Definition and classification of CP

Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behaviour, by epilepsy, and by secondary musculoskeletal problems.


CP: Upper motor neuron syndrome

Muskuloskeletal Health in Cerebral Palsy - Workshop

CP as a Musculoskeletal Disorder

Contractures  Hip Displacement  Bony Torsion  Scoliosis

GMFCS

Gross Motor Curves in Cerebral Palsy:
GMFCS Accurately Predicts:

- Risk of hip displacement
  - Soo, 2006
- Shape of proximal femur (PFG)
  - Robin, 2008
- Success rate of soft tissue surgery for hip displacement
  - Shore, 2012
- Success rate of bony surgery for hip displacement
  - Shore, 2016
- Risk and severity of scoliosis
  - Ang

Hip Displacement (MP>30%) vs GMFCS
N=354; 1990-1992

Soo et al., JBJS 2006
Was adductor surgery successful?

Shore et al, JBJS, 2012

Is bony reconstruction successful?

Shore et al, JBJS, 2015

Risk of Scoliosis: Cobb angle >10º (41%)
**Scoliosis: Cobb Angle 10° or 40°?**

<table>
<thead>
<tr>
<th>GMFCS</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>0%</td>
</tr>
<tr>
<td>II</td>
<td>10%</td>
</tr>
<tr>
<td>III</td>
<td>20%</td>
</tr>
<tr>
<td>IV</td>
<td>30%</td>
</tr>
<tr>
<td>V</td>
<td>40%</td>
</tr>
</tbody>
</table>

- Cobb > 10°
- Cobb > 40°

**Severity of Scoliosis: Cobb Angle > 40°**

<table>
<thead>
<tr>
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<td>IV</td>
<td>30%</td>
</tr>
<tr>
<td>V</td>
<td>40%</td>
</tr>
</tbody>
</table>

**Long term Outcomes**

- Hip health
- SEMLS
Measuring meaningful outcomes

A classification system for hip disease in cerebral palsy

- Quantitative Radiographic Measure
  - Migration percentage
- Qualitative Radiographic Features
  - Break in Shenton’s line
  - Shape of the femoral head
  - Development of lateral acetabular margin
  - Presence of pelvic obliquity

Normal hip
Near Normal Hip
Dysplastic Hip
Dysplastic - Mild Subluxation
Mod-Severe Subluxation
Dislocated
Salvage Surgery

Hip Health at Skeletal Maturity

[Image of hip health at skeletal maturity]
**Hip Health at Skeletal Maturity**

**Pain Severity vs MCPHCS**

- Pain severity increases as hip morphology worsens
- Pain severity higher at MCPHCS 5/6 (severe subluxation or dislocation)
- NO association between MCPHCS and GMFCS

**Hip Health at Skeletal Maturity**

**MCPHCS vs Hip Surveillance**

- Relationship between hip radiographs and a better outcome
- Those under hip surveillance had a better hip morphology at skeletal maturity

**Hip Health at Skeletal Maturity**

- Most bilateral dislocated and severely displaced hips were **painful**
- Unilateral dislocations with windswept deformities were **always painful**
- Hip surveillance was strongly associated with a better outcome
Long-term outcomes: Gait function

- 5.3° improvement
- 3.3 times MCID (1.6°)
- 71% maintained or improved long-term

![Gait Profile Score graph](image)

Long-term outcomes: Gait function

- Gait improvement per GMFCS level
- Significant improvement all GMFCS levels
- Maintained long term

![Gait Profile Score graph](image)

WHO – ICF

```
Health Condition  
| Cerebral Palsy |

Body Structure/Function | Activities | Participation |

Environmental factors | Personal factors |
```

WHO, 2001
MSK Pathology and ICF: Concepts

- Correcting deformities at the right (early) time preserves body structures, maintains function and allows participation.
- Surgery may maintain or allow small gains in function (GPS, GMFM, FMS but rarely GMFCS)
- Severe progressive deformities may result in pain, loss of ambulation, loss of standing and sitting, with major losses in function and participation

Progressive MSK Pathology: Dynamic becomes Fixed

Management Algorithm
Common MSK deformities

- Foot instability
- Equinus
- Equinovarus
- Knee FD
- Lever arm deformity – FNA, ETT
- Hip displacement - NSA
- Scoliosis

