



대한소아재활·발달의학회

Korean Society of Pediatric Rehabilitation and Developmental Medicine

Musculoskeletal problems in cerebral palsy

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Conflict of interest statement

- COI Statement
 - Dr. Yi has no actual or potential conflicts of interest in relation to this lecture.
- Disclosures
 - Funding
 - None
 - Bureau, Consultant, Major Shareholders
 - None

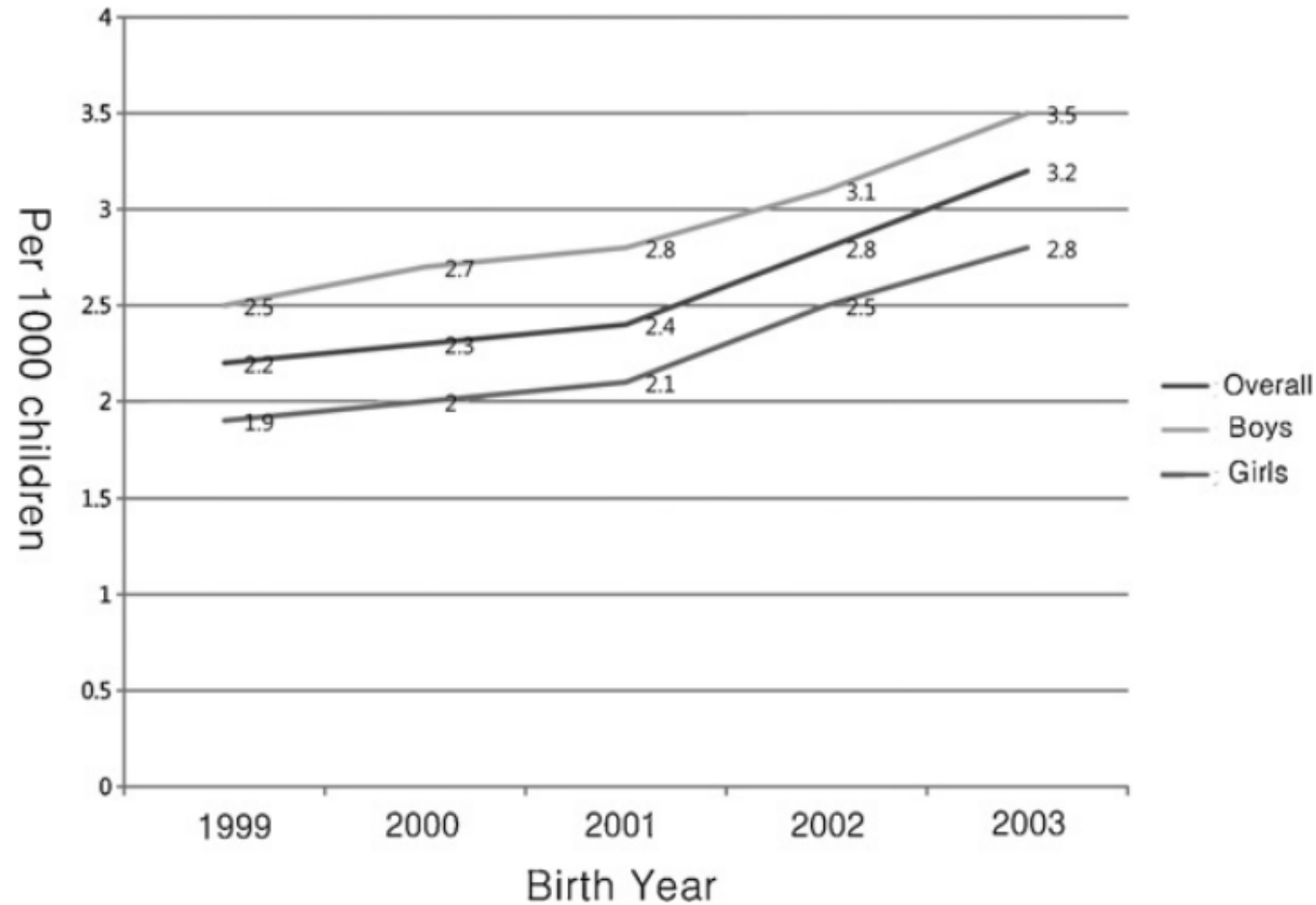


Contents

- Understanding the GMFCS level
- Hip displacement
 - Natural history of hip displacement in CP
 - Hip surveillance and algorithm (AACPD guideline)
- Pelvic obliquity and scoliosis
- Leg length discrepancy



Overall prevalence of CP is increasing in South Korea



Prevalence and lifetime healthcare cost of cerebral palsy in South Korea. *Health Policy*. 2011 May;100(2-3):234-8.

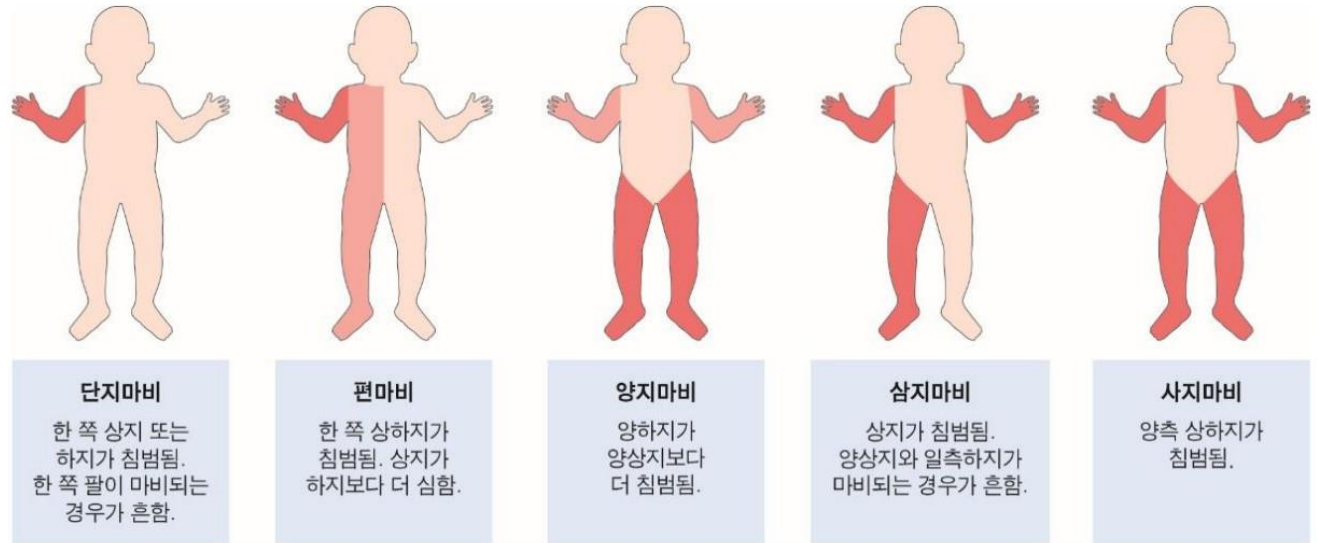


Classification of cerebral palsy

Motor type

SCPE Classification of CP Subtypes based on the predominant neurological findings	
SPASTIC CP	Bilateral Spastic (BS-CP)
	Unilateral Spastic (hemiplegia)
DYSKINETIC CP	Dystonic
	Choreo-athetotic
ATAXIC CP	

Topography

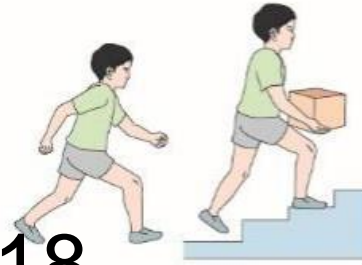


NO GUIDANCE ON PROGNOSIS



GMFCS

- 5 level ordinal scale
- <2, 2~4, 4~6, 6~12, 12~18
- Base on GMFM



1단계

제한없이 걷는다.



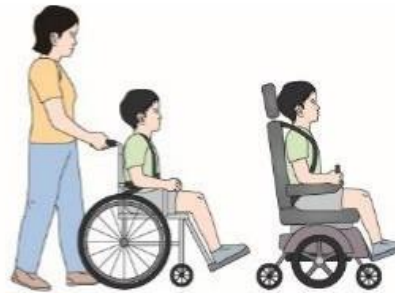
2단계

걸지만 제한적이다.



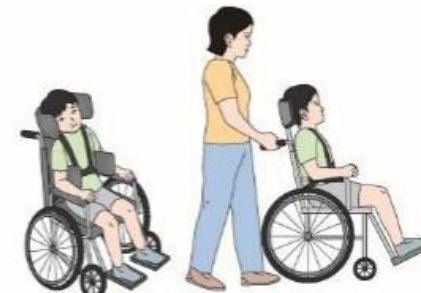
3단계

손으로 잡는 보행
보조기구를
사용하여 걷는다.



4단계

자가 이동이 가능하나
제한적이다. 전기이동
장비를 사용할 수 있다.

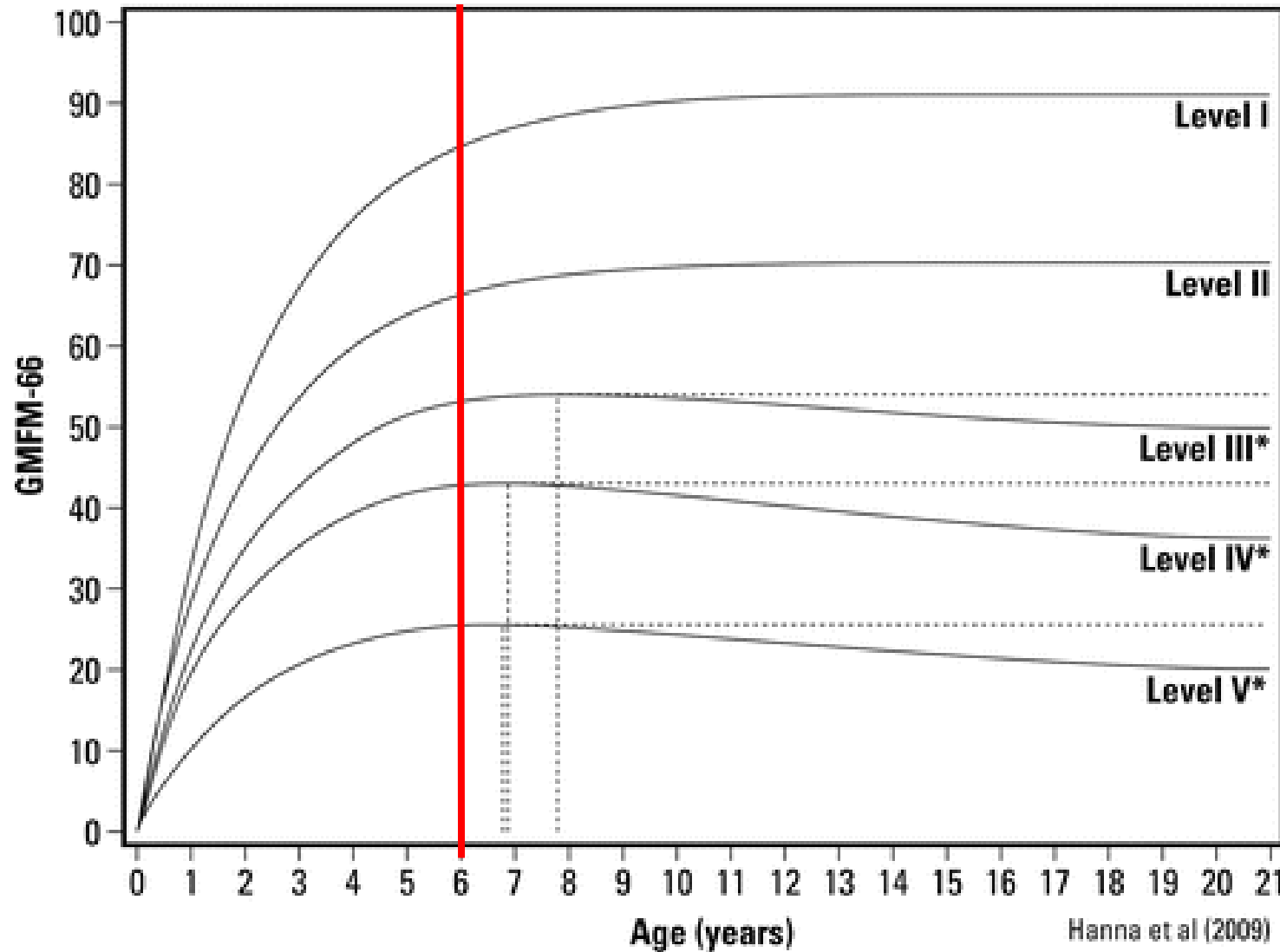


5단계

수동 휠체어로 다른
사람이 옮겨주어야 한다.



