Hip Health for Life: Effective Management of Hip Displacement in Cerebral Palsy
Pam Thomason, Kate Willoughby, Giuliana Antolovich, Abhay Khot, H Kerr Graham

The Royal Children's Hospital
Melbourne, Australia

What is hip displacement?

Progressive Musculoskeletal pathology
**Progressive musculoskeletal pathology**

![Image of musculoskeletal system]

**Hip Displacement & GMFCS**

- Soo et al, 2006

![Graph showing incidence of GMFCS levels]

**Femoral Geometry**

- Proximal femoral geometry in cerebral palsy
- J. Robin et al, 2008
- 292 children
- Relationship between GMFCS, FNA, NSA, MP
Hip Health in CP

A healthy hip:
- Has satisfactory morphology,
- Is mobile,
- Does not limit function,
- Is PAIN FREE
Classification of Hip Morphology

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
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/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
The effects of displacement/dislocation

- Joint deformity
- Contracture
- Skin breakdown
  - PAIN
- Loss of function
- Difficulty with perineal care
- Increased care burden
  - Decreased quality of life

A dysplastic, dislocated hip is a disaster…
...but the options for managing it are not much better!

Salvage Surgery

- Poor evidence base
  - Retrospective, subjective
- Anecdotally:
  - Pain relief often delayed, or incomplete
  - High morbidity: HO, proximal migration
  - High revision rate
Salvage Surgery: Evidence

Palliative hip surgery in severe cerebral palsy: a systematic review
Erik J. Blomberg*, Corina B. Brouwer*, Hélène C.M. van der Heijden-Mastenbroek*, Cees F. Buij* and Guusstraal J. Lutkenhaus*
Journal of Pediatric Orthopaedics B 23 (2014) 101

- Literature review, 2014
- Small number of papers, wide variety of surgical approaches
- HIGH complication rates:
  - THR: 29% dislocation rate, 45% heterotopic ossification
  - Arthrodesis: total complication rate 42%, non-union common
- Delayed and incomplete pain reduction – also poorly measured
- Authors stress CAUTION about any conclusions drawn

Timing For The Hip

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

Detecting and Monitoring

- Relationship with GMFCS provided the basis for development of surveillance guidelines
Putting it into context

- Kate Willoughby

ITR

- Age 23 months
- GMFCS III / IV?
- MACS III, CFCS I
- Routine hip surveillance
- Early displacement
- Early progression

ITS: Hip Surveillance

- Age 23 months
- GMFCS III / IV?
- MACS III, CFCS I
- Routine hip surveillance
- Early displacement
- Early progression
- MP: 36%, 37%
- Non-surgical options?
**Management Options: Non-operative**

OR

BoNT-A +/- Bracing
Stretching and Postural systems/programs
Complementary and Alternative approaches

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**BoNT-A and Bracing: Not effective**

- **SHORT-TERM**

  - 6/12 BoNT-A injections + SWASH (3 yrs)
  - Rate of displacement per year lower in BoNT-A group: 2.6 vs 5.7%
  - Not clinically significant
  - Fewer children in the treatment group exited to surgery: 11 vs 22
  - Clinical significance unclear due to short-term follow-up

- **LONG-TERM**

  - 10 year follow-up of VIC cohort from RCT
  - MP, MCPHCS, surgical requirements?
  - No difference between groups at 10 years
Postural Programs: Limited effect

Limitations:
- Small, heterogeneous, poorly defined samples (GMFCS)
- Retrospective data collection/recording
- Limited tolerance of positions/equipment (sleep)
- Lack of controlled studies
- Long term follow-up required

CAM Approaches: Not effective

- Long-term follow-up: hip surgery declined to pursue CAM
- Progressive displacement inevitable at GMFCS IV & V
- Pain and eventual surgery despite CAM
- DOUBLE the odds of requiring more invasive surgery
- TWELVE times the odds of a poor outcome after surgery (MCPHCS)

Management Options: Non-operative

- Little evidence of effectiveness in either slowing or preventing displacement
- May be other indications/goals:
  - BoNT-A to adductors to reduce scissoring in gait, improve hygiene/personal care
  - Standing frames for communication and social engagement
- Important that parents know that these options will neither help displacement nor make it worse
- Focus on function:
Non-operative Mx: ITS Follow-up

- Age 2y 6m
- GMFCS IV
- MACS III, CFCS I
- FMS 1,1,1
- Botox - care & function goals

ITS: Follow-up

- Age 2y 6m
- GMFCS IV
- MACS III, CFCS I
- FMS 1,1,1
- Botox - care & function goals
- No impact on hips
- Displacement progressing
- MP: 46%, 45%
- Surgical options?

