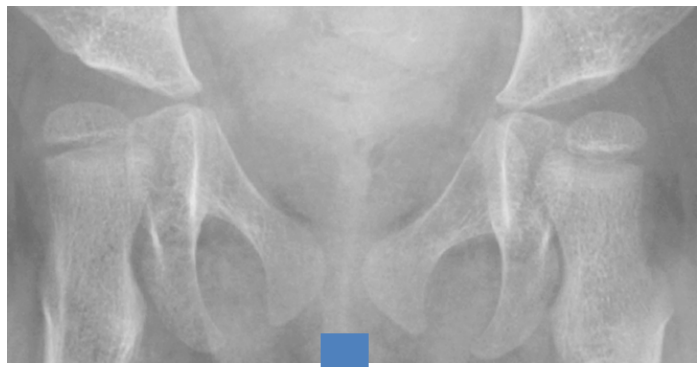


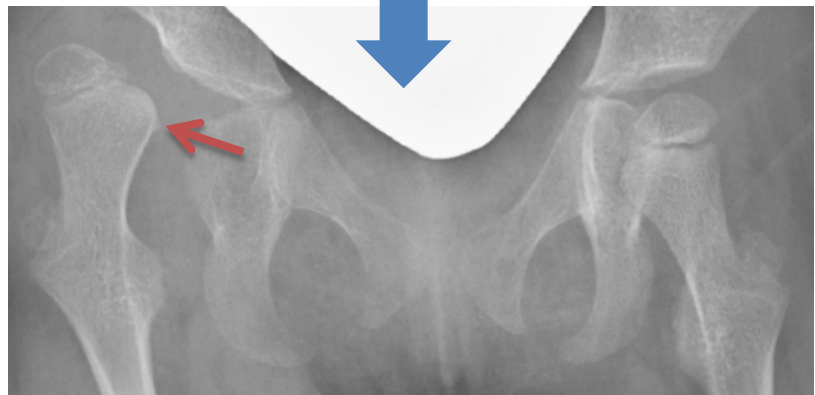


Why do Hip Surveillance?

Children with cerebral palsy are at increased risk for hip displacement. Hip displacement, or “subluxation,” is the gradual movement of the femoral head (ball) from the acetabulum (socket). As in the child’s x-rays below, progressive displacement may eventually lead to a hip dislocation where the ball is completely outside of the socket.

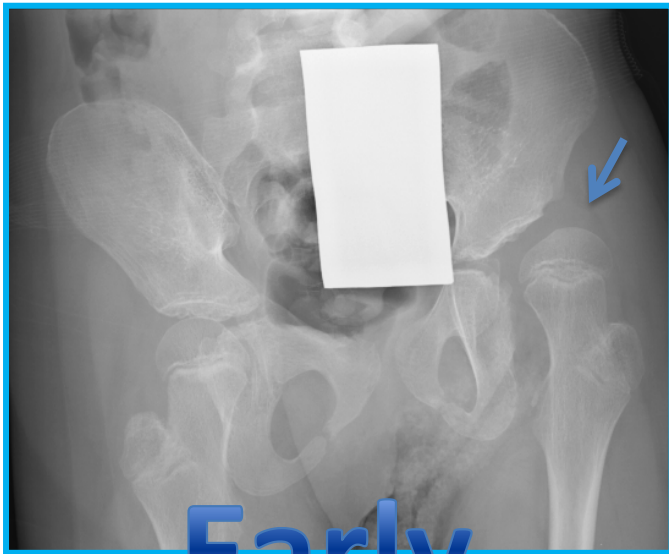


2 years



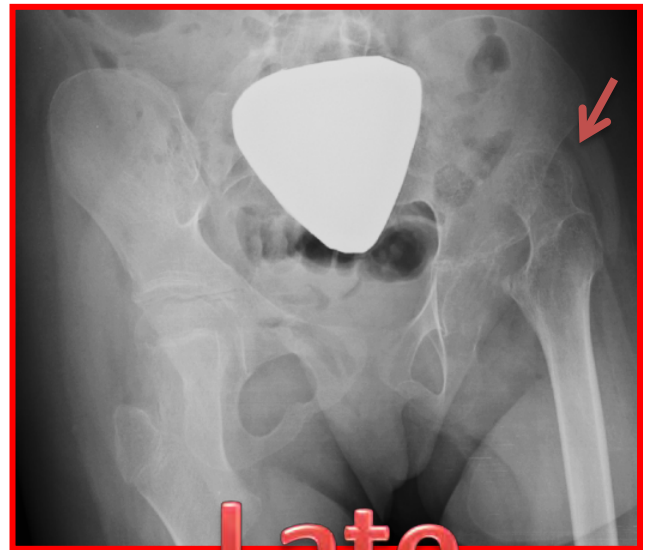
Dislocated Hip

A displaced or dislocated hip can become painful and cause problems with walking, standing, and sitting. Early identification of hip displacement with screening x-rays can identify ***silent*** hip problems that do not yet cause symptoms. Early interventions lead to better results.



Early

Hip displaced, but still partially in socket. Reconstruction of the hip is possible.



Late

Hip is dislocated and now painful. The outcome of reconstruction will not be as good.

Early identification of hip displacement opens up the option to treat hip displacement before it causes pain or decreased function.

The decision to treat hip displacement should be made by the child's parent or caregiver in consultation with a pediatric orthopaedic surgeon.