Management by GMFCS Level

GMFCS I
AV

- Age 7y 3m
- GMFCS I
- FMS 6,6,5
- Hemiplegia
  - WGH Type IV

GMFCS I

Function: FMS 6,6,6 or 6,6,5; FAQ 9 to 10
Sagittal gait pattern: Unilateral type I or II; Bilateral true equinus, mild jump
Lower Limb: Distal proximal involvement, impaired SMC, gastrosoleus contracture, equinus or equinovarus
Hips: Mean FMA: 30°
  - Mean NSA: 136°
Risk of hip displacement: rare
Scoliosis: Risk of severe scoliosis: <20% (adolescent idiopathic)

AV

- Age 7y 3m
- GMFCS I
- FMS 6,6,5
- Right Hemiplegia
  - WGH Type IV
- AFO intolerant
- Trips, difficult walk long distances & run
- Mild R hip displacement
### AV

- **Gait:**
  - R severe equinus with rollover varus
  - R DF 15PF/25PF/15PF
  - L DF 35DF/15DF/0
  - R knee hyperextension
  - Knee Ext: R SE, L SE
  - B pelvic retraction
  - Increased FNA and MP
  - L compensatory vault

- **Activities:**
  - FMS 6,6,5
  - Walking long distance
  - Running

- **Participation:**
  - School sports
  - Bush walking

- **Environmental factors:**
  - Supportive family

- **Personal factors:**
  - Self-conscious about wearing AFOs

### AV: ICF

- **Health Condition:**
  - Cerebral Palsy
  - Right Hemiplegia

- **Body Structure/Function:**
  - Gait Dysfunction
  - Calf Contracture

- **Activities:**
  - FMS 6,6,5
  - Walking long distance
  - Running

- **Participation:**
  - School sports
  - Bush walking

- **Environmental factors:**
  - Supportive family

- **Personal factors:**
  - Self-conscious about wearing AFOs

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**Surgery for equinus**

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4</th>
</tr>
</thead>
</table>

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WHO, 2001
AV: Management

- Surgery for gait correction and hip displacement
- Severe R calf contracture
  - Early surgery:
    - R TAL
    - R VDRO
  - Need to correct bony alignment and foot posture simultaneously
- R solid AFO
- Regular follow up

AV: 12 month follow-up

- Age 8y 2m
- GMFCS I
- FMS 6,5,5
- Right Hemiplegia
- R hinged AFO
- 3DGA assessment

AV: 12 month follow-up

- Gait: R equinus improved
  - DF R 5DF/5PF/10PF
  - L 3DF/5DF/0
- R foot drop now apparent
- R knee flexion
- Knee Ext: R 5F, L 5E
- R pelvic retraction improved
- L compensatory vault reduced
- Hip improved
- Will these improvements be maintained with growth?
AV: 8 years post-surgery

- Age 15y 2m
- GMFCS I
- FMS 6,5,5
- Right Hemiplegia
  - WGH Type IV
- Wants to walk properly and minimise limping
- Not using AFO
- 3DGA
- Recurrent equinus

AV: 8 years post-surgery

- Gait: R equinus
- R 16PF/16PF/18PF
- L 26DF/6DF/0
- Grown 37.5cm
- Height 161cm, weight 48kg
- R knee stiff in gait
- R rectus spasticity
- R pelvic retraction

MP: R 15%, L 15%

AV: ICF Follow-up

Health Condition
Cerebral Palsy
Right Hemiplegia

Body Structure/Function:
Gait dysfunction
Recurrent calf contracture

Activities:
FMS 6,5,5
Walking long distance

Participation:
Walking at shopping centre

Environmental factors:
Supportive family

Personal factors:
Self-conscious about gait appearance
Wants to walk with minimal limp
Doesn’t want to wear AFO
Wants to wear shoes of choice
AV: Management

Recurrent R calf contracture
- Repeat R TAL
- R PLS, AFO
- Regular follow up
- Monitor R hip

AV: 2 years post re-do TAL

- Age 17y
- GMFCS I
- FMS 6.5.5
- Right Hemiplegia
  - WGH Type IV
- Part time use of PLF AFO
- 3DGA gait assessment