Management Options: Surgical

- Abhay Khot
**Principles of surgery**

Lengthening of contracted muscles
- Adductors
- Hip flexors - iliofemoral

Correction of bone deformity
- The proximal femur
- The acetabulum

Restoration of normal joint alignment
- Acetabular index
- Migration percentage

**Aims of Surgery**

- Restore joint morphology
- Maintain adequate range of motion
- Allow joint to grow to its potential
- Prevent degenerative changes

**Joint Morphology**

- Congruence
- Containment
- Coverage
**Joint Congruence:** matching surfaces

- Movement of joint
- Pressure distribution

**Joint Containment:** femoral head migration

- Lateral subluxation
- Loss of containment

**Joint coverage:** acetabulum

- Normal coverage
- Progressive dysplasia
**Joint Morphology**

CR = Centre of Rotation  
CS = Centre of Sphere (femoral head)  
WBS = Weight bearing surface

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**Joint Morphology: changes over time**

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**Management Options: Surgical**

Salvage Surgery
- Not an option - the horse has bolted….

“Preventive” Surgery
- Can we stop this process of worsening subluxation?

Reconstructive Surgery
- Putting all the bits back in the right place….
Soft Tissue Procedures

Contracted muscles decrease joint range

Lengthening them allows more ROM

More ROM may allow better function

Abduction in broomstick casts
**Soft tissue surgery: Case examples**

- Kate Willoughby

**JMD**

- Age 2y 8m
- MP: 32%, 44%
- Adductor spasticity++

**STR surgery:**
- Add Longus & Gracilis
- Phenol to Obt Nerve

**PLAN:** Continue surveillance

**JMD: Follow-up**

- Age 12y 4m
- GMFCS II
- FMS 5, 5, 5

- Hip surveillance continued
- 9y 8m after STR
- MP: 24%, 24%
**JMD: Follow-up**

- **Characteristics:**
  - Age 2y 6m
  - GMFCS IV
  - MACS III, CFCS I
  - FMS 1,1,1

- **Treatment:**
  - Botox – no impact on hips
  - Displacement progressing

- **PLAN:**
  - Continue surveillance

---

**ITS: Follow-up**

- **Characteristics:**
  - Age 4y 3m
  - GMFCS IV; FMS 1,1,1

- **Treatment:**
  - 1y 8m after STR
  - Displacement stabilised
  - MP: 49%, 40%

- **PLAN:**
  - Continue surveillance
ITS: Follow-up

- Age 4y 10m
- GMFCS IV
- MACS III, CFCS I
- 2y 3m after STR
- Small functional change….
- but not definitive Rx for hips
- Progressive displacement
- MP: 70%, 36%

Adductor Surgery: Who benefits?

Adductor Surgery: Evidence

Adductor Surgery to Prevent Hip Displacement in Children with Cerebral Palsy: The Predictive Role of the Gross Motor Function Classification System

GMFCS – The strongest predictor for surgical success of adductor surgery in children with CP
**Adductor surgery success vs GMFCS**

<table>
<thead>
<tr>
<th>Time after surgery (months)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
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<tbody>
<tr>
<td>Adductor Surgery success</td>
<td>25%</td>
<td>20%</td>
<td>15%</td>
<td>10%</td>
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**Adductor Surgery: Who benefits?**

**Case JMD – GMFCS II**
- Age 4y 10m
- GMFCS IV
- MACS III, CFCS I
- 2y 3m after STR
- Progressive displacement
- MP: 70%, 36%

**Case ITS – GMFCS IV**
- WHAT NEXT??

**Soft tissue surgery: GMFCS IV**
- Age 4y 10m
- GMFCS IV
- MACS III, CFCS I
- 2y 3m after STR
- Progressive displacement
- MP: 70%, 36%