References:

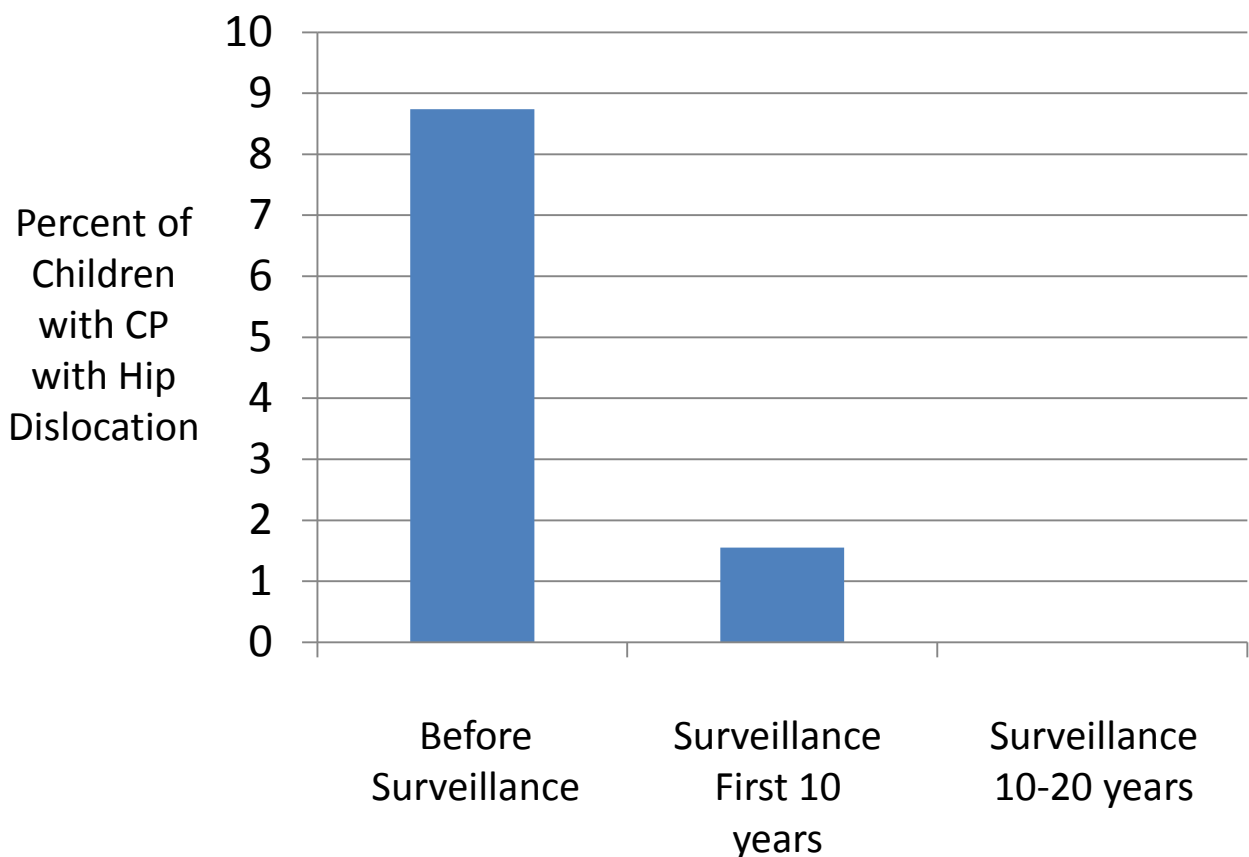
1. Hägglund G, Alriksson-Schmidt A, Lauge-Pedersen H, Rodby-Bousquet E, Wagner P, Westbom L. Prevention of dislocation of the hip in children with cerebral palsy: 20-year results of a population-based prevention programme. Bone Joint J. 2014 Nov;96-B(11):1546-52. Abstract available from: <http://www.ncbi.nlm.nih.gov/pubmed/25371472>
2. Australian Hip Surveillance Guidelines for Children with Cerebral Palsy 2014. Available from: <http://ausacpdm.org.au/professionals/hip-surveillance/australian-hip-surveillance-guidelines/>



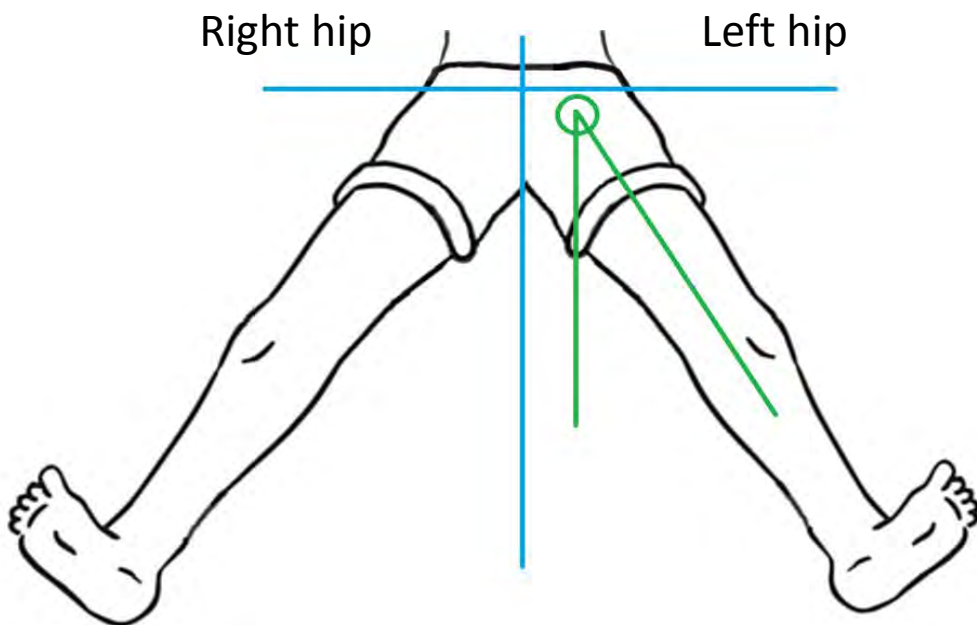
Children with cerebral palsy are at high risk of developing progressive hip problems.

Hip Surveillance is a schedule of regular clinical and x-ray examinations that can identify silent hip problems so they can be treated earlier and more effectively. Hip Surveillance has a proven record of improving a children's function in several high-quality population based studies, and is becoming the standard of care around the world for children with cerebral palsy.