The relationship between GMFM-66 and GMFCS



대동작기능평가 2판

Gross Motor Function Measure
(GMFM-66 & GMFM-88)
User's Manual 2nd Edition

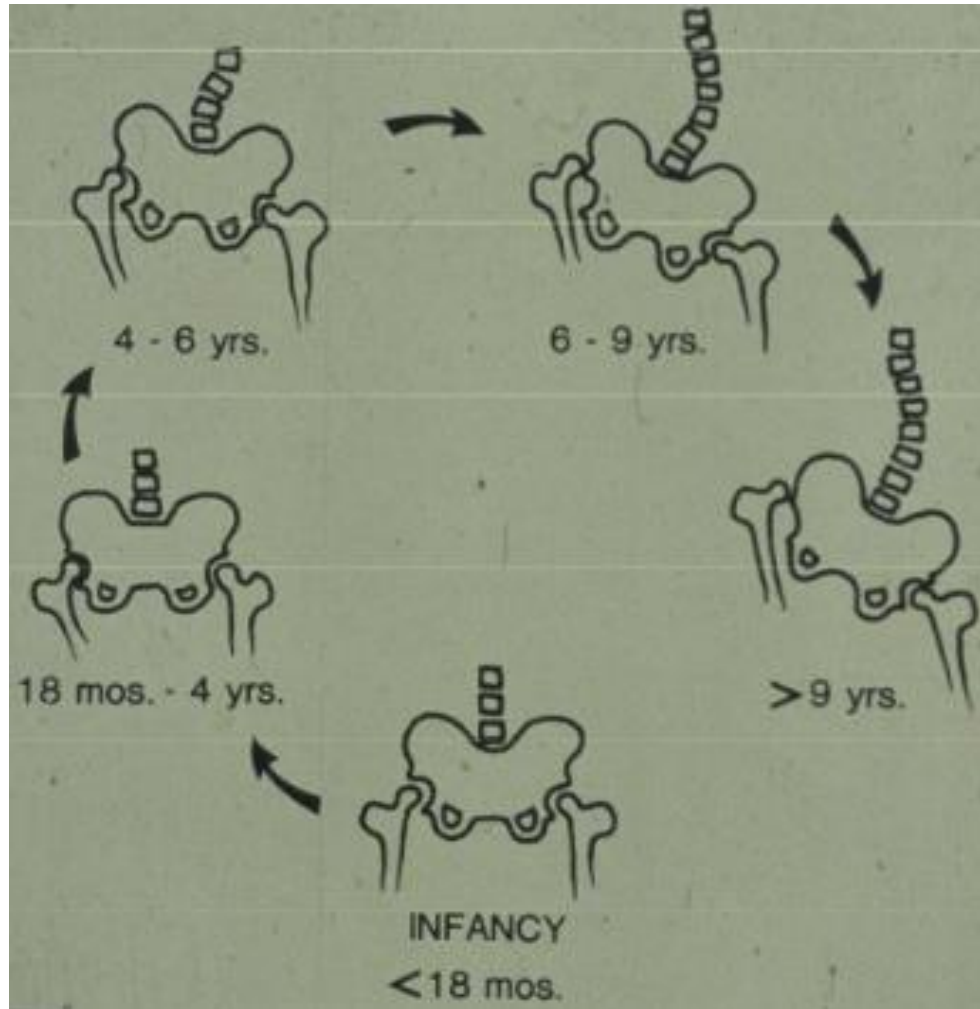
Dianne J Russell · Peter L Rosenbaum · Marilyn Wright · Lisa M Avery 외
대한소아재활보건의학회 · 고주연 · 김민영 · 오병희 외 2명

Running
Walking
Sitting
Rolling
Crawling

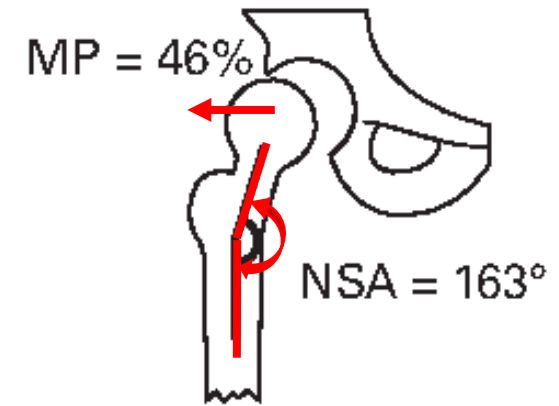
Cerebral Palsy, Item Sets, Responsiveness, Movement, Activity, Measurement, Measuring change, Roll, GMFM-66, Basal & Ceiling, GMFM-88, GMFM-66-B&C, GMMAE-2 Scoring Software

한지사미디어랩

Development of hip dysplasia and its consequences in CP



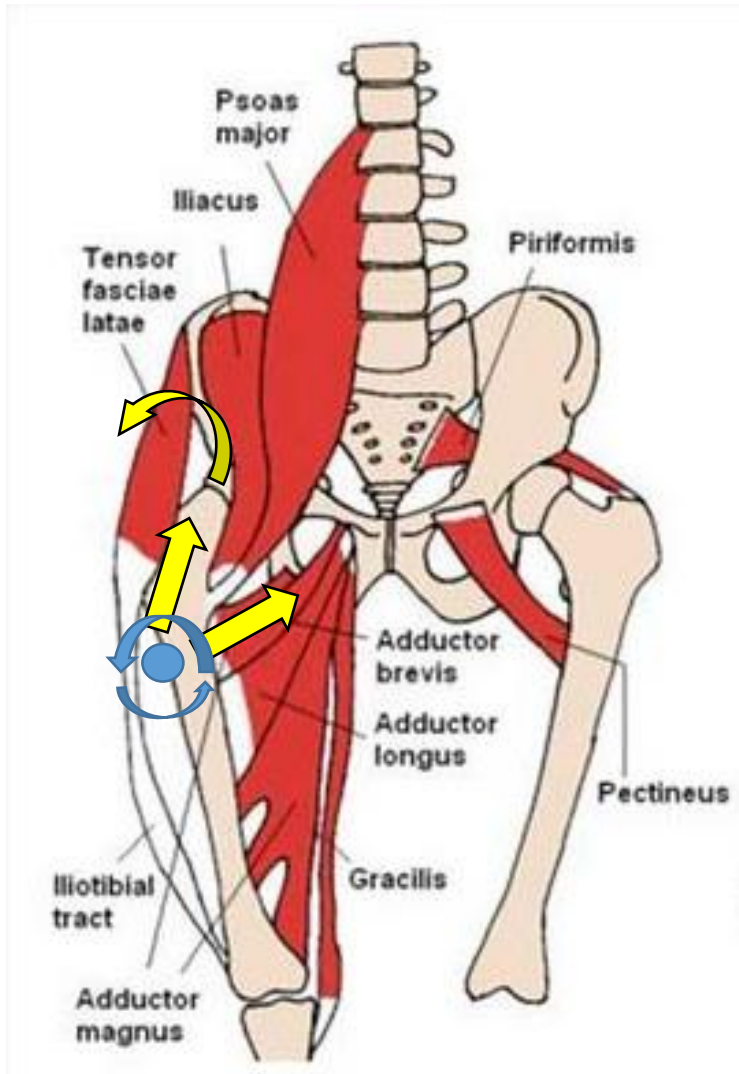
Terje Terjesen. Treatment of hip dysplasia in children with cerebral palsy.



[J. Robin, H. Graham, P. Selber, F. Dobson, K. Smith, R. Baker Proximal femoral geometry in cerebral palsy: a population-based cross-sectional study.](#)



Hip joint in spastic CP



Hip flexor > hip extensor

Hip adductor > hip abductor

→ Posterolateral migration



Radiologic evaluation



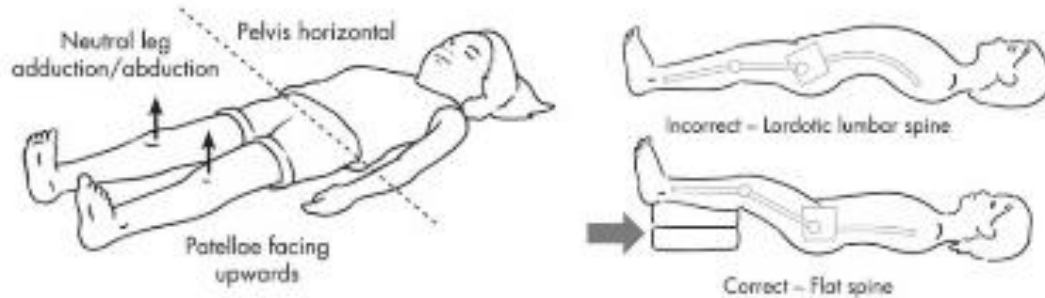
Radiology Protocol for Cerebral Palsy Hip Surveillance AP Pelvis X-Ray

Study Requested: Supine Anterior-Posterior Pelvis X-Ray

Positioning details:

Children should be positioned as follows:

- Pelvis horizontal
- Hips and legs in neutral adduction/abduction
- Patella pointing forward (feet may not necessarily point up)
- If a hip flexion contracture is present, position the lower legs on pillows to prevent anterior pelvic tilt and lumbar lordosis



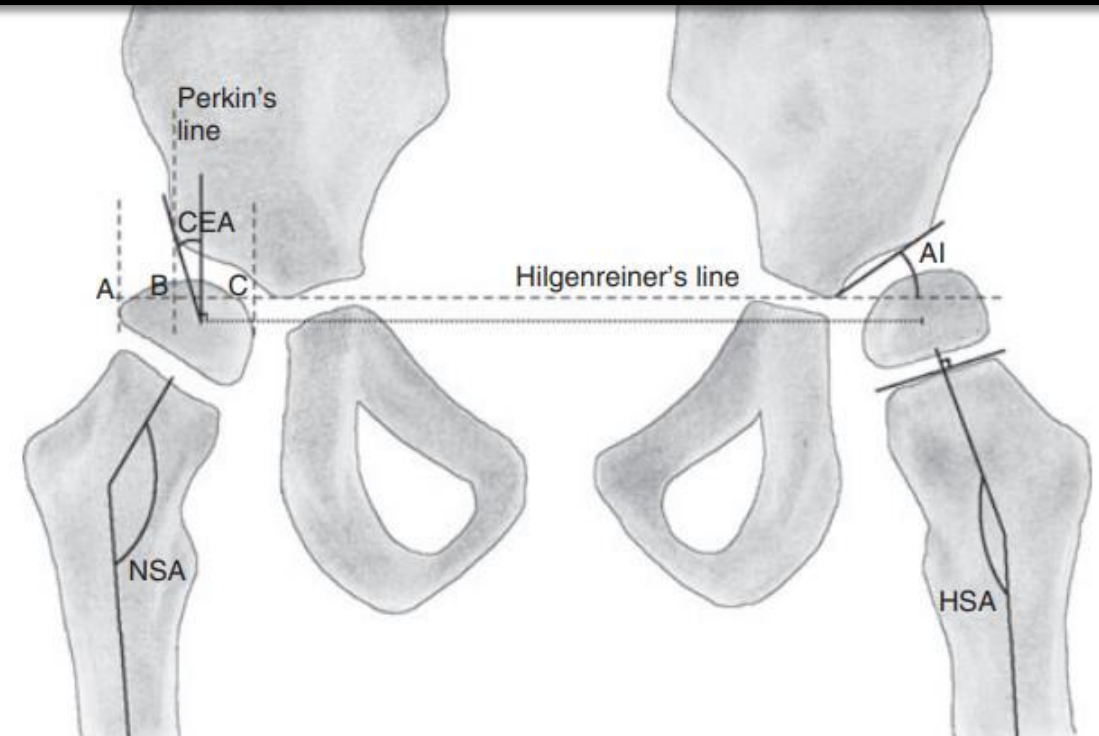
$$\text{Migration percentage} = \frac{AB}{AC} * 100\%$$

Definition: Percent of ossified femoral head that is **not** covered by ossified acetabular roof

"H" line – Hilgenreiner's horizontal line connecting open tri-radiate cartilage

- If tri-radiate cartilage is closed, horizontal may be established by the alternative lines shown in the right-sided image, the Iliac Crest Line, Inter Teardrop Line, or Inter Tuberosity Line

