CP*





Approximate  
costs



£150 - £800

Reduced  
mobility



Reduced arm &  
hand function

# Hand & Arm Function

- Goal:
  - Be able to shake hands
- Impairments:
  - Joint stiffness
  - Muscle shortening
  - Spasticity
  - Weakness



# Treatment

Stretching

Strengthening

Posture

Rehabilitation technology

- Dynamic resting splint
- Electrical Muscle Stimulation



Dynamic  
resting splint

# Electrical Muscle Stimulation

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- Muscle strengthening
- Muscle stretching
- Increased circulation
- Sensory stimulation
- Reciprocal inhibition





# Electrical muscle stimulation + Dynamic splint



# Other rehabilitation technologies for arm and hand

SaeboGlide	<a href="http://uk.saebo.com/shop/">uk.saebo.com/shop/</a>	£65
SaeboGlove	<a href="http://uk.saebo.com/shop/">uk.saebo.com/shop/</a>	£350
Virtual Reality	Mind Motion, SaeboVR	£8k+
NeuroBall	<a href="http://neurofenix.com">neurofenix.com</a>	£478.80
Move Able	<a href="http://move-able.com">move-able.com</a>	£350
SaeboFlex	<a href="http://uk.saebo.com/shop/">uk.saebo.com/shop/</a>	£850



Reduced  
mobility



Reduced arm &  
hand function



# Summary

Technology as part of Rehabilitation / Enablement Process

Good evidence base for use of FES + SDOs in CP

Clinical reasoning supports use of dynamic AFOs, hand splints + EMS

Consider safety, clinical and cost effectiveness, ways to increase access.

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