Early identification of hip displacement using surveillance guidelines developed in Sweden and Australia have been shown to decrease or even prevent hip dislocations in children with cerebral palsy. In Sweden, a Hip Surveillance program was able to eliminate hip dislocations in the population after 20 years, as seen below:

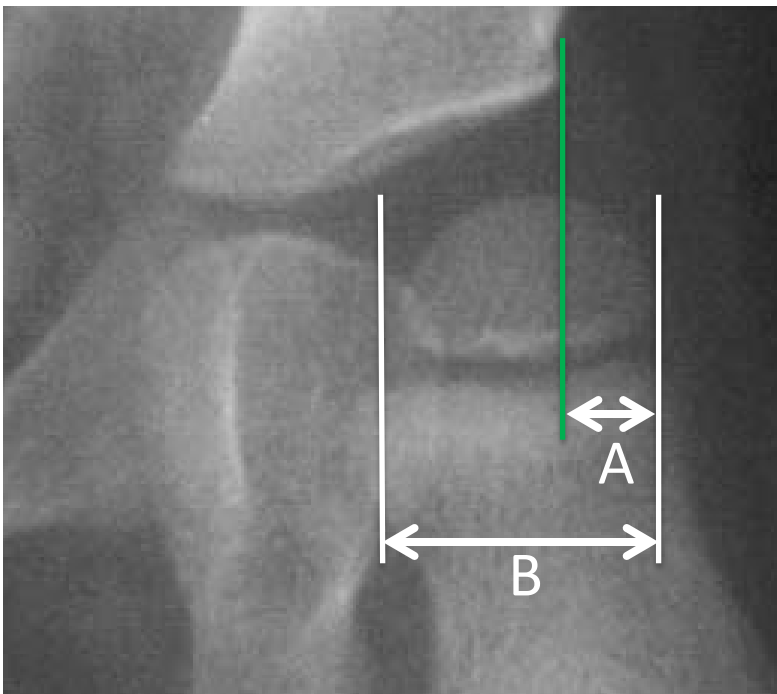


The most important clinical examination measurement is a measurement of how far each leg can be spread outwards, or “hip abduction.” The angle in green shown below is the hip abduction angle of the child’s left hip:



If the hip abduction of either hip is less than 30 degrees, the child should be evaluated by a pediatric orthopaedic surgeon.

The most important measurement on an x-ray is each hip's **migration percentage**, or the percentage of the femoral head that is outside of the margin of the acetabulum (green line).



Migration Percentage =

$$\frac{\text{Distance A}}{\text{Distance B}} \times 100\%$$

There is an increased risk of progressive hip displacement if the **Migration Percentage** is equal or greater than

30%

The child should be referred to a pediatric orthopaedic surgeon for discussion of further treatment if:

- The migration percentage on x-ray is over 30%
- The hip abduction motion is less than 30 degrees
- There is hip pain or decreased function
- There is deterioration in hip motion
- There is asymmetry in hip motion (one side moves less than the other)

References:

1. Parrott J, Boyd RN, Dobson F, Lancaster A, Love S, Oates J, Wolfe R, Natrass GR, Graham HK. Hip displacement in spastic cerebral palsy: repeatability of radiological measurement. *J Pediatr Orthop.* 2002;22:660-667. Abstract available from: <http://www.ncbi.nlm.nih.gov/pubmed/12198471>
2. Reimers J. The stability of the hip in children: a radiological study of results of muscle surgery in cerebral palsy. *Acta Orthop Scand.* 1980;184:1-100. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/6930145>



Hip displacement is among the most common deformities in children with cerebral palsy, and occurs in one-third of children with cerebral palsy. The risk of hip displacement is directly related to a child's motor function ability.

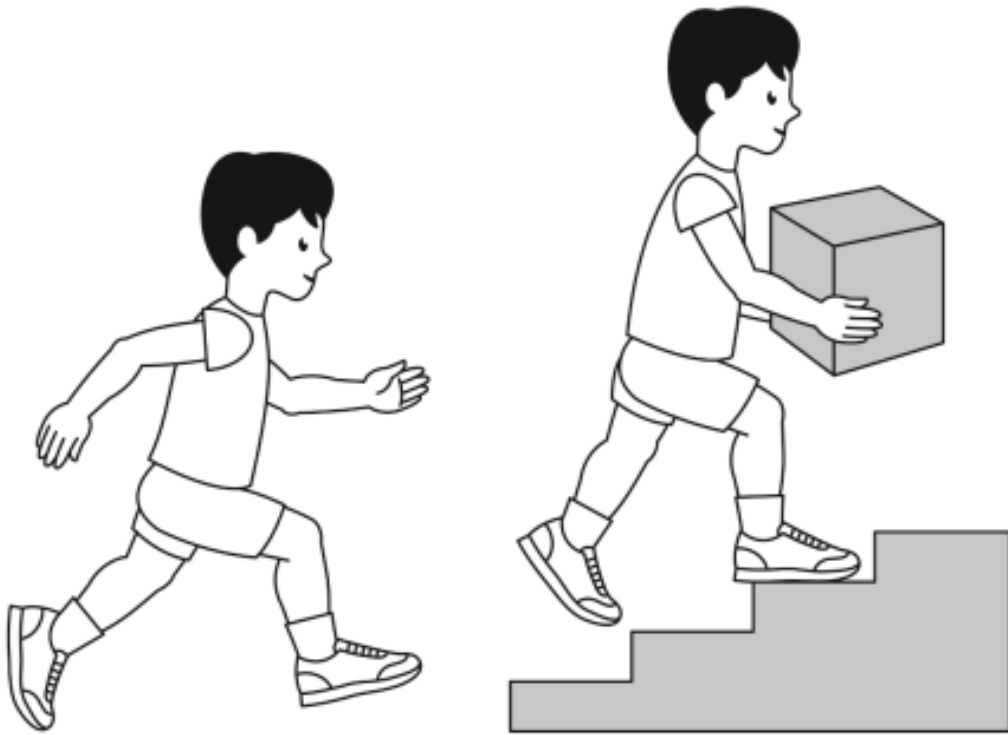
The five level Gross Motor Function Classification System (GMFCS) is an easy to understand classification of a child's ability to initiate movement.