"P" line – Perkin's perpendicular line at lateral edge of ossified acetabulum

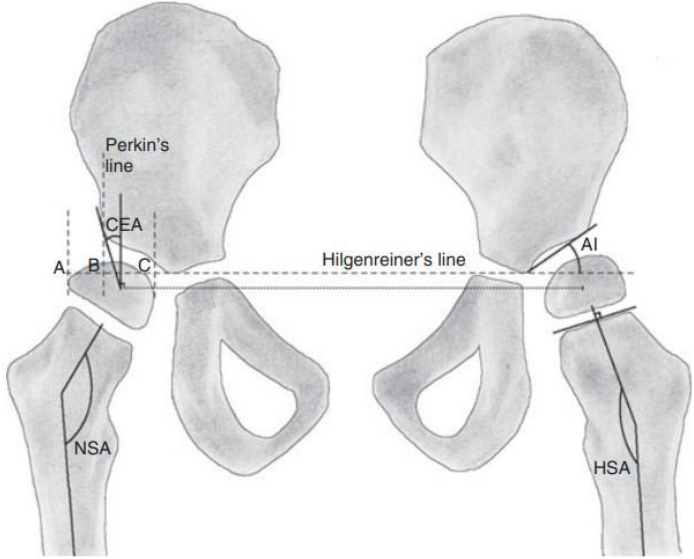
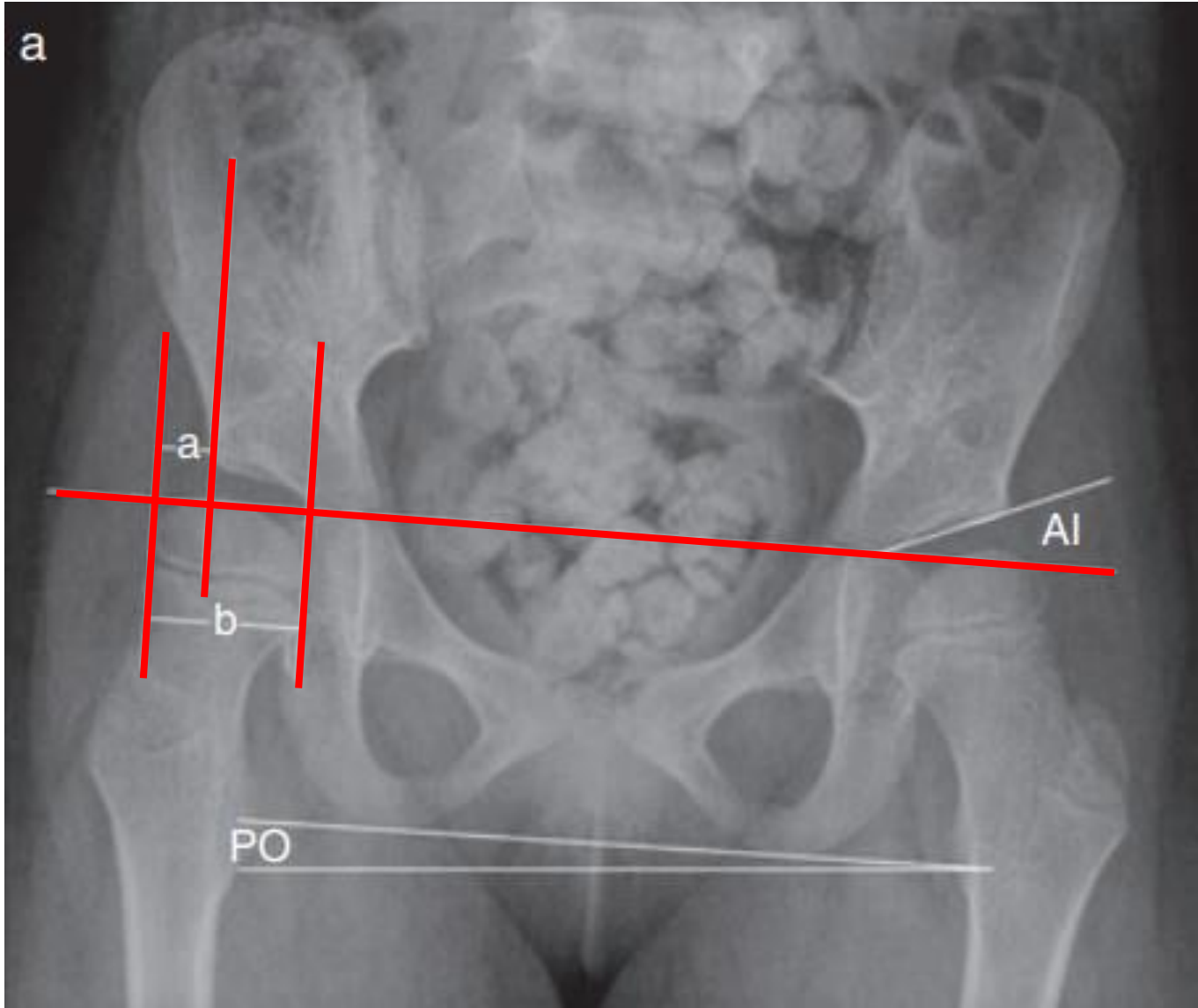


Anteroposterior hip X-ray measurements.

$$\text{Migration percentage} = \frac{AB}{AC} * 100\%$$

AI, acetabular index; CEA, centre-edge angle; HSA, head-shaft angle; NSA, neck-shaft angle.





HIP DISPLACEMENT IN CEREBRAL PALSY

BY BRENDAN SOO, MBBS, JASON J. HOWARD, MD, FRCS(C), ROSLYN N. BOYD, PHD, MSc(PHYSIOTHERAPY),
SUSAN M. REID, MCLINEPi, ANNA LANIGAN, RN, RORY WOLFE, PHD,
DINAH REDDIHOUGH, MD, FRACP, FAFRM, AND H. KERR GRAHAM, MD, FRCS(ED), FRACS

*Investigation performed at the Royal Children's Hospital, Murdoch Children's Research Institute,
University of Melbourne, Parkville, Victoria, Australia*

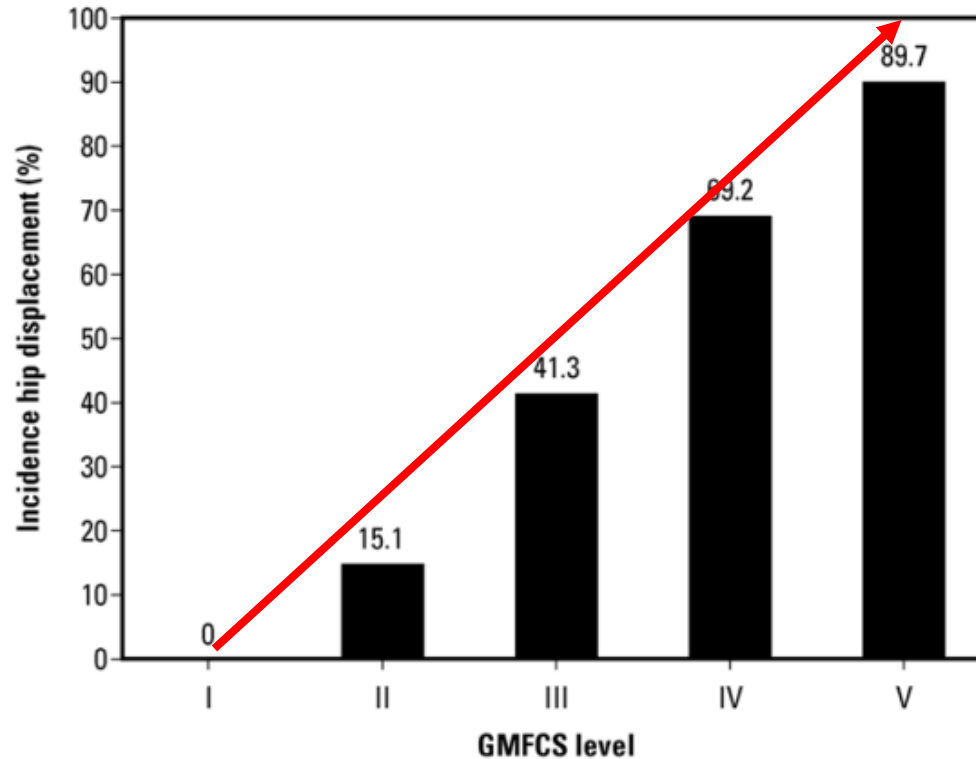


Fig. 4
Incidence of hip displacement (a migration percentage of >30%) according to the Gross Motor Function Classification System (GMFCS) level.



GMFCS



1단계



2단계



3단계

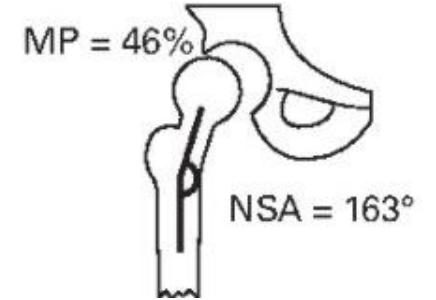
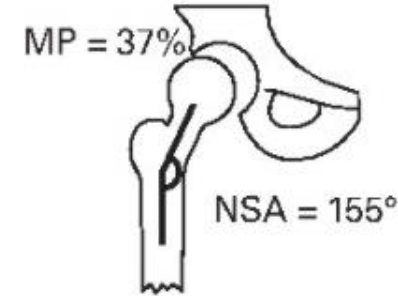
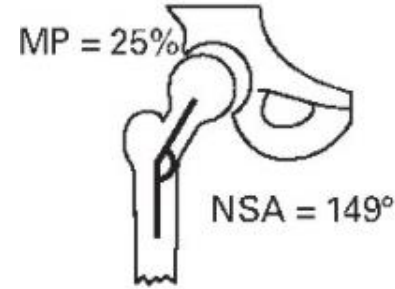
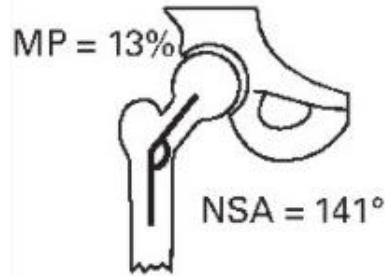
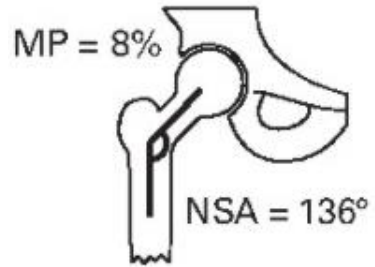


4단계

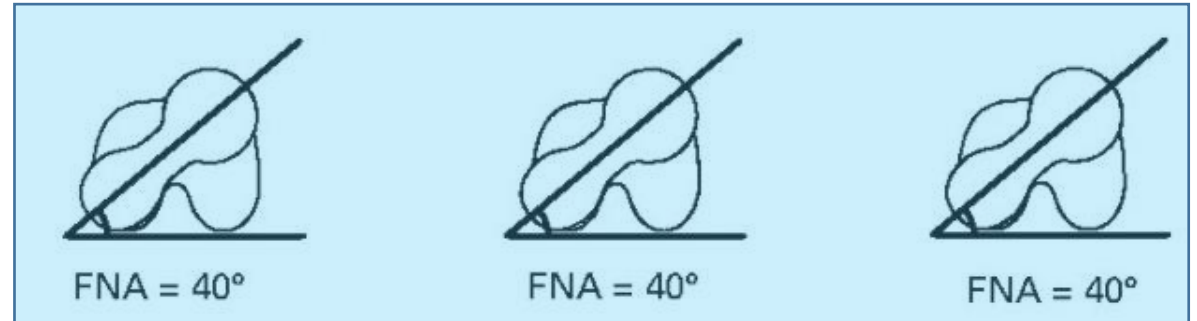
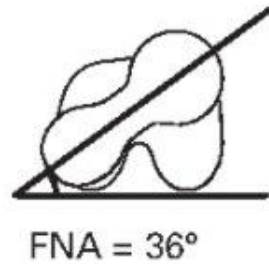
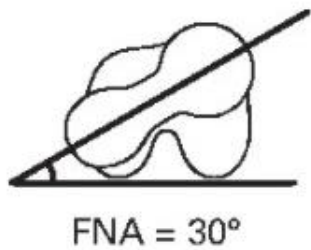


5단계

NSA, MP



FNA



Yearly progression of hip displacement

GMFCS level	MP progression / year
I	0.2 / year
II	1.2 / year
III	1.3 / year
IV	3.9 / year
V	9.5 / year

- 335 children in Norway
- Mean age at the first radiograph : 3 years (range 6mo–7y 11mo)



Spastic hip at risk according to MP

- MP < 30 % (18 y) → remain stable in adulthood
- 30 to 60 % of MP (18 y) → 25% further displacement
- 60 to 90 % of MP (18 y) → 100% dislocation

F Miller, M R Bagg. Age and migration percentage as risk factors for progression in spastic hip disease. Dev Med Child Neurol. 1995 May;37(5):449-55.



Conclusions – natural history

- Hip displacement directly associated with GMFCS
- Non-ambulant : high FNA
- NSA associated with GMFCS
- Migration percentage: need to keep < 30%



Hip Surveillance

- Early detection of hip displacement
- Active screening program
- **WHY IS HIP SURVEILLANCE IMPORTANT?**
 - Hip displacement and dislocation can lead to pain, reduced function and reduced quality of life.
 - Hip surveillance allows for early detection of hip displacement.
 - Early detection enables referral for assessment and/or management.
 - Hip surveillance for children with CP should be completed using a systematic approach.