**WHAT NEXT??**
Reconstructive Surgery

- Abhay Khot

Reconstructive Surgery: Principles

- Restore anatomy
- Reverse dysplastic changes
- Maintain or increase range of motion in functional arc

Reconstructive Surgery

- Femoral osteotomy
  - +/- Open adductor lengthening
- +/- Pelvic osteotomy
Restoring femoral anatomy: FNA

Restoring femoral anatomy: NSA

Varus De Rotation Osteotomy: VDRO
Peri-operative Medical Management

- Dr Giuliana Antolovich
  Consultant Paediatrician

Pre-operative "work-up"

Pre-operative "tune-up"

Role of oral medication

Peri-operative management algorithm

Physical Disability

CEREBRALPALSY
- Ex-premature
- Hyoxia at birth
- Other

ACQUIRED BRAIN INJURY
- Hypoxic Encephalopathy
- Infection
- Traumatic
- Post-tumour

NEURO-PROGRESSIVE CONDITIONS
- Pantothenate kinase-associated neuredegeneration
- Wilson’s Disease
- Aicardi-Goutieres
- Other leukodystrophy
- Pontocerebellar hypoplasia

SPINAL CORD LESIONS
- Familial/hereditary
- Spastic paraparesis
- Spinal cord injury

www.thebransonproject.com
www.greenvilleshrinershospital.org

www.dailymail.co.uk
PRE OPERATIVE MANAGEMENT

PRE-OPERATIVE ASSESSMENT
- Part of routine care
- Alert to physician of upcoming surgery
- Plan available

DRUGS
- Part of routine care
- Additional Rx pre-op
- Plan available

PRE OPERATIVE MANAGEMENT

NUTRITION
- Pre-Op TUNE UP
- Pre-Op PLAN
  - (Two weeks prior)

BLOOD WORK
- FBE
- Ferritin
- B12
- Folate

RENAL FUNCTION
- Electrolytes
- Magnesium

LIVER FUNCTION
- Albumin/Protein
- Nutritional markers

THYROID FUNCTION
- Vitamin D
- CAB
- CMP
- CO2

ZINC
- Selenium

Wound healing
- Skin integrity

PRE OPERATIVE MANAGEMENT

CONSIDER SUPPLEMENTAL FEEDS

MANAGEMENT OF CONSTIPATION
- Oral aperients
- Lactulose
- Movicol®
- Osmolax®
- PR medications
- Small or large volume enemas
- Microlax®
- Bisacodyl volume enema

MANAGEMENT OF REFUX
- Thickened feeds
- Feed volume
- Ranitidine
- Esomeprazole

www.akronchildrens.org
### PRE OPERATIVE MANAGEMENT

#### RESPIRATORY
- Baseline CO2
- Overnight oximetry
- Formal sleep study
- Antibiotics
- Nebulized saline
- Hypertonic
- Physiotherapy

#### Overnight respiratory support
- CPAP
- BiPAP
- Supplemental oxygen

#### Atopy
- Seasonal rhinitis
- Allergic rhinitis
- Intransal steroids

#### SECRETION MANAGEMENT
- Benzhexol, glycopyrrolate, atropine
- Upper airway management
- Intransal steroids
- Dental health

#### CONSIDER PRE-SURGERY ADMISSION “TUNE-UP”

#### OPTIMIZE NUTRITION
- Supplemental feeds
- Nasogastric/nasojejunal feeds
- Short term

#### OPTIMIZE RESPIRATORY FUNCTION
- Intensive respiratory care
- Physiotherapy
- Antibiotics
- Nebulized saline
- Secretion management

#### SECRETION MANAGEMENT
- Benzhexol, glycopyrrolate, atropine
- Upper airway management
- Intransal steroids
- Dental health

#### DRUGS
- GABA-active medications
  - BACLOFEN
  - DIAZEPAM
- Anti-epileptics
  - GABAPENTIN
  - LEVETIRACETAM
  - TOPIRAMATE
- A2-adrenergic Agonists
  - CLONIDINE
  - TIZANIDINE
- Anti-cholinergic
  - BENZHEXOL
- Intrathecal baclofen