It is a five-level classification system, ranging from levels I (most function) to V (least function).

Children with less severe cerebral palsy develop their motor milestones, such as sitting independently and walking, at similar ages to their peers without cerebral palsy. Children with more severe cerebral palsy will take longer to achieve the same milestones. The GMFCS system takes into account the developmental growth of children over time, and so it gives different descriptions for each GMFCS level at different age groups. This allows the GMFCS level to stay constant over time, even though the child is continuing to develop. You can find the **full GMFCS Classification** under the **Additional Resources tab**.

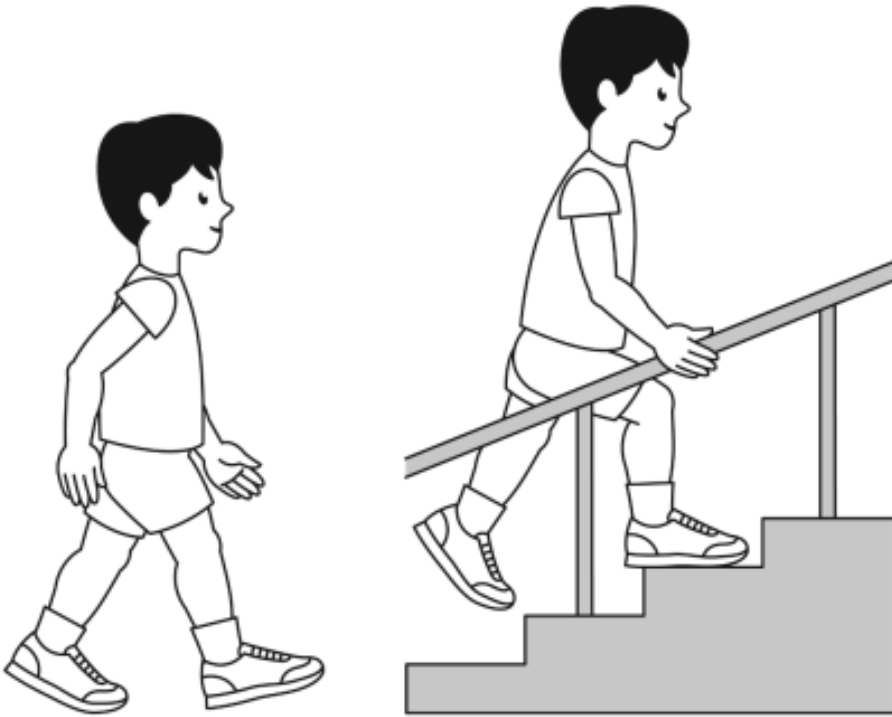
The GMFCS descriptions for the 6-12 age group are as follows:

Gross Motor Classification System (GMFCS) Level I



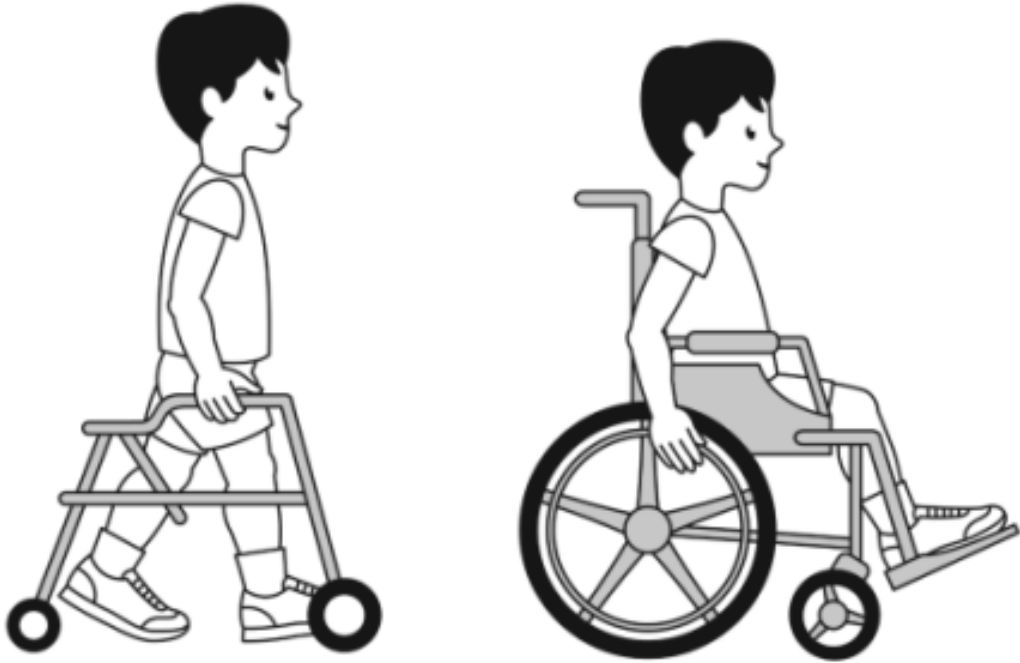
Children walk at home, school, outdoors, and in the community. They can climb stairs without the use of a railing. Children perform gross motor skills such as running and jumping, but speed, balance, and coordination are limited.

GMFCS Level II



Children walk in most settings and climb stairs holding on to a railing. They may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas, or confined spaces. Children may walk with physical assistance, a hand-held mobility device, or use wheeled mobility over long distances. Children have only minimal ability to perform skills such as running or jumping.