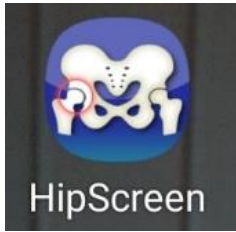




Hip Surveillance - Target Population

- Pediatric/Children & Youth Population (age =19 years) diagnosed with CP or those children not yet diagnosed with CP but for whom there is a clinical suspicion of having CP.



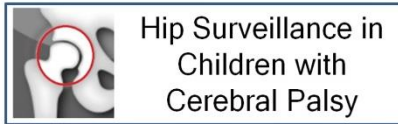


HipScreen

created and designed at



Complete Guidelines



AACPDH Hip Surveillance Care Pathway 2017



2014 Australian Hip Surveillance Guidelines



British Columbia Hip Surveillance Guidelines



Swedish Hip Surveillance Guidelines


AACPDH Hip Surveillance Care Pathway

Adapted from www.aacpdh.org.

<p>GMFCS Level I</p>	<ul style="list-style-type: none"> Age 2: Clinical Exam Age 4: Clinical Exam Age 6: Clinical Exam
<p>GMFCS Level II</p>	<ul style="list-style-type: none"> Age 2: Pelvis X-ray and Clinical Exam Age 4: Clinical Exam Age 6: Pelvis X-ray and Clinical Exam Age 8: Clinical Exam Age 10: Pelvis X-ray and Clinical Exam. Discharge from surveillance if MP \leq 30% at age 10
<p>Group IV Hemiplegia</p> <p><i>Features: Pelvic rotation, hip flexion-adduction-internal rotation, knee flexion, ankle equinus. Can be GMFCS Level I or II.</i></p>	<ul style="list-style-type: none"> Age 2: Pelvis X-ray and Clinical Exam Age 4: Clinical Exam Age 6: Pelvis X-ray and Clinical Exam Age 8: Clinical Exam Age 10: Pelvis X-ray and Clinical Exam <u>every 2 years</u> Age 12 – 16 (or skeletal maturity): Pelvis X-ray and Clinical Exam <u>every 2 years</u> Discharge from surveillance if skeletally mature and MP \leq 30%. Continue surveillance beyond skeletal maturity if pelvic obliquity associated with increasing scoliosis is present.
<p>GMFCS Level III</p>	<ul style="list-style-type: none"> Age 2 – 8: Pelvis X-ray and Clinical Exam <u>every year</u> Age 10 – 16 (or skeletal maturity): Pelvis X-ray and Clinical Exam <u>every 2 years</u> Discharge from surveillance if skeletally mature and MP \leq 30%. Continue surveillance beyond skeletal maturity if pelvic obliquity associated with increasing scoliosis is present.
<p>GMFCS Level IV</p> <p>GMFCS Level V</p>	<ul style="list-style-type: none"> Ages 2 – 3: Pelvis X-ray and Clinical Exam <u>every 6 months</u> Ages 4 – 11: Pelvis X-ray and Clinical Exam <u>every year</u>. Increase frequency to <u>every 6 months</u> if: 24 months of surveillance has not yet been completed, MP changes $>$ 10% in a 12 month period, or MP $>$ 30%. Ages 12 – 16 (or skeletal maturity): Pelvis X-ray and Clinical Exam <u>every year</u> Discharge from surveillance if skeletally mature and MP \leq 30%. Continue surveillance beyond skeletal maturity if pelvic obliquity associated with increasing scoliosis is present.

Hip Surveillance


Complete Guidelines




AACPDM Hip Surveillance Care Pathway 2017



2014 Australian Hip Surveillance Guidelines



British Columbia Hip Surveillance Guidelines



Swedish Hip Surveillance Guidelines



AusACPDM
Australasian Academy of Cerebral Palsy and Developmental Medicine

Australian Hip Surveillance Guidelines for Children with Cerebral Palsy 2014

Wynter M, Gibson N, Kentish M, Lave SC, Thomason P, Willoughby K, Graham HK

Australian Hip Surveillance Guidelines 2014 Adapted from www.ausacpdm.org.au.

GMFCS I	GMFCS II	GMFCS III	GMFCS IV	GMFCS V	Winters, Gage and Hicks hemiplegia group IV (WGH IV)
<ul style="list-style-type: none"> Initial clinical assessment and antero-posterior (AP) pelvic radiograph at 12-24 months of age (or at identification if older than 24 months) Review at 2 years of age <ul style="list-style-type: none"> Verify GMFCS level If GMFCS is confirmed, repeat clinical assessment. AP pelvic radiograph is NOT required 	<ul style="list-style-type: none"> Initial clinical assessment and AP pelvic radiograph at 12-24 months of age (or at identification if older than 24 months) Review 12 months later <ul style="list-style-type: none"> Verify GMFCS level If GMFCS II confirmed, repeat clinical assessment and AP pelvic radiograph If GMFCS level has changed, ongoing surveillance according to confirmed classification If MP is abnormal and/or unstable, continue 12 monthly surveillance until stability is established When MP is stable, review at 4-5 years of age 	<ul style="list-style-type: none"> Initial clinical assessment and AP pelvic radiograph at 12-24 months of age Review 6 months later <ul style="list-style-type: none"> Verify GMFCS level If GMFCS III confirmed, repeat clinical assessment and AP pelvic radiograph If GMFCS level has changed, ongoing surveillance according to confirmed classification If MP is abnormal and/or unstable, continue 6 monthly surveillance until MP stability is established 	<ul style="list-style-type: none"> Initial clinical assessment and AP pelvic radiograph at 12-24 months of age Review 6 months later <ul style="list-style-type: none"> Verify GMFCS level If GMFCS IV confirmed, repeat clinical assessment and AP pelvic radiograph If GMFCS level has changed, ongoing surveillance according to confirmed classification 	<ul style="list-style-type: none"> Initial clinical assessment and AP pelvic radiograph at 12-24 months of age Review 6 months later <ul style="list-style-type: none"> Verify GMFCS level If GMFCS V confirmed, repeat clinical assessment and AP pelvic radiograph If GMFCS level has changed, ongoing surveillance according to confirmed classification 	<ul style="list-style-type: none"> RGH IV gait pattern clearly demonstrated by 4-5 years of age. The child with a classification of WGH IV has the potential for late onset progressive hip dysfunction regardless of GMFCS level Review at 5 years of age <ul style="list-style-type: none"> Verify WGH and GMFCS If WGH II, ongoing hip surveillance according to confirmed GMFCS If WGH IV and MP stable, review 10 years of age If MP is abnormal and/or unstable, continue 12 monthly surveillance until MP stability established
<ul style="list-style-type: none"> If GMFCS level has changed, ongoing surveillance according to confirmed classification If identified as Winters, Gage and Hicks (WGH) IV hemiplegia, ongoing surveillance according to WGH IV classification Review at 5 years of age <ul style="list-style-type: none"> Verify GMFCS level 	<ul style="list-style-type: none"> Review at 4-5 years of age <ul style="list-style-type: none"> Verify GMFCS level If GMFCS II confirmed, repeat clinical assessment and AP pelvic radiograph If GMFCS level has changed, or if identified as WGH IV hemiplegia, ongoing surveillance according to confirmed classification If MP is stable, review at 8-10 years of age If MP is abnormal and/or unstable, continue 12 monthly surveillance until stability is established Review at 8-10 years of age, prepuberty <ul style="list-style-type: none"> Verify GMFCS level 	<ul style="list-style-type: none"> When MP is stable, reduce frequency to 12 monthly surveillance Review at 7 years of age <ul style="list-style-type: none"> Verify GMFCS level If GMFCS III confirmed, repeat clinical assessment and AP pelvic radiograph If GMFCS level has changed, ongoing surveillance according to confirmed classification If MP is abnormal and/or unstable, continue 6 monthly surveillance until MP stability is established 	<ul style="list-style-type: none"> If MP is abnormal and/or unstable, continue 6 monthly surveillance until MP stability is established When MP is stable, reduce frequency of surveillance to 12 monthly Review at 7 years of age <ul style="list-style-type: none"> If MP is stable, below 30% and gross motor function is stable, surveillance may be discontinued until puberty 12 monthly AP pelvic radiographs must resume prepuberty and continue until skeletal maturity 	<ul style="list-style-type: none"> If MP is abnormal and/or unstable, continue 6 monthly surveillance until MP stability is established When MP is stable, reduce frequency of surveillance to 12 monthly Review at 7 years of age <ul style="list-style-type: none"> If MP is stable, below 30% and gross motor function is stable, surveillance may be discontinued until puberty 12 monthly AP pelvic radiographs must resume prepuberty and continue until skeletal maturity 	<ul style="list-style-type: none"> Review at 10 years of age <ul style="list-style-type: none"> Verify WGH IV If WGH IV confirmed, repeat clinical assessment and AP pelvic radiograph Continue 12 monthly surveillance until skeletal maturity At skeletal maturity if significant scoliosis, pelvic obliquity, leg length discrepancy or deteriorating gait, continue 12 monthly surveillance
<ul style="list-style-type: none"> If GMFCS I is confirmed, repeat clinical assessment. AP pelvic radiograph is NOT required and if all other significant signs, discharge from surveillance If GMFCS level has changed, ongoing surveillance according to confirmed classification If identified as WGH IV hemiplegia, ongoing surveillance according to WGH IV classification 	<ul style="list-style-type: none"> If GMFCS II confirmed, repeat clinical assessment and AP pelvic radiograph If GMFCS level has changed, or if identified as WGH IV hemiplegia, ongoing surveillance according to confirmed classification If MP is stable, discharge from surveillance If MP is abnormal and/or unstable, continue 12 monthly surveillance until stability is established or skeletal maturity In the presence of pelvic obliquity, leg length discrepancy or deteriorating gait, continue 12 monthly surveillance 	<ul style="list-style-type: none"> If MP is stable, below 30%, and gross motor function is stable, AP pelvic radiographs may be discontinued until prepuberty 12 monthly AP pelvic radiographs must resume prepuberty and continue until skeletal maturity At skeletal maturity, in the presence of pelvic obliquity, leg length discrepancy or deteriorating gait, continue 12 monthly surveillance 	<ul style="list-style-type: none"> Independent of MP, when clinical and/or radiographic evidence of scoliosis or pelvic obliquity is present, 6 monthly surveillance is required until skeletal maturity At skeletal maturity, if MP is abnormal and progressive scoliosis or significant pelvic obliquity is present, continue 12 monthly surveillance 	<ul style="list-style-type: none"> Independent of MP, when clinical and/or radiographic evidence of scoliosis or pelvic obliquity is present, 6 monthly surveillance is required until skeletal maturity At skeletal maturity, if MP is abnormal and progressive scoliosis or significant pelvic obliquity is present, continue 12 monthly surveillance 	<ul style="list-style-type: none"> Group I: Normal Group II: Normal Group III: Prepubertal Group IV: Pubertal Group V: Skeletal maturity Group VI: Skeletal maturity with scoliosis



AACPD Hip Surveillance Care Pathway 2017



2014 Australian Hip Surveillance Guidelines



British Columbia Hip Surveillance Guidelines



Swedish Hip Surveillance Guidelines

CHILD HEALTH BC
HIP SURVEILLANCE PROGRAM
 for Children with Cerebral Palsy

British Columbia Consensus Statement on Hip Surveillance for Children with Cerebral Palsy

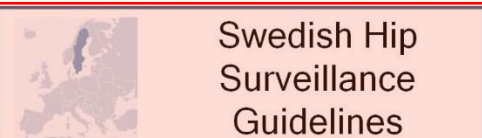
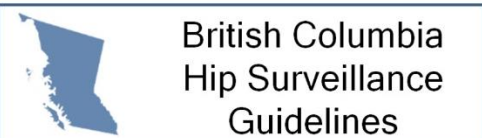
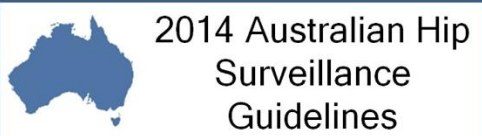
Information for Health Care Professionals
 Caring for Children with Cerebral Palsy

British Columbia Hip Surveillance Guidelines

Adapted from www.childhealthbc.ca.