AV: 2 years post re-do TAL

- Gait: WGH IV pattern
- R equinus improved
- R 4DF/0/SPF
- L 24DF/12DF/0
- Knee hyperextension
- Gait better in AFO
- Height 161cm, weight 56kg
- Hips:
  - MP: R 15%, L 15%
  - Both hips MCPHCS 2 – ‘Near normal’
AV: Long-term follow-up

- Age 19y
- GMFCS I
- FMS 6,5,5
- Right Hemiplegia
  - WGHType IV
- Pain L bunion & arch of L foot
  R knee locks back, does not bend well
- Part time use of PLF AFO
- 3DGA gait assessment

AV: Long-term follow-up

- Gait pattern stable
- Toe heel on R
- Foot drop, poor SMC
- Height stable, weight 60kg
- Calf length maintained
- R 18DF/5DF/12PF
- L 30DF/10DF/0
- MCPHCS 2 both hips
  - Will hips become a problem?

AV: ICF Follow-up

Health Condition
Cerebral Palsy
Right Hemiplegia

Body Structure/Function:
- Mild Gait Dysfunction
  - Calf Contracture

Activities:
- FMS 6,5,5
  - Walking long distance

Participation:
- Walking at shopping centre

Environmental factors:
- Supportive family

Personal factors:
- Self-conscious about gait appearance
  - Walking with visible limp
  - Part-time AFO use
  - Wearing shoes of choice
**GMFCS I - Summary**

- **Function:** FMS 6,6,6 or 6,6,5; FAQ 9 to 10
- **Sagittal gait pattern:**
  - Unilateral type I or II
  - Bilateral true equinus, mild jump
- **Lower Limb:**
  - Distal-proximal involvement, impaired SMC, gastrocsoleus contracture, equinus or equinovarus
  - Mean FMA: 50°
  - Mean NSA: 136°
  - Risk of hip displacement: rare
- **Scoliosis:** Risk of severe scoliosis: <20% (adolescent idiopathic)
- **Young children:**
  - Physiotherapy PLS or hinged AFO
  - Tone management BoNT-A too mild for SDR or ITB
- **Older children:**
  - Unilateral: gastrocsoleus lengthening
  - Bilateral: rarely single level surgery, gastrocnemius only
- **Adolescents:**
  - Maintain PRST, gym programs, sports may be difficult at a high level

**GMFCS II**

- **NC**
  - GMFCS II
  - FMS 5,5,5
  - Spastic equinovarus
  - Right Hemiplegia
    - WGH Type IV
  - Foot and ankle pain
  - Can't walk far
  - Dislikes UL posturing

---

AusACPDM Biennial conference, Adelaide
March 2016
GMFCS II

- Function: FMS 6.5-5.5, FAO 8-9
- Sagittal gait pattern: Unilateral type I to IV
- Bilateral mild jump, apparent equinus, crouch

Lower Limb:
- Unilateral:
  - Hip: flexed, adducted & internally rotated, LLD
  - Knee: stiff flexed
  - Foot and ankle: equinus or equinovalgus, ETT
- Bilateral:
  - Hip: flexed, psoas contracture, adducted & internally rotated
  - Knee: flexed, hamstring contracture
  - Foot and ankle: pes valgus, ETT, gastrocnemius contracture, hallux valgus

Hips:
- Mean FNA: 36°
- Mean NSA: 141°
- Risk of hip displacement: 15%

Scoliosis:
- Risk of severe scoliosis: <20%, do not progress

Varus Foot: Severity and Flexibility?

NC: Severity and flexibility?

- Gait:
  - R severe equinovarus
- DF: R 25PF/25PF/35PF
- L 10DF/5DF/10PF
- R knee hyperextension, reduced loading
- Knee Ext: R 0, L 0
- R pelvic retraction
- Arm position
Muskuloskeletal Health in Cerebral Palsy - Workshop

NC: ICF

Health Condition
Cerebral Palsy
Right Hemiplegia

Body Structure/Function:
- Gait dysfunction
- Equinovarus foot deformity
- Foot/ankle pain
- UL posturing

Activities:
- FMS 5, 5, 5
- Can't walk far

Participation:
- School activities/excursions
- Keeping up with friends

Environmental factors:
- Parents anxious about intervention

Personal factors:
- Dislikes appearance of upper limb

Surgery for Equinovarus

Tibialis Posterior Surgery for Pes Varus

A: Intramuscular tenotomy
B: 'Z' lengthening
C: Transposition anterior to medial malleoli
D: Split posterior tibial tendon transfer (PPTT)
E: Anterior interneurax transfer