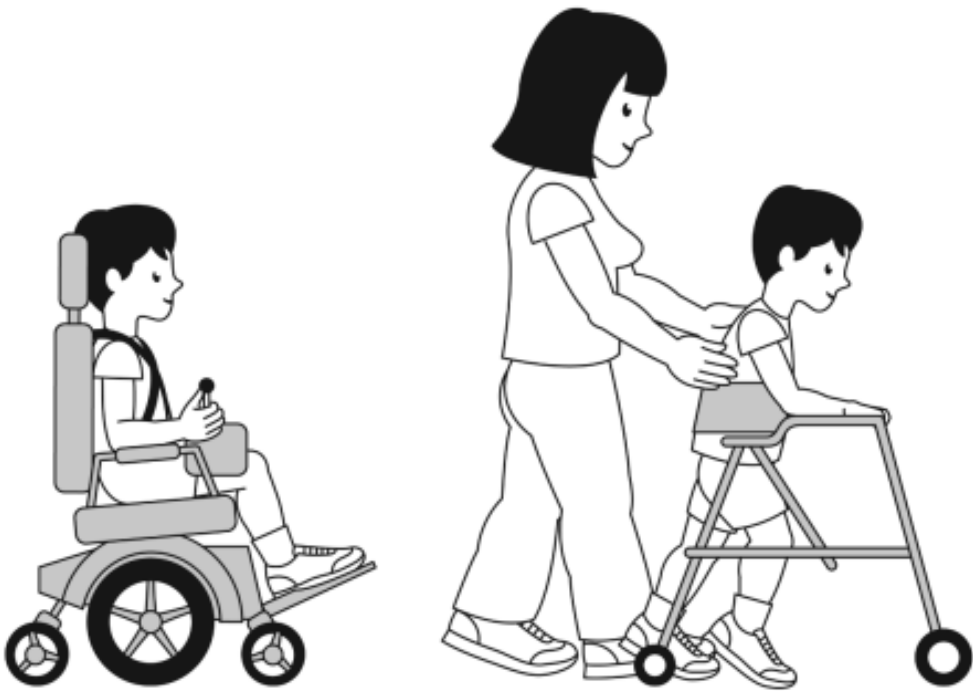
GMFCS Level III



Children use a hand-held mobility device in most indoor settings. They may climb stairs holding onto a railing with supervision or assistance.

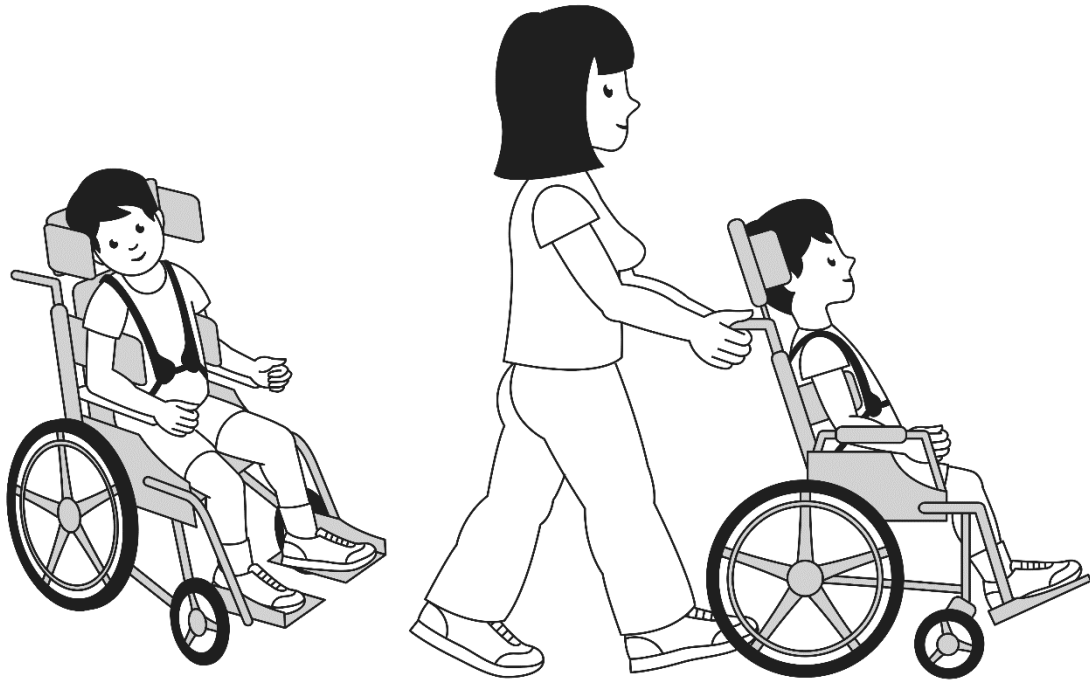
Children use wheeled mobility when traveling long distances or may self-propel for shorter distances.