#### Neuroleptics
- TETRABENAZINE
- RESERPINE

#### DOPA-active drugs
- LEVODOPA
- BROMOCRIPTINE
- PERGOLIDE

#### DOPA-antagonists depletors
- CHLORPROMAZINE
**GABAPENTIN**

- **MECHANISM OF ACTION UNCLEAR**
  - ?Exact action in the brain
  - Structurally related to GABA (γ-aminobutyric acid)
  - No evidence of capacity to bind to GABA_{A} or GABA_{B} receptors
  - Not converted into GABA or dGABA
  - Not an inhibitor of GABA uptake or degradation

- **Multiple reported actions**
  - Anti-epileptic
  - Management of neuropathic pain
    - Dystonia
    - Anxiolytic
  - Management of dysautonomia
    - Cerebral irritability
    - Gut pain
    - Food tolerance

---

**GABAPENTIN**

- **Multiple reported actions**
  - NEUROPATHIC PAIN
    - Pain-related responses in neuropathic pain models (including spinal injury)
  - ALLODYNYA
    - Pain-related behavior in response to a normally innocuous stimulus
  - INFLAMMATION
    - Pain-related responses following peripheral inflammation
  - HYPERALGESIA
    - Exaggerated response to painful stimuli

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- Taylor 1997: Proc Nutr Soc 56:105-113
- Hauer et al., 2007: Pediatrics 119:e519
- Baguley et al., 2007: J Neurol Neurosurg Psychiatry 78:539–541
- Bielory et al., 1997: J Allergy Clin Immunol 99:207-216
**Combined benefit on pain, movement & tone**

**Peri-operative management**

**Palliative care**

**Gabapentin**

- Pain
- Nerve based pain
- Dystonia
- Pain related behavior
- Sensitivity to pain
- Inflammation
- Anxiety
- Gut related pain

**Pain**

↓

**Nerve based pain**

↓

**Dystonia**

↓

**Pain related behavior**

↓

**Sensitivity to pain**

↓

**Inflammation**

↓

**Anxiety**

↓

**Gut related pain**

↓

**Combined benefit on pain, movement & tone**

**Peri-operative management**

**Palliative care**

**Gabapentin**

- Sedation
- Ataxia
- Weakness
- Dizziness
- Emotional lability
- Low mood
- Agitation, aggression
- Hyperactivity
- Flu-like symptoms when starting
- May exacerbate myoclonic epilepsy

**Pre Operative Management**

**Two weeks prior**

- Dystonia management
  - ?Diazepam-sparing
- GORD management
  - Stress, fasting
  - Ranitidine
    - 4-8mg/kg/day as bd dose
- Constipation
  - Microlax® enema day prior

**Oral function post-op period**

- Borderline oral function
  - Sedation, fasting, GORD, pain
  - Unable to take usual medications
  - Unable to manage nutrition, fluids, oral analgesics
  - Dependence on IV access

- Naso-gastric inserted at time of surgery

- ?Evidence

- ↓ RISK = ↑ BENEFIT
“Some people grumble that roses have thorns; I am grateful that thorns have roses.”
Alphonse Karr

“Different but not less”.
Temple Grandin

VDRO: Goals and Expectations

- Kate Willoughby

VDRO: Goals and Expectations

- Ambulant children (GMFCS I-III)
  - Maintain hip joint integrity
  - Gait improvement
  - Decrease risk of future pain from mod displacement?
- Non-ambulant children (GMFCS IV and V)
  - Maintain hip joint integrity
  - Avoid future dislocation and sequelae
  - Maintain sitting (?standing) function
- Return to preoperative level of function 9 – 12 months
- Younger children recover faster, slower in adolescents
**VDRO: Outcomes**

- Effective & reliable for stabilizing the hip
- Radiologically, most hips remains satisfactory in the short and longer term
- Radiological monitoring should continue until skeletal maturity
  - ? risk of rebound coxa valga

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**Is bony reconstruction successful?**

![Graph showing outcomes over time](image)

**How do we measure success?**

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

Hips enlocated, no repeat STR or VDRO = SUCCESS!!