<p>GMFCS I & II</p>		<ul style="list-style-type: none"> At each Clinical Exam, verify GMFCS level and identify children with a Group IV gait If GMFCS level has changed or child is identified as having a Group IV gait, ongoing surveillance according to confirmed classification Initial Clinical Exam at identification of CP Review annually with Clinical Exam Review at 5 years of age with Clinical Exam and AP pelvic radiograph If radiograph findings are normal at 5 years, discharge from surveillance
<p>Hemiplegia Group IV</p>		<ul style="list-style-type: none"> Until 5 years of age, surveillance as per recommendations for children at GMFCS I & II After 5 years of age, Clinical Exam and AP pelvic x-ray 12 monthly until skeletal maturity
<p>GMFCS III</p>		<ul style="list-style-type: none"> At each Clinical Exam, verify GMFCS level; if GMFCS level has changed, ongoing surveillance according to confirmed classification Initial Clinical Exam at identification of CP Clinical Exam and initial AP pelvic radiograph at 24 months of age Clinical Exam and AP pelvic radiograph 12 monthly until 6 years of age After 6 years of age, until skeletal maturity, review with: <ul style="list-style-type: none"> Clinical Exam 12 monthly AP pelvic radiograph 24 monthly
<p>GMFCS IV & V</p>		<ul style="list-style-type: none"> At each Clinical Exam, verify GMFCS level; if GMFCS level has changed, ongoing surveillance according to confirmed classification Initial Clinical Exam at identification of CP Clinical Exam and initial AP radiograph at 24 months of age Clinical Exam and AP pelvic radiograph 6 monthly until 6 years of age After 6 years of age, continue Clinical Exam and AP pelvic radiograph 12 monthly until skeletal maturity





Radiographic follow-up in CPUP to prevent hip dislocation

Children with cerebral palsy (CP) have an increased risk of hip dislocation. Without a surveillance program, combined with subsequent indicated treatment, 10-20% of all children with CP develop hip dislocation. Several risk factors are known *, but also children without these established risk factors are at risk of developing hip dislocation. To prevent hip dislocation, the child's hips should be followed both clinically and radiographically during the entire growth period.

- * Risk factors
- GMFCS III-V
 - Scoliosis
 - Windswept deformity
 - Adduction – flexion contracture
 - Spasticity of hip adductor and flexor muscles

Follow-up program

The program is based on the child's age and GMFCS level. The findings at the clinical examination must also be taken into account in the overall assessment. At times, it will be necessary to deviate from the program and perform examinations more often than the care program recommends.

GMFCS I	No radiographic examination, unless deterioration of hip and/or spine is noted during the clinical examinations.
GMFCS II	Radiographic examinations at 2 and 6 years of age. If MP is <33% and no deterioration is noted during the clinical examinations, no additional radiographic examinations are needed.
GMFCS III-V	Radiographic examination immediately following a confirmed/suspected diagnosis of CP followed by annual radiographic examinations until eight years of age. After age 8, the time interval between examinations is determined individually based on the result of the previous clinical and radiological examinations. Children > 8 years with normal radiology for several years and no deterioration noted during the clinical examinations are recommended to undergo radiographic examinations every two years until growth plate closure.



AACPDM



CARE PATHWAYS

HIP SURVEILLANCE

Bottom Line 'Evidence-Informed' Recommendations for the Hip Surveillance
in Individuals with Cerebral Palsy

*Authors (AACPD Hip Surveillance Care Pathway Team): M O'Donnell (team lead),
T Mayson (project manager and clinical examination sub-group leader), S Miller (radiology sub-group leader), R Cairns, K Graham, S Love,
F Miller, K Mulpuri, U Narayanan, H Read, B Shore, K Stannage, P Thomason, J Vargus-Adams, L Wiggins, K Willoughby, M Wynter.*

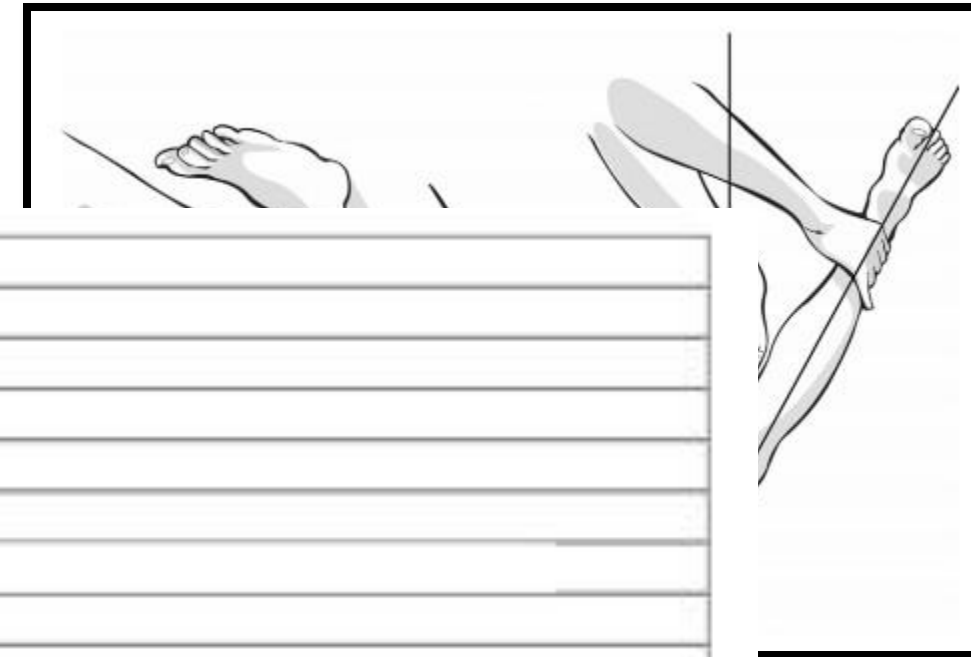
- Risk for hip displacement is directly related to GMFCS level.
- Children whose ability to move is at GMFCS Level I have the lowest risk of hip displacement. They receive the fewest Clinical Examinations and x-rays.
- Children whose ability to move is at GMFCS Level V have the highest risk of hip displacement (8 out of 10 children that are at GMFCS Level V will have hip displacement). Clinical Examinations and x-rays are done most often for children that are at GMFCS Levels IV and V.
- In addition to GMFCS, children with hemiplegia (one side of the body affected) who walk with one hip turned and pulled inward (this is called a Gait Type IV pattern of walking) are at higher risk for hip displacement.



Physical Examination

- Hip
- Hip
- Fem
- Har
- Kne
- Moc

Passive Range of Motion	Hip Flexion
	Hip Extension
	Hip Internal Rotation
	Hip External Rotation
	Hip Abduction
	Popliteal angle
Tone	Hip Flexors
	Hip Adductors
	Hamstrings
Special Tests	Femoral Neck Anteversion
Asymmetry Assessments	Pelvic Obliquity
	Spinal Deformity
	Leg Length Discrepancy
Questions	Question re: Deterioration in Ability to Care
	Question re: Decrease in Ability to Weight-Bear through Hip
	Question re: Deterioration in Ability to Walk
Other	Melbourne Cerebral Palsy Hip Classification Scale - Expanded Revised