GMFCS Level IV



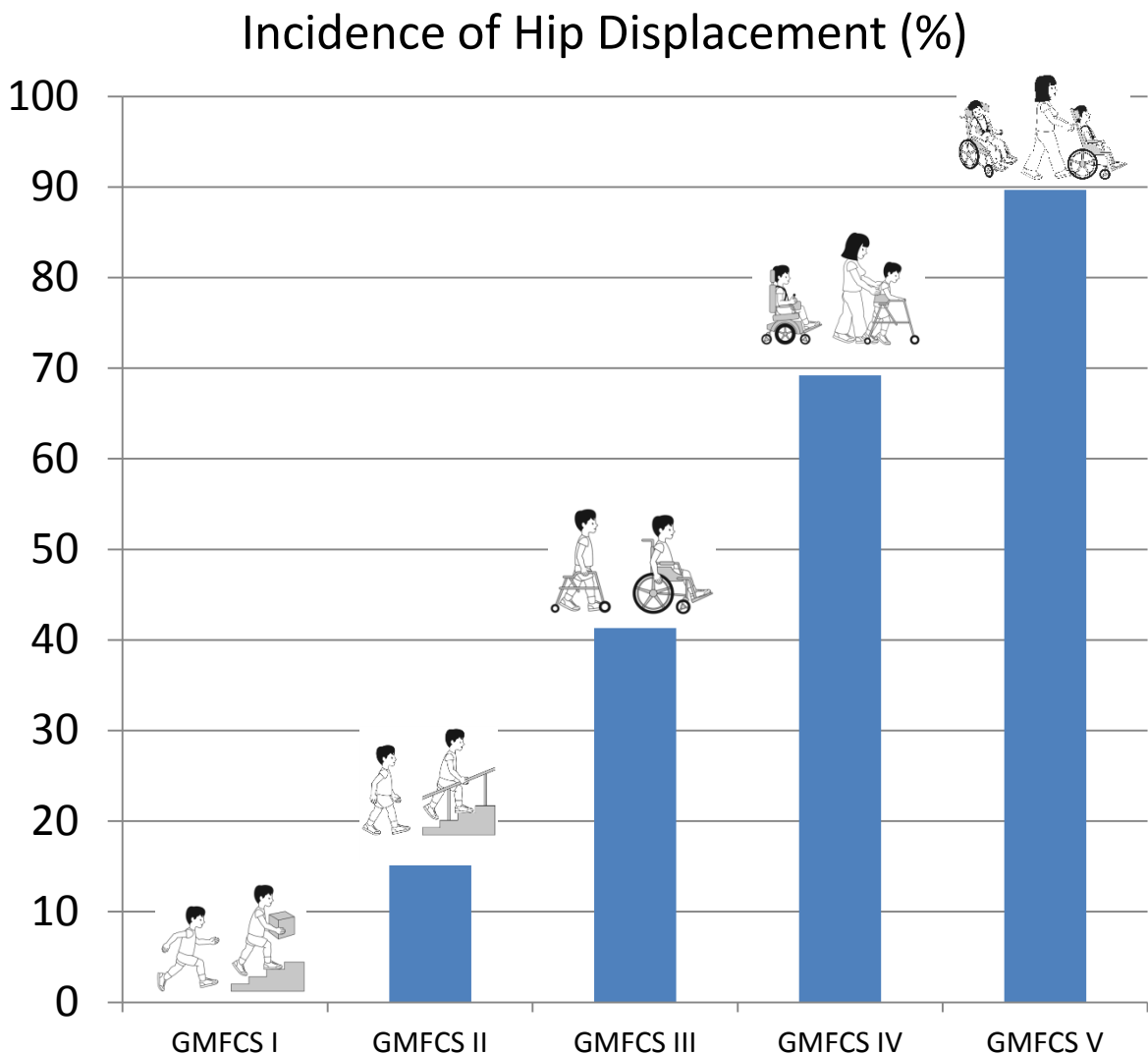
Children use methods of mobility that require physical assistance or powered mobility in most settings. They may walk for short distances at home with physical assistance or a body support walker. At school, outdoors, and in the community, children are transported in a manual wheelchair or use powered mobility.

GMFCS Level V



Children are transported in a manual wheelchair in all settings. Children are limited in their ability to maintain anti-gravity head and trunk postures and control arm and leg movement.

Population studies have shown that the GMFCS Level accurately stratifies the risk of hip displacement, and therefore, is used to determine the frequency of surveillance.

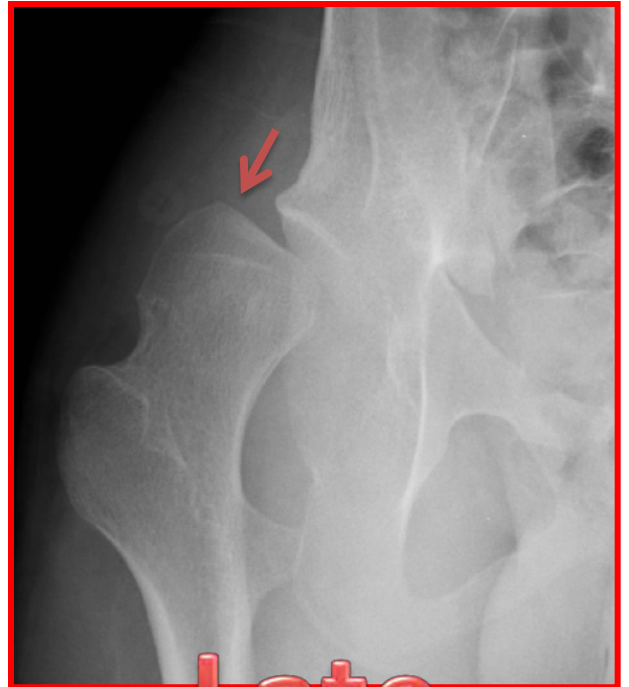


While the children who cannot walk have the highest risk of hip displacement, even those children that walk can develop hip displacement. When the hip displacement is caught early, more reliable and successful treatment is possible.



Early

A walking child with early hip displacement still has a round femoral head and is a candidate for successful reconstruction.



Late

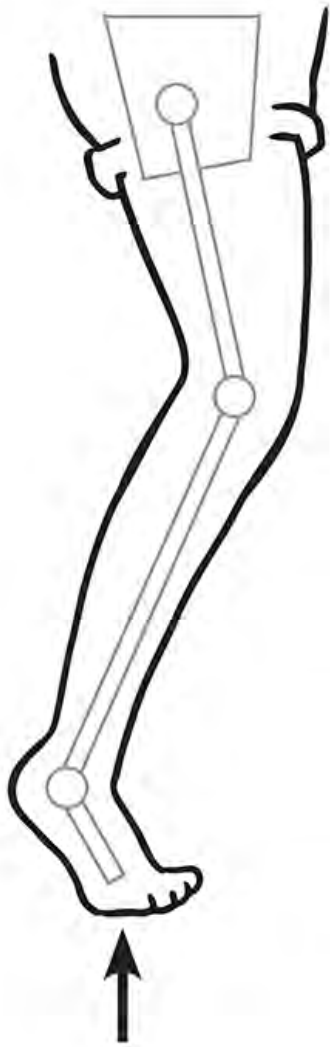
If the hip displacement is not treated, the femoral head can deform and flatten. This makes reconstruction procedures less successful.