AusACPDM Biennial conference, Adelaide
March 2016
Triple tendon surgery
1. Tib post recession, 2. SPLATT, 3. TAL

NC: Management

Triple Tendon
- Tib Post Recession
- SPLATT
- TAL
NC: Management

NC: Follow-up

- Age 14y
- GMFCS II
- FMS 6,6,5
- Right Hemiplegia
  - WGH Type II

Health Condition
- Cerebral Palsy
- Right Hemiplegia

Activities:
- FMS 6,6,5
- Can walk upstairs and run to catch a tram

Participation:
- School activities/excursions
- Keeping up with friends

Environmental factors:
- Parents anxious about intervention

Personal factors:
- Doesn't like appearance of upper limb
DK

- Age 7y 2m
- GMFCS II
- FMS 6,5,5
- Spastic Diplegia
  - R Jump
  - L True equinus
- Calf length
  - R 5PF/10PF/38PF
  - L 10DF/0/18PF

Barefoot Now
Pelvic Tilt
 60
 0
Ant
Pst
deg
Hip Flexion
70
-20
Flex
Ext
deg
Knee Flexion
75
-15
Flx
Ext
deg
Dorsiflexion
30
-30
Dor
Pla
deg
Pelvic Obliquity
30
-30
Up
Dwn
deg
Hip Adduction
30
-30
Add
Abd
deg
Knee Adduction
30
-30
Var
Val
deg
Ankle Rotation
30
-30
Int
Ext
deg
Pelvic Rotation
30
-30
For
Bak
deg
Hip Rotation
30
-30
Int
Ext
deg
Knee Rotation
30
-30
Int
Ext
deg
Foot Progression
30
-30
Int
Ext
deg

DK: ICF

Health Condition
  Cerebral Palsy
  Spastic Diplegia

Body Structure/Function:
  Gait: R jump, L true equinus
  Calf contracture L>R
  Hamstrings:
    Decreased balance

Activities:
  FMS 6,5,5
  Difficulty running and playing cricket; slow

Participation:
  School activities/excursions
  Playing cricket
  Walking confidently in crowds

Environmental factors:
  Family summer holiday:
    AFO discomfort in heat

Personal factors:
  Enjoys sport; can’t run in AFOs;
    does not want to wear them

Goals of surgery in diplegia

- Equinus
  - Just enough dorsiflexion to ensure full knee extension at skeletal maturity
  - Deliberate, slight under-correction
  - Intra-op: passive DF to neutral
  - Kinematics: DF <10 late stance
  - Preserve coupling
- Knee
  - Choose the correct dose, in the context of SEMLS
Surgical dose for the knee

DK: Management

6/03/2006
- Bilateral BTX-A Hs
- Bilateral semimembranosus lengthening
- R semitendinosus transfer
- L Strayer, R Hoke

DK: 12 months post-surgery

- Age 8y 9m
- GMFCS II
- FMS 5.5.5
- Spastic
- Diplegia
  - R crouch
  - L mild
- FDD knees 5F
- Call length:
  - R 20DF/10DF/8PF
  - L 16DF/14DF/18PF
- B hinged AFOs
**DK: 2 years post-surgery**

- Age 10y
- GMFCS II
- FMS 6,6,5
- Spastic
- Diplegia
  - Mid
- Calf length
  - R 13DF/0/10PF
  - L 18DF/10DF/4PF
- No AFOs

**DK: 5 years post-surgery**

- Age 12y 10m
- GMFCS II
- FMS 666
- Spastic
- Diplegia
  - Mid
- Calf length
  - R 6DF/3PF/10PF
  - L 24DF/10DF/10PF
- No AFOs

**DK: ICF Follow-up**

**Health Condition**
- Cerebral Palsy
- Spastic Diplegia

**Body Structure/Function:**
- Gait: mildly reduced hip and knee extension
- Hip weakness
- Decreased balance

**Activities:**
- FMS 6,6,5
- No difficulty playing cricket & soccer

**Participation:**
- School activities/excursions:
  - Playing cricket
- Walking confidently in crowds

**Environmental factors:**
- Spending lots of time at beach without AFOs

**Personal factors:**
- Enjoying sport,
  - Happy not to be wearing AFOs
GS
- Age 15y 6m
- GMFCS II
- FMS 5,5,5
- Spastic diplegia
  - Crouch
  - B knee pain
  - FFD knees
- Quads lag 30°
- Rectus spasticity
- No orthoses