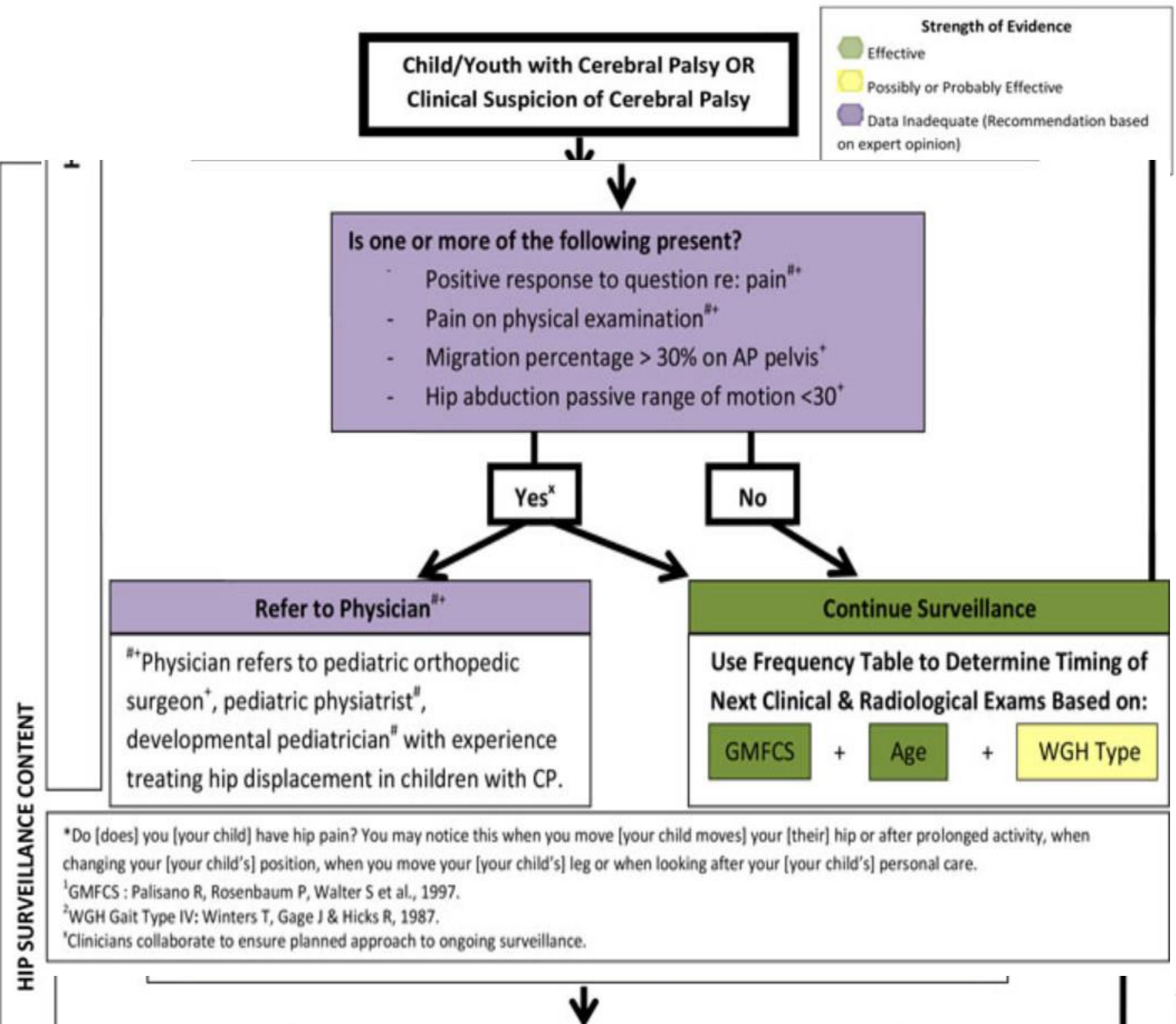


femoral
cerebral palsy. J

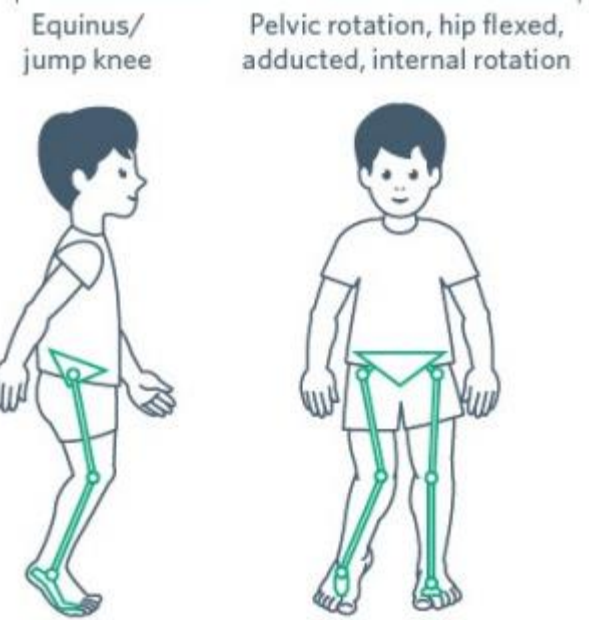


2

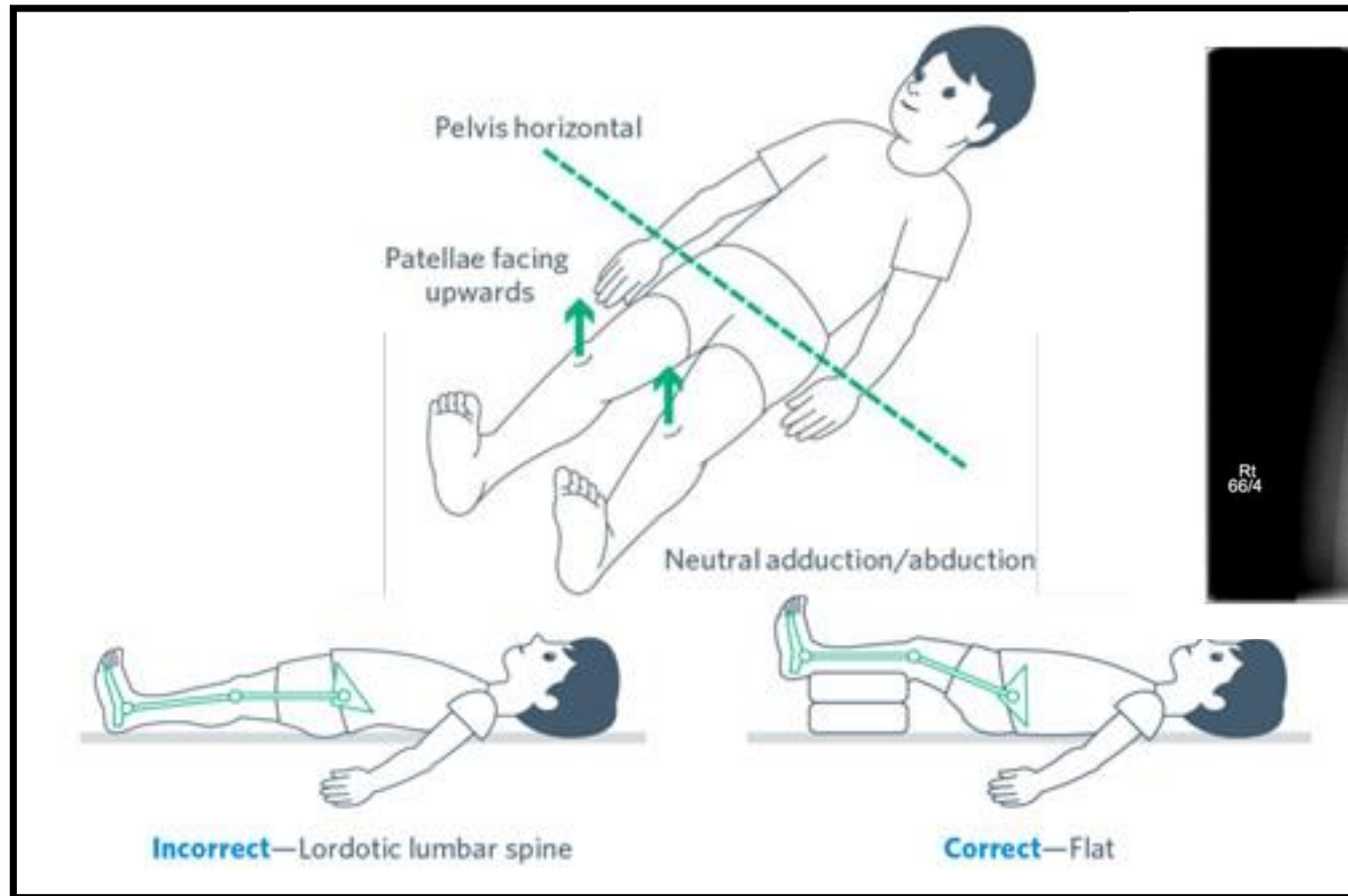




Group IV










































































Radiographic evaluation



Hip Surveillance – How ?

- Frequency
 - Child's age, GMFCS level, and WGH gait type
 - Increases with increasing GMFCS level
 - Frequency modifiers : absolute MP value, percentage change in MP
- Initiated by 2 years of age
- Discharge criteria
 - GMFCS levels III to V (and WGH Gait Type IV hemiplegia): discharged at skeletal maturity
 - GMFCS levels I and II : discharged earlier if MP is stable and under 30%.
 - Continued surveillance : MP greater than 30% or those with pelvic obliquity in the presence of increasing scoliosis



Age (Years)	GMFCS I	GMFCS II	GMFCS III	GMFCS IV & V		Any GMFCS Level with Winters Gage Hicks Gait Type IV	
							
2.0 years or at ID		 	 				
2.5							
3							
3.5							
4							
5							
6		 					 
7							
8							
9							
10		 					 
11							
12 to 16 or Skeletal Maturity (SM)			Bi-Annually to SM† 	Bi-Annually to SM† 	Annually to SM† 	Annually to SM† 	Bi-Annually to SM†  Bi-Annually to SM† 

Skeletal Maturity (SM) is defined as closure of the triradiate cartilage.








: Clinical Examination



: AP Pelvis Radiograph

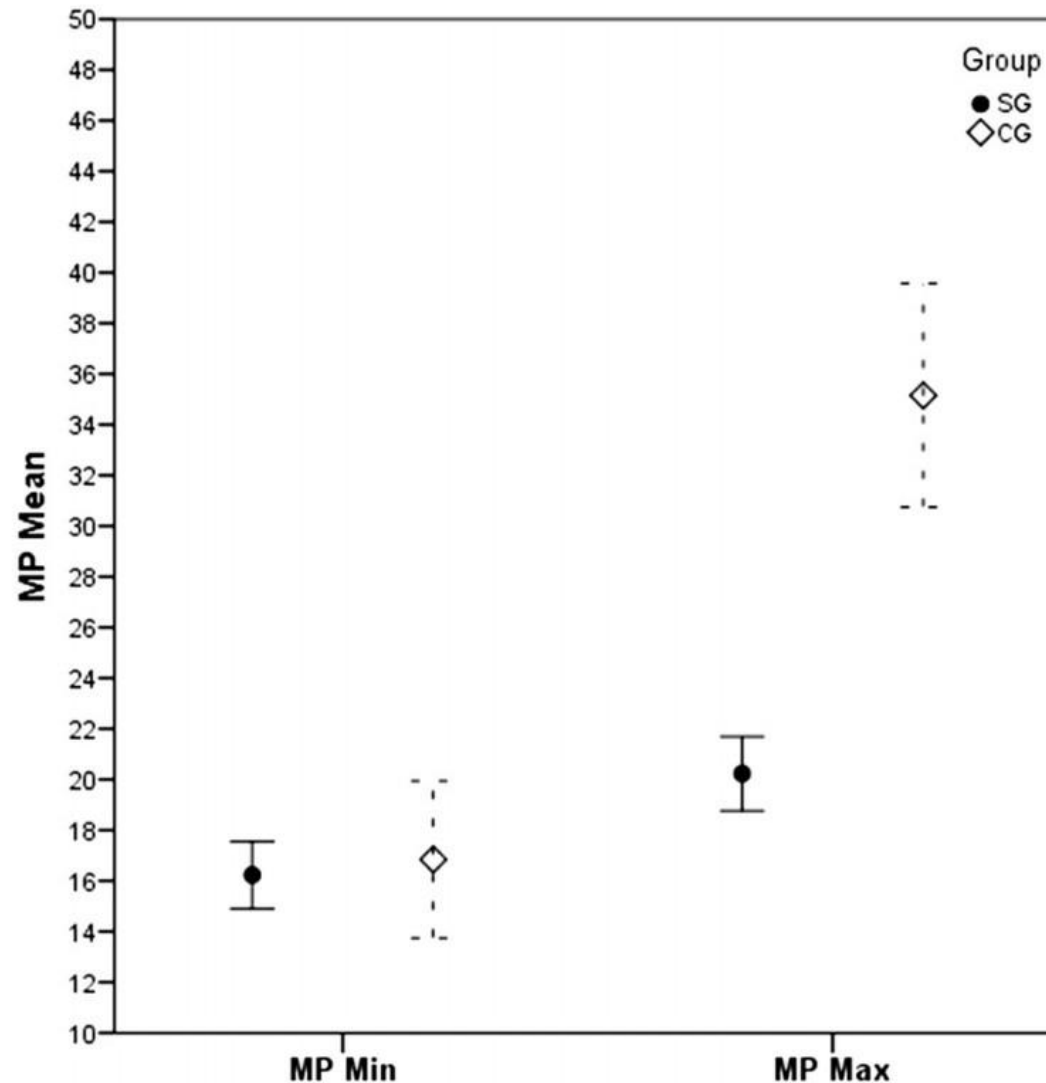


HIP SURVEILLANCE FREQUENCY

Age (Years)	GMFCS I 	GMFCS II 	GMFCS III 	GMFCS IV & V 	Any GMFCS Level with Winters Gage Hicks Gait Type IV 
Notes re: Initiation	If CP is diagnosed or suspected after age 2 but before 4 years, begin surveillance immediately. Do not wait until 4 years of age.		If CP is diagnosed or suspected after age 2, immediately begin 12-monthly schedule for a minimum of 24 months.	If CP is diagnosed or suspected after age 2, immediately begin 6-monthly schedule and continue for a minimum of 24 months at that frequency.	If CP diagnosed or suspected after age 2 but before age 4, begin surveillance immediately.
*If there is any doubt of the GMFCS level, follow the recommendation for the higher level.					
Frequency Modifiers			* Do not reduce from previous higher frequency if: (1) 24 months of surveillance have not yet been completed based on a child's surveillance start date; (2) stability is not yet achieved over a period of 2 years. Stability is defined as < 10% change in MP over a 12 month period; OR (3) MP > 30%.		.
Discharge	Discharge if MP ≤30% at age 10 (unless WGH Gait Type IV).		Discharge if skeletally mature and MP ≤30%.		
† In the presence of pelvic obliquity associated with clinical or radiographic evidence of increasing scoliosis, the hip/s continue to be at risk and should ideally be monitored even beyond skeletal maturity.					



Effects of the standing program with hip abduction in children with cerebral palsy



GMFCS level III

Standing program

- > 1 h daily
- From 1 to 5 year

Figure 2. Anterior and posterior view of the standing in abduction.

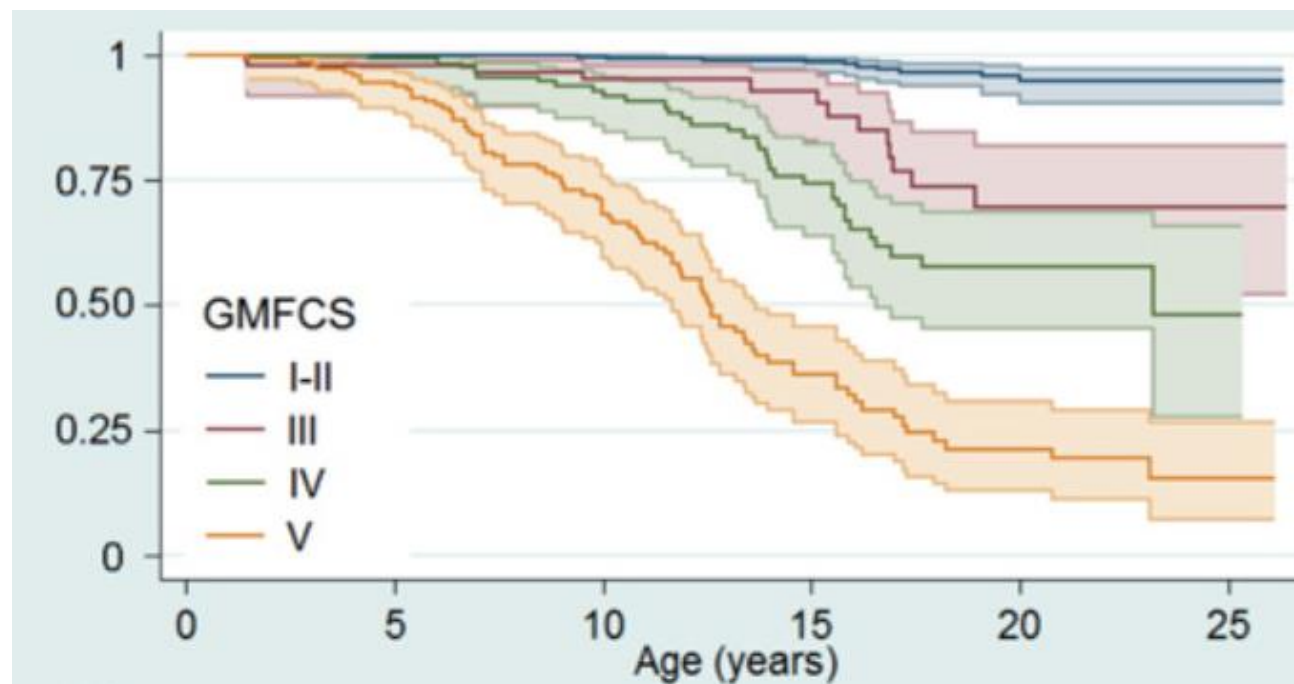
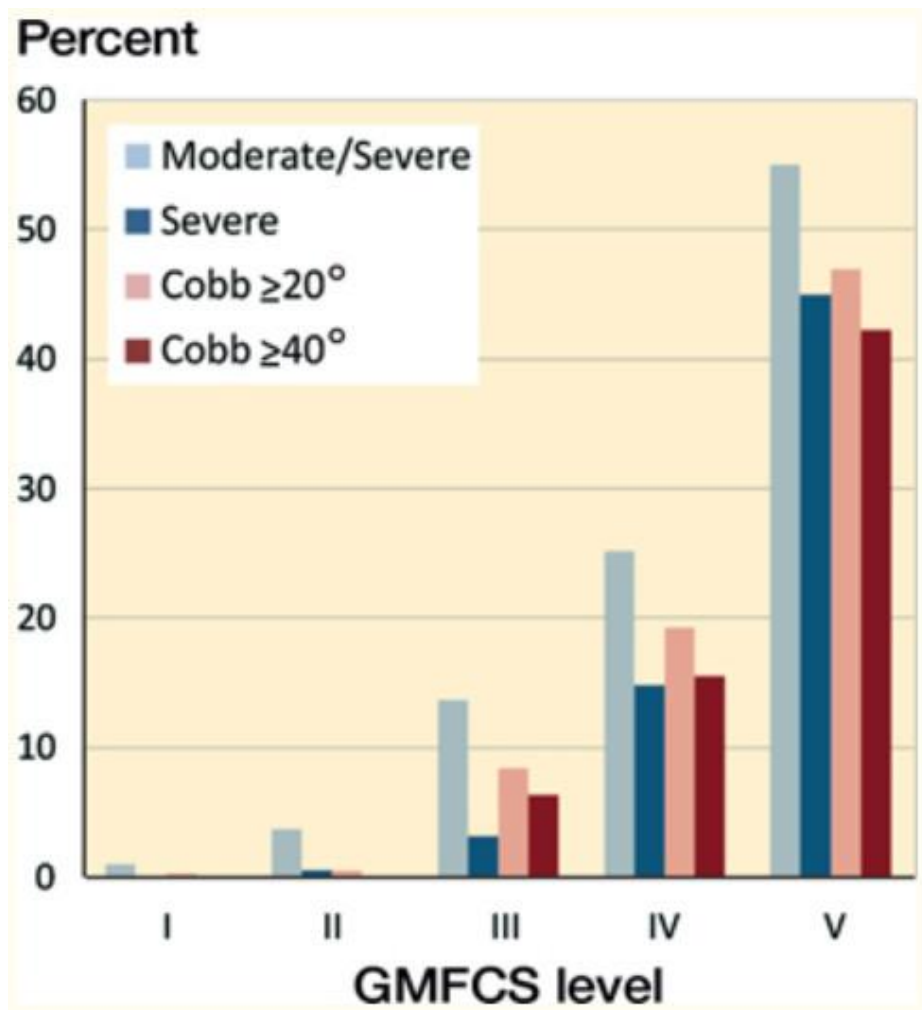