CN: Follow-up

- Now 15 years
- 3 years post surgery
- Residing in supported accommodation
- Now 24kg
- General health markedly improved
- Carers concerned r.e ongoing PAIN:
  - Decreased sitting tolerance
  - Not tolerating standing frame
  - Pain on movement – washing, dressing

- SUCCESS?
**Timing For The Hip**

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

**ITS: Long-term follow-up**

- Age 5 + 6
- 8 months post-VDRO
- Continue close hip surveillance through orthopaedic clinic

**Our current question?**

Should bony surgery be the index operation for some children?
Our current question?

- Kate Willoughby

Current practice: Alternative??

Hip Surveillance

- Hip Displacement reaches ≥30-40%
- Muscle Surgery
- Bony Surgery

Follow-up and surveillance following surgery

- Hips remain stable
- Hip displacement progresses
- GMFCS IV: 73%
- GMFCS V: 86%
- Bony Surgery

Cerebral Palsy Hip Interventions Project: CP-HIP

Research Team:

Principal Investigator: Prof Kerr Graham

Associate Investigators:

- Kate Willoughby (Study Coordinator)
- Mr Abhay Khot
- Ms Pam Thomason
- Dr George Chalkiadis & Dr Ben Hallett – Anaesthetists
- Dr Tim Cain – Medical Imaging
- Ms Kim Jachno – Clinical Epidemiology and Biostatistics
CP-HIP:

Inclusion:
- GMFCS IV or V
- MP 30-60%
- Abduction range <40°

Stratified Randomisation:
- Age, GMFCS, MP

Outcomes:
- Migration Percentage
- CPCHILD
- Pain
- GMFM
- Safety/Adverse events

Heterogeneity in CP and hips:

- Young child - Moderate hips - Tight muscles
- Young child - Mod-severe hips - Muscles length ok
- Older child - Severe hips - Asymmetric muscles

How do we study such a broad population?

Cerebral palsy Hip Outcomes Project: CHOP

- Prospective, pragmatic cohort study
- Multi-centre study: 22 sites internationally
- Lead site: Hospital for Sick Children Toronto, Canada
- Lead investigator: Dr Unni Narayanan
The Adolescent Hip

- 16 years
- CP hemiplegia
- GMFCS I
- FMS 6,5,5 (was 6,6,6)
- LLD
  - 1.5cm real
  - 4 cm apparent
- Left hip subluxation
- Dysplastic left femoral head & acetabulum
**AB: Physical exam, kinematics**

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<td>6</td>
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<tr>
<td>IR/ER/FNA</td>
<td>48/25/30</td>
<td>60/15/40</td>
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<td>32/58/68</td>
<td>45/55/72</td>
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<tr>
<td>Knee E</td>
<td>0</td>
<td>-15</td>
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<tr>
<td>DorsiF</td>
<td>18/18/0</td>
<td>0/-10/-15</td>
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**AB: Radiograph & classification**

MP: R 13, L 53

**AB: Surgery**

- Hip reconstruction
- Gait correction
- Customised Proximal Femoral Osteotomy
  - Extension/Rotation/Varus
- Customized Pelvic Osteotomy
  - Dega
- Open adductor release
- Distal Femoral Extension Osteotomy
- Tibial derotation: SMO
- TAL
**AB: Post reconstruction**

![Image of a hip with implants]

**AB: Follow-up**

- 18 years
- GMFCS I
- FMS 6,5,5
- LLD
- Enlocated Left hip

**AB: Follow-up Physical Exam**

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<td>49/25/27</td>
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<tr>
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<td>53/63/73</td>
<td>17/36/37</td>
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<tr>
<td>Knee E</td>
<td>1</td>
<td>4</td>
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<tr>
<td>DorsiF</td>
<td>20/10/0</td>
<td>10/6/-12</td>
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AB: Radiograph & classification

MP: R 7, L 0

Follow-up in Hemiplegia

- 11 children
- Conclusion:
  - Unilateral SEMLS improved gait
  - Persistent hip dysplasia (MCPHCS)
Need for follow up in hemiplegia