GS: Surgical history
04/01/2010
- 10 years
- Bilateral os calcis lengthening
- Bilateral Strayer & SFL
GS: ICF

Health Condition
Cerebral Palsy
Spastic Diplegia

Body Structure/Function:
Severe crouch gait
Hip and knee flexion
Quad spasticity
Patellar spasticity
Pain
Mild ID

Activities:
FMS 5.0.5
Trying to play soccer
Frequent falls

Participation:
School activities/excursions
Keeping up in soccer

Environmental factors:
Stair access at school

Personal factors:
English is second language

Surgery for crouch gait

GS: Management

30/11/2015
- 16 years
- Bilateral PTS
- Bilateral MHS and ST to Add Tub
- BoNT-A hamstrings
GS: Follow-up

- Age 16y 7m
- GMFCS II
- FMS 3,1,1
- Spastic diplegia
  - Crouch improved
- No knee pain
- Full knee E
- Quads lag 8°
- Solid AFOs
- Crutches currently
- Rehabilitation

GS: ICF follow-up

Health Condition
Cerebral Palsy
Spastic Diplegia

Body Structure/Function:
Severe crouch gait.
Hip flexion/rotation.
Quads lag, rectus spasticity.
Sids M1.

Activities:
FMS 3,1,1
Participating in intensive rehabilitation

Participation:
School activities/excursions.
Keeping up in soccer

Environmental factors:
Stair access at school

Personal factors:
English is second language

GMFCS II: Summary

Function:
FMS 6,5,5 to 5,5,1; FAQ 8 to 9

Sagittal gait pattern:
Unilateral type I to IV.
Bilateral mild jump, apparent equinus, crouch

Lower Limb:
Unilateral:
- Hip: flexed, adducted & internally rotated, LLD
- Knee: stiff flexed
- Foot and ankle: equinus or equinovalgus, ETT

Bilateral:
- Hip: flexed, psoas contracture, adducted & internally rotated
- Knee: flexed, hamstring contracture
- Foot and ankle: pes valgus, ETT, gastrosoleus contracture, hallux valgus

Hips:
- Mean FNA: 36°
- Mean NSA: 141°
- Risk of hip displacement: 15%
- Risk of severe scoliosis <20% do not progress
GMFCS II: Summary

Management:
Young children: Physiotherapy, hinged or solid AFO
Tone management, BoNT-A multilevel, severe spasticity SDR
Older children: Unilateral or Bilateral SEMLS (6 to 12 years) + rehabilitation
Adolescents: Maintain function and mobility.
Strengthening: PRBT at home or school, gym programs
Modified sports
Minor surgery for recurrent deformities or gait deviations

GMFCS III

DB
- Age 9y 6m
- GMFCS III
- FMS 4.2.1
- Spastic diplegia
- Posterior walker
- 4 point sticks
- B solid AFOs
GMFCS III

Function: FMS 5.4.4 to 2.2.1; FAQ 6 to 8

Sagittal gait pattern: Unilateral n/a
Bilateral: Jump, apparent equinus, crouch

Lower Limb: Deformities more severe than GMFCS II weakness predominates
Bilateral: Hip: flexed, psoas contracture, adducted & internally rotated, more severe than GMFCS II, weakness
Knee: flexed, hamstring contracture, weakness
Foot and ankle: marked pes valgus, ETT, foot instability, hallux valgus

Hips: Mean FNA: 40°
Mean NSA: 149°
Risk of hip displacement: 41%

Scoliosis: Risk of severe scoliosis: 20% do not progress

DB

- Age 9y 6m
- GMFCS III
- Spastic diplegia
- R 18DF/0/10PF
- L 20DF/5DF/15PF
- Planovalgus feet
- Lower limb weakness
- FFD
  - Hips 15F
  - Knees R 18F, L 10F

- Gait: severe jump
- Increased FNA R>L
  - R 28, L 20
- External foot progression due to planovalgus

AusACPDM Biennial conference, Adelaide
March 2016
DB:
- Gait: severe jump
- Increased FNA R>L
  - R 28, L 20
- External foot progression due to planovalgus