Wirk

mity

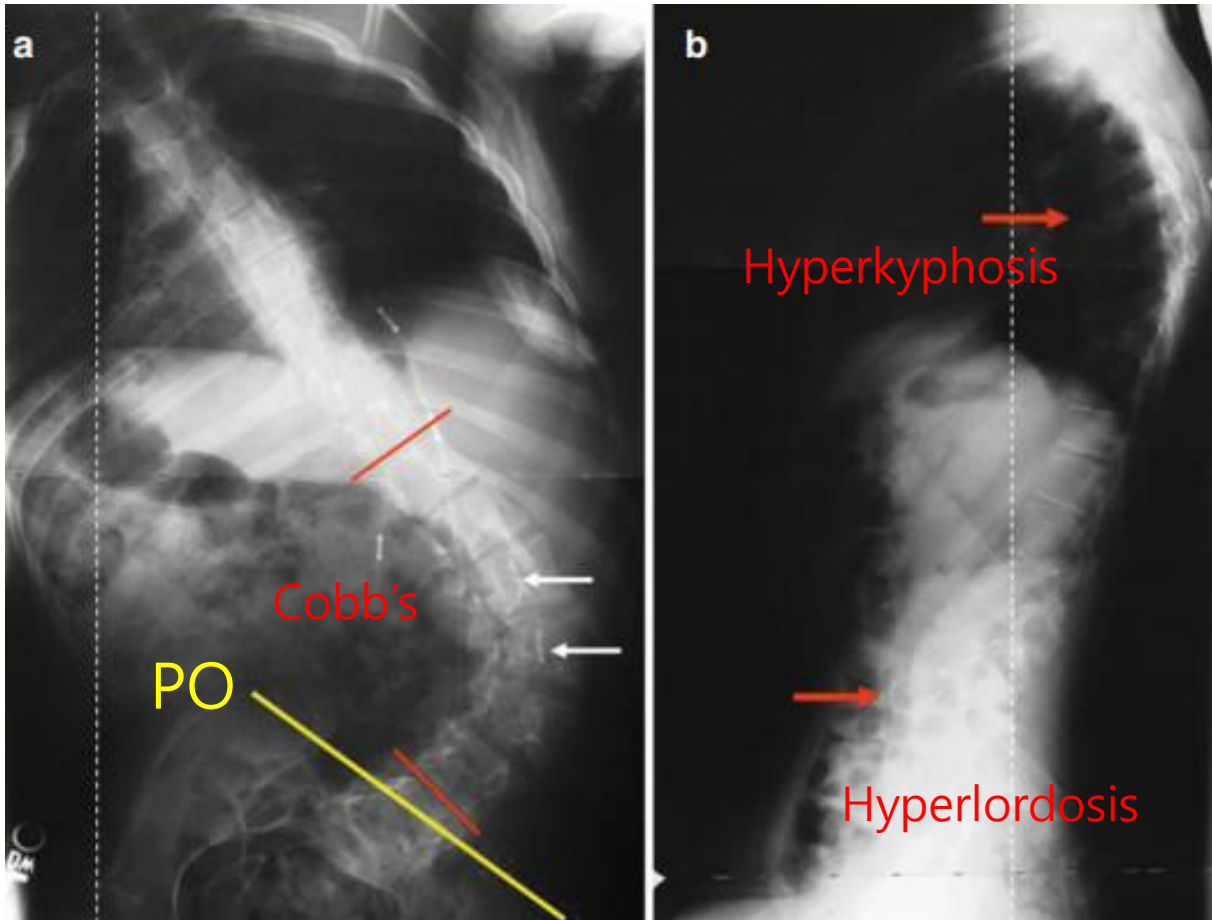


Pelvic obliquity and scoliosis



Gunnar Hägglund et al. Incidence of scoliosis in cerebral palsy: A population-based study of 962 young individuals. *Acta Orthop.* 2018 Jul 30; 89(4): 443–447.





Spinal bracing



Terjesen T, et al. Treatment of scoliosis with spinal bracing in quadriplegic cerebral palsy. *Dev Med Child Neurol.* 2000.





- Optimal correction with braces can be obtained as long as the curves are flexible.
- Use the braces only when the trunk of the patient is in an upright position.

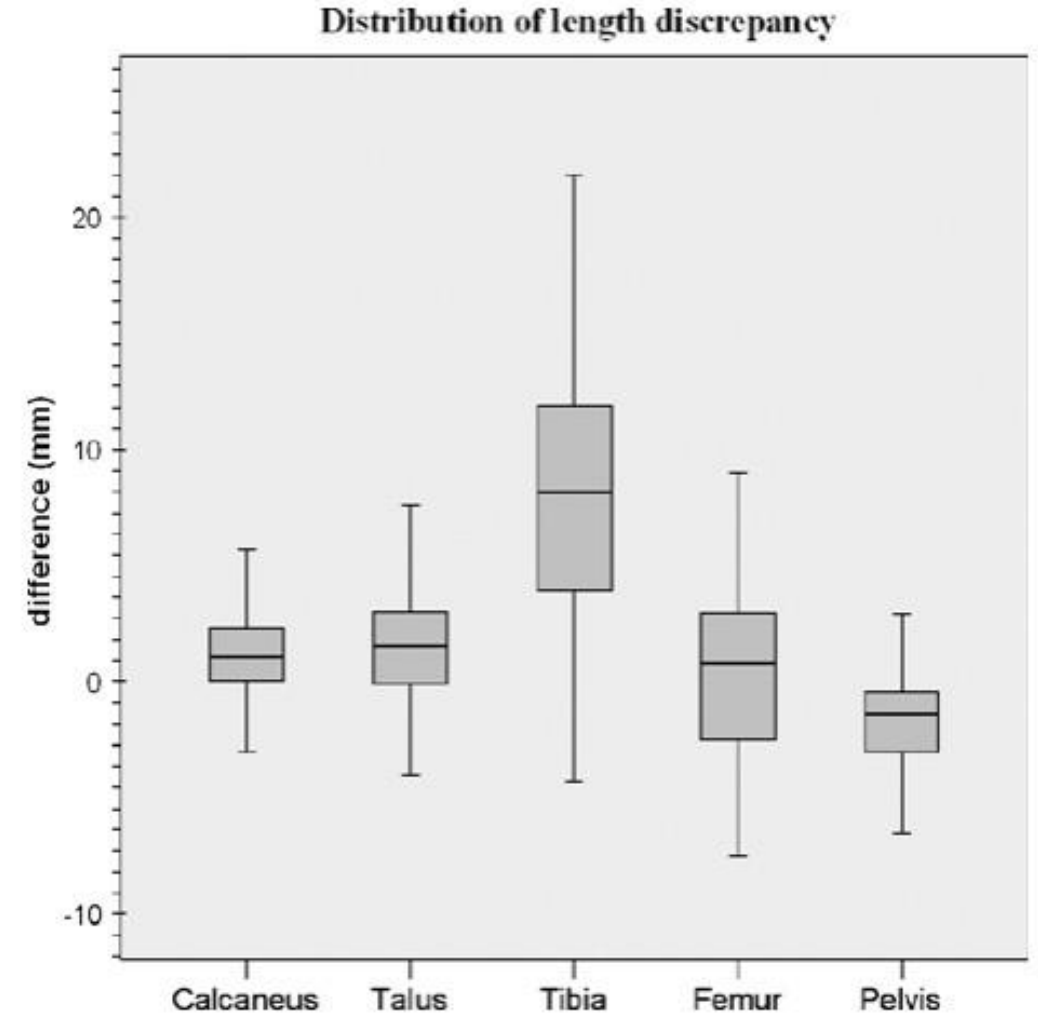
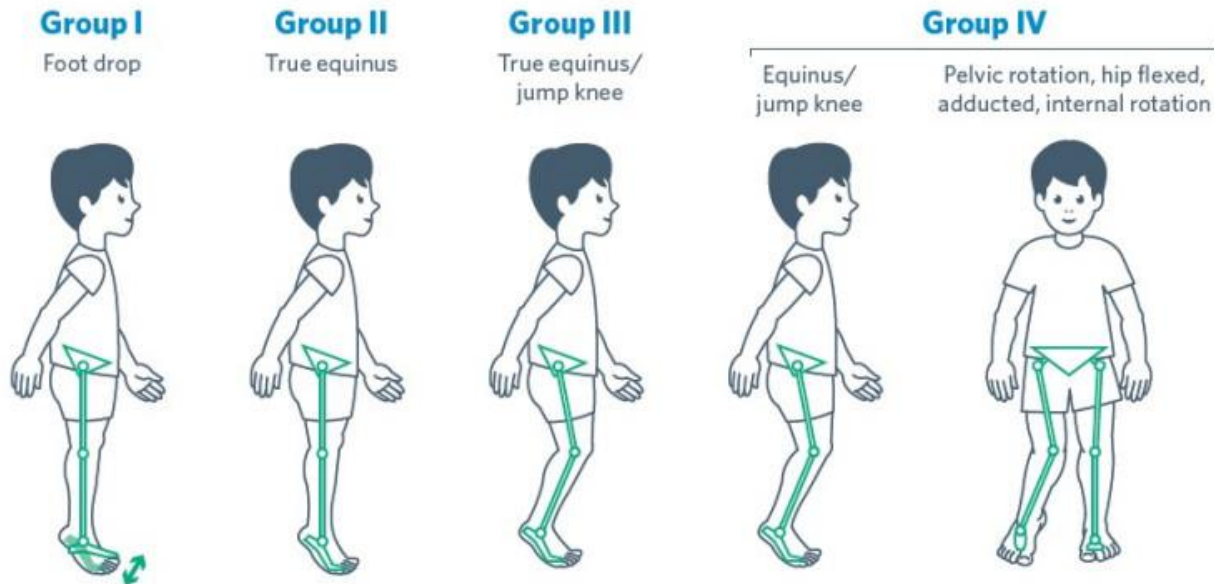


Leg length discrepancy (Hemiplegic CP)



Leg Length Discrepancy in Spastic Hemiplegic Cerebral Palsy

- Winters' type 1 or 2
- GMFCS level I
- Mean age: 17.6 years (n=44)



Flat foot



Sarcopenia

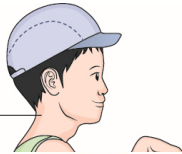
Low BMD

R

Patellar alta



목이 뒤로 넘어가거나
한쪽으로 기울어져 구축



주관절 굴곡구축과



첨족



첨내반족



첨외반족



편평외반족

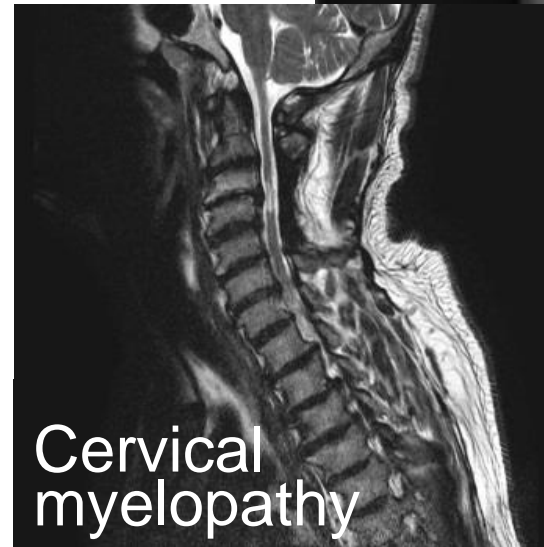


무지외반증

까치발모양 구축이 흔함



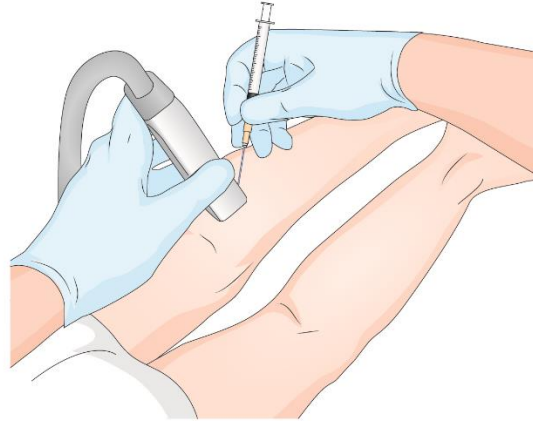
발목은 위로 아래로
안쪽으로 바깥쪽으로
경직에 따라 다양한 구축이
보일 수 있음



Cervical myelopathy



Prevention of musculoskeletal deformities



왜 자세유지도구가 필요한가요?