A subset of walking children (GMFCS Levels I and II) is at even higher risk of hip displacement than would be expected by their GMFCS Level. These children have half of their body affected by cerebral palsy, termed “hemiplegia.” Though these children may be very functional, they have a high risk of silent hip displacement.

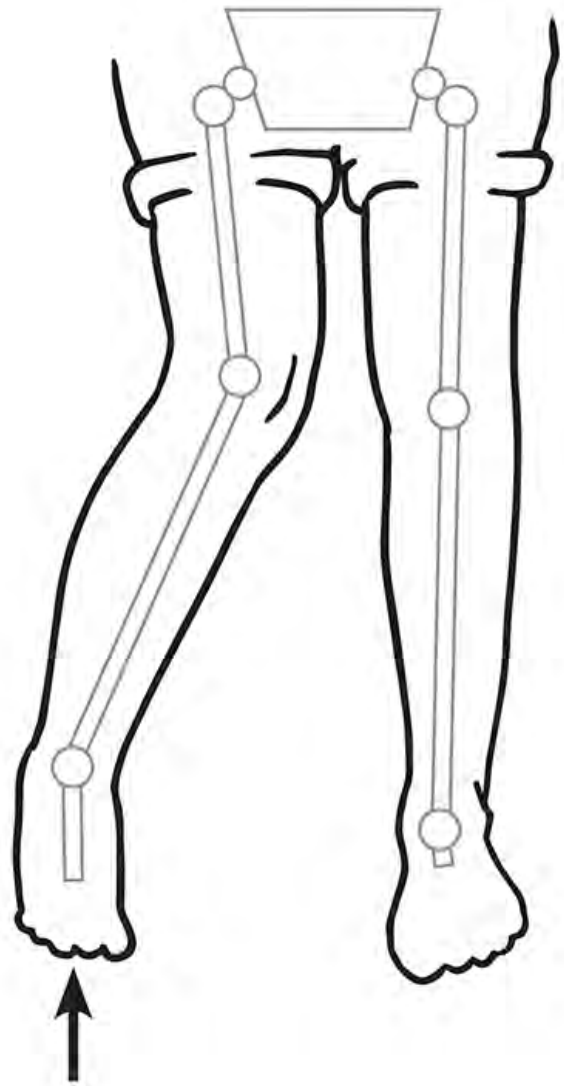
The highest risk group among these children with hemiplegia are termed “Group IV Hemiplegic Gait Pattern.” The features of their walking include:

- Inward rotation of the pelvis (pelvic rotation)
- Inward rotation of the hip (internal hip rotation)
- Affected leg crossed towards the midline of the body (hip adduction)
- Bent knee (knee flexion)
- Toe walking (ankle equinus)

Side view



Front view



In most hip surveillance guidelines, children with a Group IV Hemiplegic Gait pattern require more frequent examinations than would be expected by their GMFCS Level alone.

References:

1. Hagglund G, Lauge-Pedersen H, Wagner P. Characteristics of children with hip displacement in cerebral palsy. BMC Musculoskelet Disord. 2007;8:101-106. Abstract available from: <http://www.ncbi.nlm.nih.gov/pubmed/17963501>
2. Palisano RJ, Rosenbaum P, Bartlett D, Livingston MH. Content validity of the expanded and revised Gross Motor Function Classification System. Dev Med Child Neurol. 2008;50:744-750. Abstract available from: <http://www.ncbi.nlm.nih.gov/pubmed/18834387>
3. Soo B, Howard JJ, Boyd RN, Reid SM, Lanigan A, Wolfe R, Reddihough D, Graham HK. Hip displacement in cerebral palsy. J Bone Joint Surg [Am]. 2006;88:121-129. Abstract available from: <http://www.ncbi.nlm.nih.gov/pubmed/16391257>



How often should Hip Surveillance be done?

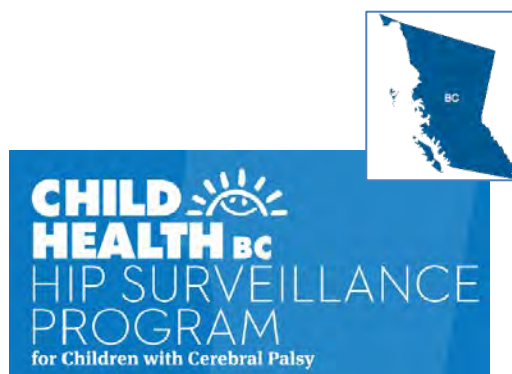
Hip Surveillance should be performed from the time a diagnosis of cerebral palsy is made up until skeletal maturity.

Hip Surveillance may be performed by a qualified and trained medical practitioner. This could be a physical therapist, physician assistant, nurse practitioner, pediatrician, physiatrist, or orthopaedic surgeon.

The American Academy for Cerebral Palsy and Developmental Medicine (AACPDMD) has published a Hip Surveillance Care Pathway based upon successful and published guidelines from North America, Europe, and Australia.

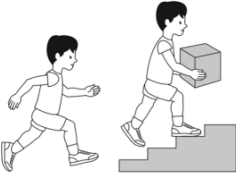
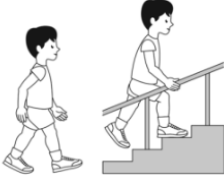
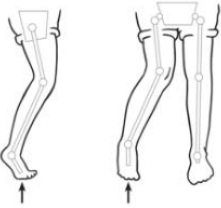
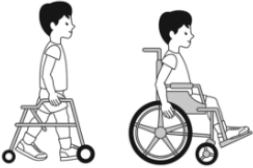
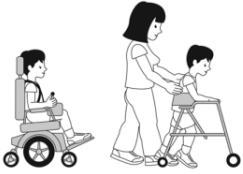
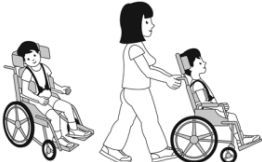
The common thread in all hip surveillance guidelines is that children with more severe cerebral palsy will require more frequent clinical assessments and x-rays.