DB: Pre-op Radiology

DB: ICF
- Health Condition: Cerebral Palsy, Spastic Diplegia
- Body Structure/Function: Severe jump gait, Weakness
- Activities: FMS 4,2,1, Walking at school – moving from class to class
- Participation: School excursions, Keeping up in soccer
- Environmental factors: School situated on a hill
- Personal factors: Anxious about surgery
DB: Management

- Age 9y, 9m
- Surgery for gait correction, hip displacement
- **SEMLS:**
  - Bilateral VDRO’s, perc add releases
  - Bilateral Hamstrings lengthening
  - Bilateral Vulpius
  - Subtalar fusions
  - BoNT-A hamstrings
- Bilateral solid AFO
- Regular follow up

DB: 12 month follow-up

- Age 10y 9m
- GMFCS III
- FMS 4,2,1
- Diplegia
- Bilateral solid AFO
- 3DGA assessment

DB: 12 month follow-up

- Gait - Equinus improved
- DF: R 14DF/5DF/7PF
  - L 20DF/10DF/4DF
- Hip and knee flexion improved
- Hip Ext: R 5E, L 8E
- Knee Ext: 5E bilaterally
- Hip rotation improved
**DB: 5 years post-surgery**
- Age 14y 9m
- GMFCS III
- FMS 5,3,1
- Diplegia
- Uses walker for sports, wheelchair for long distances such as excursions
- Solid AFOs

**DB: 5 years post-surgery**
- Gait
  - Mild FFD hips and knees
  - R 18DF/4PF/16PF
  - L 12DF/6PF/16PF
  - L knee stiff in gait

**DB: 10 years post-surgery**
- Age 20y
- GMFCS III
- FMS 5,3,3
- Crutches only
- Diplegia
- Walks everywhere
- Solid AFOs not using now
- 3DGA
**DB: 10 years post-surgery**

- **Gait**
  - Generally stiffer
  - Gait consistent
  - Hip E good.
  - Knee E mbd FFD: L knee
    - R 8DF/8PF/16PF
    - L 10DF/8PF/12PF
  - Height 162cm, weight 53kg
  - L knee stiff in gait
  - Posterior pelvic tilt
  - Stiff foot L>R

**DB: Post-op Radiology**

**DB: 10 years post-surgery**

- **Hips**
  - MP: R 12% L 8%
  - MCPHCS:
    - R: MCPHCS 2
    - L: MCPHCS 1
  - Will hips be a problem?
DB: ICF follow-up

Health Condition
- Cerebral Palsy
  - Spastic Diplegia

Body Structure/Function:
- Severe jump gait
- Weakness
- Occasional knee and foot pain

Activities:
- FMS 5,3,3

Participation:
- Attending TAFE
- Keeping up in soccer

Environmental factors:
- TAFE accessible

Personal factors:
- Sometimes feels lonely

DB: Long-term follow-up

Age 10 years 12 years 18 years

DB: Long-term follow-up

Age 10 years 12 years 18 years
Correcting foot deformity

- STF vs OCL

Correction of pes valgus with OCL

OCL = Os Calcis Lengthening

OCL: Technique
Sagittal gait patterns: Hemiplegia

Sagittal gait patterns: Diplegia

GMFCS III: Summary

Function: FMS 4.4 to 2, 1; FAQ 6 to 8
Sagittal gait pattern: Bilateral
Bilateral jump, apparent equinus, crouch
Lower Limb: Deformities more severe than GMFCS II
Bilateral
Hip: flexed, psoas contracture, adducted & internally rotated, more severe than GMFCS II, weakness
Knee: flexed, hamstring contracture, weakness
Foot and ankle: marked pes valgus, ETT, foot instability, hallux valgus
Hips: Mean FNA: 40°
Mean NSA: 149°
Risk of hip displacement: 41%
Scoliosis: Risk of severe scoliosis: 20% do not progress
GMFCS III: Summary

Management:
Young children: Physiotherapy, hinged or solid AFO, assistive devices
Tone management: BoNT-A used judiciously
Early and regular hip surveillance, ‘preventive’ surgery for hip displacement
Older children: Bilateral SEMLS (6 to 12 years) + rehabilitation
Adolescents: Maintain function and mobility
Ongoing management of weakness: PRST - gym programs
Aerobic exercise for fitness and weight control
Minor surgery for recurrent deformities or gait deviations