EFFECTIVE

DO IT **S+**

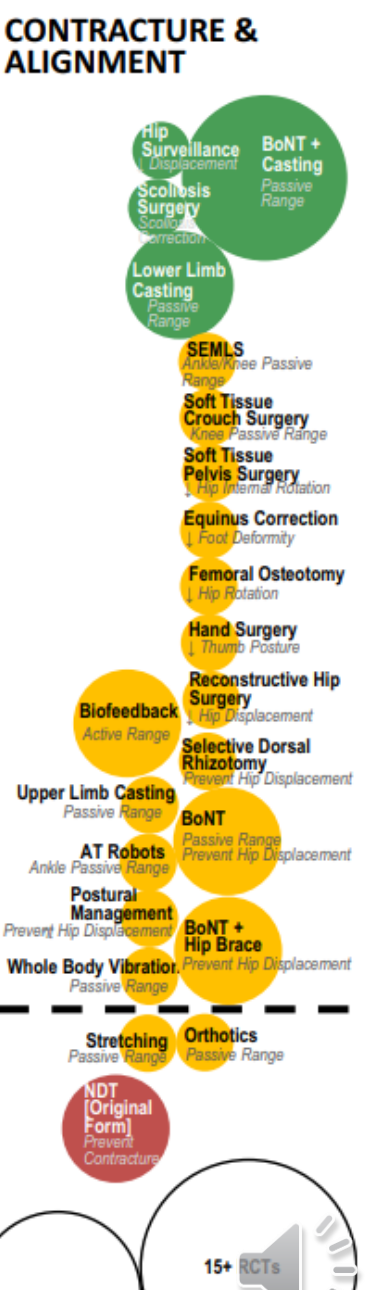
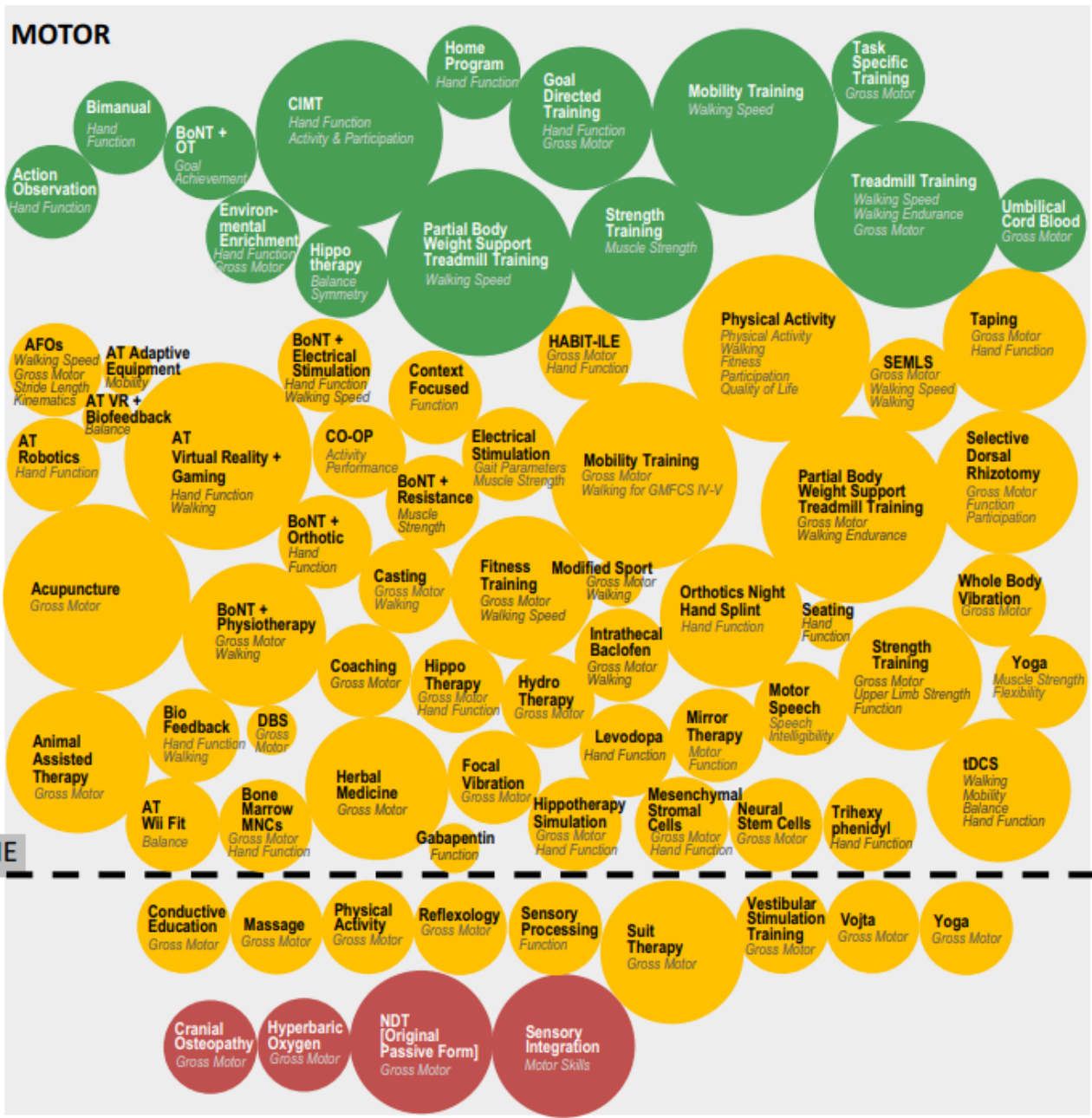
PROBABLY DO IT **W+**

WORTH IT LINE

PROBABLY DON'T DO IT **W-**

DON'T DO IT **S-**

INEFFECTIVE



LEGEND: AFOs= Ankle Foot Orthoses; AT= Assistive Technology; BoNT= Botulinum Toxin; CIMT= Constraint Induced Movement Therapy; CO-OP= Cognitive Orientation to Occupational Performance; COPCA= Coping with and Caring for infants with special needs - a family centered program; DBS= Deep Brain Stimulation; GAME= Goals Activity Motor Enrichment; NDT= Neurodevelopmental Therapy; OT= Occupational Therapy; SEMLS= Single Event Multi Level Surgery; tDCS=Transcranial Direct Current Stimulation

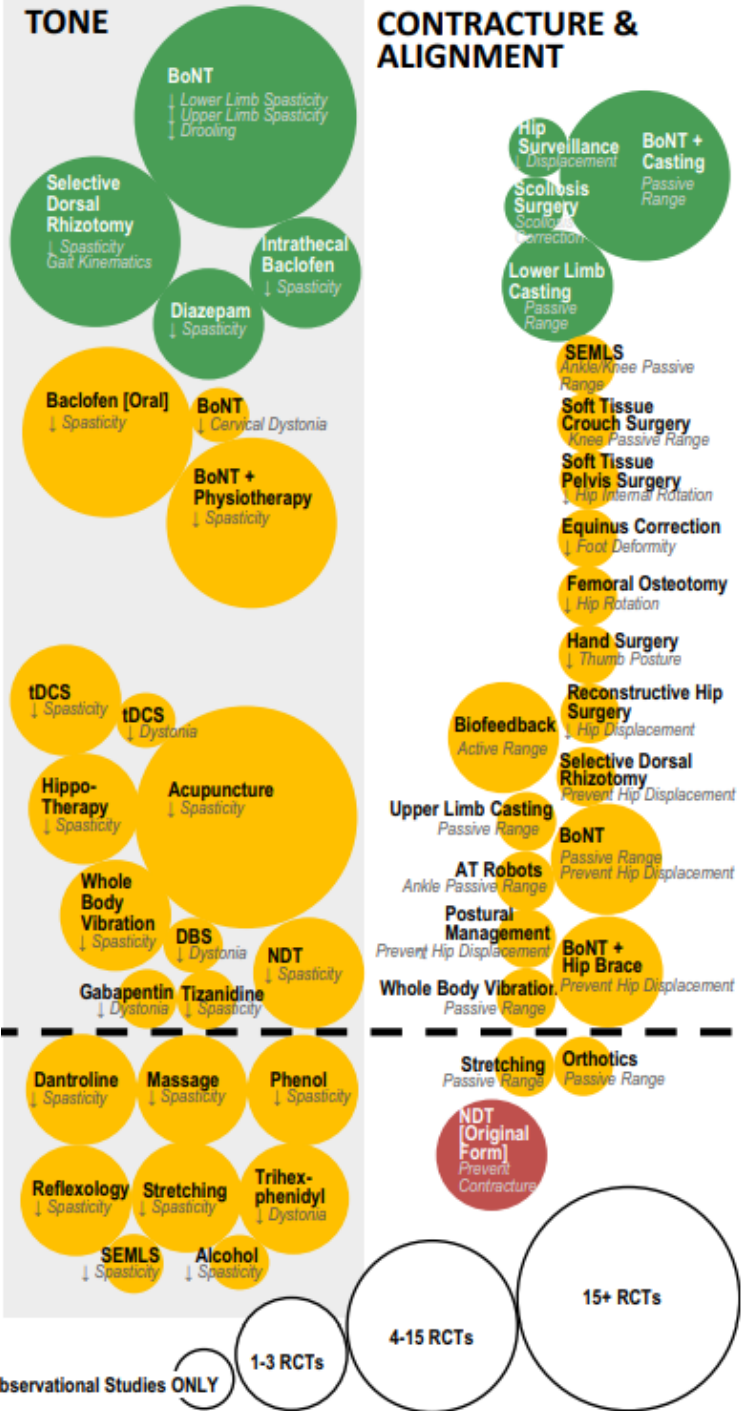
Observational Studies ONLY

1-3 RCTs

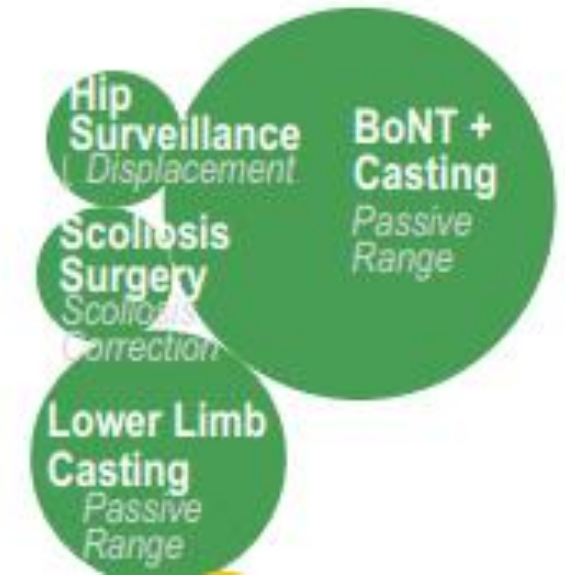
4-15 RCTs

15+ RCTs

EFFECTIVE



CONTRACTURE & ALIGNMENT



Novak I et al. State of the Evidence Traffic Lights 2019: Systematic Review of Interventions for Preventing and Treating Children with Cerebral Palsy. *Curr Neurol Neurosci Rep.* 2020 Feb 21;20(2):3.



Thank you for your attention!



대한소아재활·발달의학회

Korean Society of Pediatric Rehabilitation and Developmental Medicine