- 14.3 years
- Asymmetric Diplegia R>L
- GMFCS II
- FMS 5,5,5
- FAQ 7 + 14

BC

- Previous Surgery
  - Mar 2002 - B Proximal FDRO's
  - Aug 2003 - R/O blade plates
- Pain R hip, infrequent L hip
- Paralympic soccer, karate, cricket, tenpin bowling
- R hip pain has caused him to quit soccer
- Hip pain 6-7, with regular sport: 8-9 / 10
BC: Physical exam & kinematics

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<td>Pop Angle</td>
<td>36/47/59</td>
<td>30/36/60</td>
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BC: Radiograph & classification

MP: R 25, L 21

BC: Surgery

- Right peri acetabular osteotomy
**BC: Follow-up**

- FMS 6 6 6
- FAQ: 9 + 17
- 12/07/10: Right periacetabular osteotomy
- No pain in R hip
  Occasional pain L hip

**BC: Physical exam & kinematics**

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<td>Pop Angle</td>
<td>38/50/57</td>
<td>28/40/55</td>
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**BC: Radiograph & classification**

MP: R 0, L 20
The hip in a wider context

- Kate Willoughby

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The hip in a wider context

- Evidence Informed Practice

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Child factors: GZ

- Age 2y 1m
- GMFCS V; FMS 1,1,1
- Hip surveillance
- MP: 59%, 54%
- Preferred Plan: STR
Child factors: GZ

- Age 2y 1m
- GMFCS V; FMS 1.1.1
- Hip surveillance
- MP: 59%, 54%
- Preferred Plan: STR
- Nasopharyngeal airway
- PEG, frequent vomiting
- Frequent URTI + ICU
- Action:
  - Continue surveillance
  - Wait for fitness to improve

Child factors: GZ

- Age 2y 8m
- MP: 82%, 65%
- Preferred Plan: STR
- Nasopharyngeal airway
- Frequent URTI + ICU
- PEG, vomiting
- waiting on fundo
- Action:
  - Refer for anaesthetic Ax
  - Wait for fitness to improve

Child factors: GZ

- Age 2y 8m
- MP: 82%, 65%
- Preferred Plan: STR
- Nasopharyngeal airway
- Frequent URTI + ICU
- PEG, vomiting
- waiting on fundo
- Action:
  - Refer for anaesthetic Ax
  - Wait for fitness to improve

Best Available Evidence

Clinical Experience and Expertise

Patient factors
**GZ: Follow-up**

Assess response to GA  
Symmetry restored  
Medically fit for VDRO

**Parent Factors: SH**

- Age 2y 5m  
- GMFCS V  
- MP: 30%, 22%  
- Referred by Paediatrician  
- STR recommended  
- Family declined

**SH: Follow-up**

- Surveillance continued by Paediatrician  
- Age 4y 1m  
- Progressive displacement  
- MP: 30%, 46%  
- Referred back to Ortho  
- STR recommended again  
- Family declined again
**SH: Follow-up**

- Surveillance continued by Paediatrician
- Age 4y 1m
- Progressive displacement
- MP: 30%, 46%
- Referred back to Ortho
- STR recommended again
- Family declined again

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**SH: Follow-up**

- Surveillance continued by Paediatrician
- 12 months later…

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**SH: Follow-up**

- Age 5y 11m
- Left hip dislocation
- Parents consent to STR
- Difficult post-op course
  - Feeding difficulties – NGT placed
  - Difficult seizure control
  - Not tolerating broomstick cast
  - Customised bracing required

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SH: Where are we now?
- Age 7y 5m
- 18 months after STR
- Pelvic symmetry restored
- Left MP remains high
- Dysplastic left acetabulum
- Will likely need VDROs
- Likelihood of parent consent for another surgery?

Difficult Decisions: JZ
- Age 7y 3m
- GMFCS V; MACS V; CFCS IV
- Cognition (receptive vs expressive)
- PEG
- Restrictive lung disease
- Overnight BIPAP
- Frequent ICU admissions
- Recurrent reflux:
  - re-do Fundo
  - decreased ICU admissions

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

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**JZ: What should we do?**

Hips? Spine? Nothing?

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**Summary and Conclusion**

- Abhay Khot