GMFCS IV

CW
- Age 13 years
- GMFCS IV
- FMS 1,1,1
- MACS III, CFCS II
- Managing standing transfers
- Uses walker for transferring
- AFO’s very uncomfortable
- Increasing dystonic posturing
Muskuloskeletal Health in Cerebral Palsy

Function: FMS 2,1,1 to 1,1,1; FAQ 1 to 5

Lower Limb: Hip and knee: Flexion deformities common

Foot and ankle: ETT and pes valgus, hallux valgus + bunions

Hips:
- Mean FNA: 40°
- Mean NSA: 155°
- Risk of hip displacement: 69%

Scoliosis: Risk of severe scoliosis: 25%

CW

- Age 13 years
- GMFCS IV
- FMS 1,1,1
- MACS III, CFCS II
- Managing standing transfer
- Uses walker for transferring
- Developing foot deformity
- AFO’s very uncomfortable
- Increasing dystonic posturing
- Baclofen trial
  - Fear of hospital & needle phobia

CW: Follow-up

- Age 17 years
- GMFCS IV
- FMS 1,1,1
- MACS III, CFCS II
- High school student
- PAINFUL feet
- Can’t wear shoes
- Losing standing transfers
Muskuloskeletal Health in Cerebral Palsy - Workshop

Health Condition
Cerebral Palsy

Body Structure/Function:
- Dystonia
- Planovalgus foot deformity
- Hallux valgus, PAIN

Activities:
- FM5 1.1
- Standing transfers
- Stepping transfers

Participation:
- Adapted school sports
- Cinema with friends

Environmental factors:
- Toilet access at school & local shopping centre/cinema – no hoist
- Mother anxious about ANY interventions

Personal factors:
- Fear of interventions
- Does not want AFOs

WHO, 2001

CW: GMFCS IV

- His/Family concerns:
  1. Foot pain
  2. Loss of standing transfers
  3. Inability to wear shoes

- What else could be an issue for this young man?

CW: Hips

AusACPDM Biennial conference, Adelaide
March 2016
CW: Hip Management

CW: Spine

CW: Hips OK, Spine OK, Feet?
CW: Intervention

Planovalgus deformity:
- Transfer PL to brevis
- Talonavicular fusion

Hallux valgus:
- 1st MTP fusion

Post-op Mx:
- Total 8 weeks in BK plaster (COP and cast AFO at 3/52)
- AFOs for ALL standing

CW: 6 months post-surgery

- Stable fusions
- Pain-free
- Standing transfers
- Still not keen on AFOs
- Plan to wean AFOs during standing transfers
- Transitioned to adult services

CW

Health Condition
Cerebral Palsy

Body Structure/Function:
- Dystonia
- Planovalgus foot deformity
- Hallux valgus, PAIN

Activities:
- FMS 1,1,1
- Standing transfers
- Stepping transfers

Participation:
- Adapted school sports
- Cinema with friends

Environmental factors:
- Toilet access at local shopping centre/cinema – able to complete stand 1/1
- Mother anxious about ANY interventions

Personal factors:
- Fear of interventions
- Does not want AFOs

WHO, 2001
GMFCS IV - Summary

Function:
- FMS 2,1,1 to 1,1,1; FAQ 1 to 5

Lower Limb:
- Hip and knee: Flexion deformities common
- Foot and ankle: ETT and pes valgus, hallux valgus + bunions

Hips:
- Mean FNA: 40°
- Mean NSA: 155°
- Risk of hip displacement: 69%

Scoliosis:
- Risk of severe scoliosis: 25%

Young children:
- Tone management
- Hip soft tissue releases

Older children:
- Reconstructive hip surgery
- Spine surgery

Adolescents:
- Limited foot/ankle surgery

GMFCS V

- 11 years;
- GMFCS V, MACS IV, CFCS III
- Family recently relocated to Victoria
- No prior hip surveillance
- PAIN
**GMFCS V**

- **Function:** FMS 1,1,1; FAQ 1 or 2
- **Lower Limb:** Hip, knee and ankle: Flexion deformities common
- **Hips:**
  - Mean FNA: 40°
  - Mean NSA: 163°
  - Risk of hip displacement: 90%
- **Scoliosis:** Risk of severe scoliosis: 50%

