The Hemiplegic Foot and Ankle
Non-surgical management in Paediatrics

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Ankle Structure

• Ankle is a stable joint
• Medial and lateral displacement prevented by malleoli and ligaments
• Maximum plantar flexion $50^\circ$, dorsiflexion $10^\circ$
• Least stable in plantar flexion
• Normal gait requires approximately 10 degrees in dorsiflexion and 20 degrees in plantar flexion
The ability to walk can be impaired by the presence of lesions at various levels: the nervous system, the musculoskeletal system, the cardiovascular system, and the respiratory and visual systems.

Environmental conditions can affect patients’ locomotor abilities.

Neurodevelopmental paediatrician can perform a complete assessment in order to analyse all the factors liable to interfere with ability to walk.
Hemiplegia

Weakness/paralysis of half of the body resulting from disease or injury to the motor centres of the brain

Cerebral Palsy: Disorder caused by a non-progressive brain injury or malformation that occurs while the child’s brain is under development
Aetiology

Congenital: mostly unknown
- perinatal cerebrovascular accident /stroke
- Intravascular Haemorrhage (IVH)
- Structural anomalies: polymicrogyria, AVM, CVM
- Sturge Weber syndrome/ Leukodystrophies

Acquired
- Brain tumour
- Traumatic brain injury
- Infection: Menigitis, meningoenceohalitis
- Autoimmune: Vasculitis
- Metabolic
Corticospinal Pathway

- Also called the pyramidal system
- **Voluntary** (conscious) control of skeletal muscles:
  - begins at upper motor neurons of primary motor cortex
  - axons descend into brain stem and spinal cord to synapse on lower motor neurons

Cerebral cortex

Motor path away from brain toward muscle or gland
Inhibition Corticospinal Tract

Positive:
- Spasticity
- Hyperreflexia
- Clonus
- Co-contracture

Negative:
- Weakness
- Impaired motor control
- Poor co-ordination
- Sensory deficit
Problems in the hemiplegic foot/ankle

- How each child is affected varies
- Weakness, spasticity, lack of control of movement and balance/ dystonia
- Early identification -> early support
- Neuroplasticity (transfer of function to different area of brain)
- MDT approach
- Goal oriented therapy
- Regular assessment
Don’t forget associated disabilities

- Vision
- Upper limb
- Seizures
- Intellectual
- Spatial awareness
- Psychosocial
- Family support/ sibling support
Ankle: plantar flexed
Foot: Inverted
Identification/ referral pathways

- Parents
- Nurseries/schools
- Health visitor
- GP
- Physiotherapist
- Occupational therapist
- Orthotics
- Other pediatricians
Assessment

Qualitative functional assessment
• Oral and written information
• Clinical examination

Quantitative functional assessment
• Goniometry
• Digital video evaluation
• Gait analysis
• Selective muscle strength/Muscle Mapping
• Spasticity
"The individual is rarely going to be altered very much whereas the environment slowly but surely can"

Tom Shakespeare
Co-ordinated Management

- Orthopaedic Surgery
- Botulinum Toxin
- Oral medications
- Orthotics
- Physio/OT
- Activities in home life

Child and Family
- Physiotherapy
- Occupational Therapy
- Orthotics
- Selective Dorsal Rhizotomy
- Botulinum Toxin
- Electrical Stimulation FES
- Mirror Therapy
- Orthopaedic Interventions
- Antispasticity Medications
WHO ICF 2007

Health Condition (disease or disorder)

Body structure and Function (Impairment)

Activity (Activity limitation)

Participation (Participation Restriction)

Environmental Factors

Personal Factors
Clinical Application of ICF
(Adapted from Kohlemainen et al 2011)

Health Condition
Hemiplegia

Body structure and Function (Impairment)
Control of hip knee and ankle function

Activity (Activity limitation)
To be able to run

Participation (Participation Limitation)
Play football with friends

Environmental Factors
Support and experiences from others regarding ball skills

Personal Factors
Child’s motivation and confidence towards running and playing football
Therapeutic Approach to Hemiplegia: Our Challenge

Family and Child

Health

Social Care

Education
## Therapy

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<th>Body Structure and Function</th>
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<td>Strength training</td>
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<td>Effects of change especially growth</td>
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Medications

Consider benefits as well as the short- and long-term side effects.

Often a process of trial and error to determine which drug will work best – in what dosage.
Anti-spasticity medications

- Oral (tablet, syrup)
- Intramuscular
- Intrathecal

Oral and Intrathecal routes usually used for generalized spasticity
Benefits / unwanted effects

Control muscle contractions/ tremors /spasms
Delay surgery
Increase range of motion
Improve ability to participate in therapies
Reduce impairment
Relax overactive/ tight muscles

Confusion
General weakness
Constipation / Diarrhoea / incontinence
Dizziness / drowsiness
Flu-like symptoms
Headache / nausea
High blood pressure
Insomnia
Liver damage
Pain upon injection
Slowed heart rate
Slurred speech
Baclofen

GABA receptor agonist, acts as an inhibitory neurotransmitter by blocking excitatory transmitters

Transdermal, oral and intrathecal routes

Used in Hemiplegia especially at night time to alleviate muscle pain, reduce spasms

Introduce gradually over 4-6 weeks

Usual maintenance dose 2mg/kg/day (max 60 mg in a day)

Other:
- Diazepam: benzodiazepine; modulate GABA A receptor
- Dantrolene
- Tizanidine
Botulinum Toxin

- Neuromuscular blocking effect
- Specific muscles, inhibit over excitation; opportunity to relax, grow and stretch
- Goal oriented treatment necessary
- Cosmetic improvement vs functionality
- Pre and post assessment to see whether goals achieved
- Ultrasound guided
- Sedation / Entanox / general anaesthesia
- Benefit seen in 2-4 weeks
- Usually effect lasts 3-4 months, but functional improvement last longer
- May need multiple injections over the years
When to refer to Orthopaedics

• Leg length discrepancy
• Evidence of evolving fixed deformities / contractures

Conclusion: injection of BoNT-A is effective in the management of lower limb spasticity in children with CP, and when combined with physiotherapy and the use of orthoses, these interventions may improve gait and goal attainment.

NICE CG Spasticity in under 19s: management, guideline; CG145 Published date: July 2012