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**Timing of Hip Surgery**

- Management BEFORE dislocation and joint degeneration
- Dislocated hips lose articular cartilage which cannot be replaced
- Loss of cartilage = premature degenerative arthritis
- Degenerative arthritis = PAIN

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**CN: Timing of Hip Surgery**

- 11 years
- GMFCS V; FMS 1,1,1
- MACS IV, CFCS III
- Family recently relocated to Victoria
- No prior hip surveillance
- PAIN
- Undernourished, PEG not used – 14kg
**CN: Health Condition**

**Cerebral Palsy**

- **Body Structure/Function:**
  - Hip dislocation
  - Severe acetabular dysplasia
  - Early degenerative arthritis

- **Activities:**
  - FMS 1, 1, 1
  - Sitting
  - Car travel
  - Standing frame

- **Participation:**
  - Attending school
  - Seated activities with siblings

- **Environmental factors:**
  - Access to only a simple stroller
  - No specialised equipment
  - Single parent – difficulty coping with full-time care role

- **Personal factors:**
  - Engaging personality

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**WHO, 2001**

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**CN: Management**

- **July 2013**
  - PEG feeding instigated
  - Bilateral VDROs
  - Bilateral Pelvic Osteotomy

  - 2 months later
    - Corticosteroid injections + BNT-A

  - 3 months later
    - Repeat corticosteroid injections + BNT-A

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**CN: Follow-up**

- **Now 15 years**
- **3 years post surgery**
- **Residing in supported accommodation**
- **Now 24kg**
- **General health markedly improved**
- **Carers concerned re ongoing PAIN**
Muskuloskeletal Health in Cerebral Palsy - Workshop

Muskuloskeletal Health in Cerebral Palsy

Health Condition
Cerebral Palsy

Activities:
- FMS 1,1,1
- Sitting
- Car travel
- Standing frame

Participation:
- Attending school
- Seated activities with siblings

Environmental factors:
- Supported accommodation
- Customised wheelchair
- Standing frame, Bathing equipment

Personal factors:
- Engaging personality

Body Structure/Function:
- Hip dislocation
- Genue valgum
- Severe scoliosis
- Early degenerative arthritis
- Pain

JZ

- Age 7y 3m
- GMFCS V; FMS 1,1,1
- MACS V; OFCS IV
- Cognition (receptive vs expressive)
- PEG
- Restrictive lung disease
- Overnight BiPAP
- Frequent ICU admissions

WHO, 2001

JZ

Health Condition
Cerebral Palsy

Activities:
- FMS 1,1,1
- Bathing, dressing
- Standing transfers
- Siting

Participation:
- Attending school
- Activities outside the home with family

Environmental factors:
- Supportive parents and school community
- Co-sleeping with Mother

Personal factors:
- Engaging, cheeky personality
- "Happy boy"

WHO, 2001

AusACPDM Biennial conference, Adelaide
March 2016
JZ: Hip Surveillance Review

- Age 7y 3m
- GMFCS V; MACS V; CFCS IV
- PEG
- Restrictive lung disease
- Overnight BiPAP
- MP: 65%, 21%
- Referred to Orthopaedics
- Severe scoliosis

JZ: Scoliosis

Early presentation, early progression

JZ: What should we do?

Hips? Spine? Nothing?
GMFCS V - Summary

Function: FMS 1.1.1, FAQ 1 or 2

Lower Limb: Hip, knee and ankle: Flexion deformities common
- Mean FNA: 40°
- Hip: Mean NSA: 163°
- Risk of hip displacement: 90%
- Scoliosis: Risk of severe scoliosis: 50%

Young children: Tone management (oral meds, ITB)

Older children: Continued tone management
- Hip soft tissue releases (very limited effect)
- Reconstructive hip surgery
- Spine surgery

Adolescents: Continued hip and spine monitoring into adulthood

The Role of Orthopaedic Surgery in the Management of the Child with CP

Musculoskeletal pathology in CP is progressive

Operating on the extremities has a limited impact on function

The goals of orthopaedic management are:
- to correct fixed deformities and contracture
- to maintain musculoskeletal integrity
- to prevent painful fixed deformities and premature arthritis
- to keep children on an optimum gross motor curve