The following four Hip Surveillance guidelines are included below:



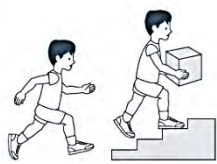
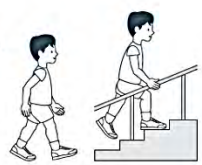
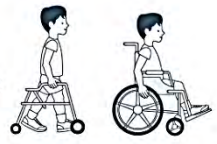

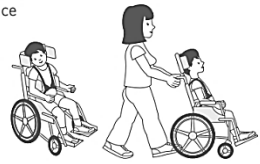





AAPCDM Hip Surveillance Care Pathway 2017

Adapted from www.aacpdm.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 • 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. |

Australian Hip Surveillance Guidelines for Children with Cerebral Palsy 2014

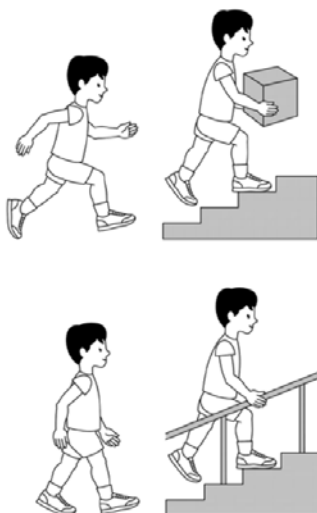
Adapted from www.ausacpdm.org.au

| GMFCS I | <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 3 years of age <ul style="list-style-type: none"> Verify GMFCS level If GMFCS I is confirmed, repeat clinical assessment. AP pelvic radiograph is NOT required | <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"> If GMFCS I is confirmed, repeat clinical assessment. AP pelvic radiograph is NOT required and if nil 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  |
|--|---|--|---|
| GMFCS II | <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"> 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"> 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  |
| GMFCS III | <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"> 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 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  |
| GMFCS IV | <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"> 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 prepuberty 12 monthly AP pelvic radiographs must resume prepuberty and continue until skeletal maturity | <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  |
| GMFCS V | <ul style="list-style-type: none"> Initial clinical assessment and AP pelvic radiograph at 12-24 months of age Review 6 months later Repeat clinical assessment and AP pelvic radiograph <ul style="list-style-type: none"> Verify GMFCS level If GMFCS V confirmed, continue 6 monthly surveillance until 7 years of age or until MP stability is established | <ul style="list-style-type: none"> If GMFCS level has changed, ongoing surveillance according to confirmed classification Review at 7 years of age <ul style="list-style-type: none"> If MP is stable, below 30% and gross motor function is stable, continue 12 monthly surveillance until skeletal maturity | <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  |
| Winters, Gage and Hicks hemiplegia group IV (WGH IV) | <p>WGH IV gait pattern clearly declares itself by 4-5 years of age. The child with a classification of WGH IV has the potential for late onset progressive hip displacement regardless of GMFCS level.</p> <ul style="list-style-type: none"> Review at 5 years of age <ul style="list-style-type: none"> Verify WGH and GMFCS <ul style="list-style-type: none"> If WGH I-III, 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 Review at 10 years of age <ul style="list-style-type: none"> Verify WGH IV <ul style="list-style-type: none"> 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 <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>Group I Foot drop</p>  </div> <div style="text-align: center;"> <p>Group II True equinus</p>  </div> <div style="text-align: center;"> <p>Group III True equinus/ jump knee</p>  </div> <div style="text-align: center;"> <p>Group IV Equinus/ jump knee</p>  </div> <div style="text-align: center;"> <p>Group IV Pelvic rotation, hip flexed, adducted, internal rotation</p>  </div> </div> <p style="text-align: center; font-size: small;">Gait patterns in hemiplegia (Winters, Gage and Hicks, 1987)</p> | | |

British Columbia Hip Surveillance Guidelines

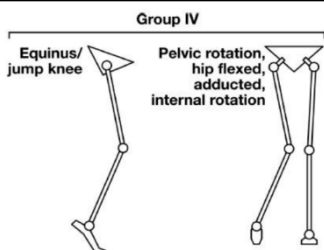
Adapted from www.childhealthbc.ca.

GMFCS 1 & II



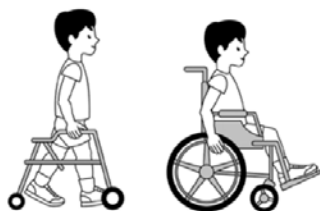
- At each Clinical Exam, verify GMFCS level and identify children with a Group IV gait
- If GMFCS level has changed or child is identified as having a Group IV gait, ongoing surveillance according to confirmed classification
- Initial Clinical Exam at identification of CP
- Review annually with Clinical 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

Hemiplegia Group IV



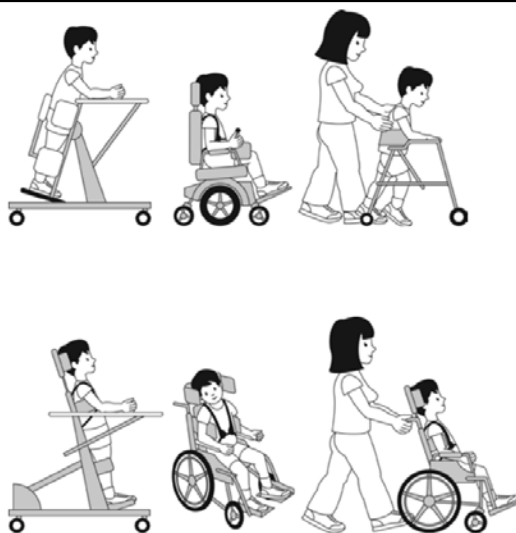
- Until 5 years of age, surveillance as per recommendations for children at GMFCS I & II
- After 5 years of age, Clinical Exam and AP pelvic x-ray 12 monthly until skeletal maturity

GMFCS III



- 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:
 - Clinical Exam 12 monthly
 - AP pelvic radiograph 24 monthly

GMFCS IV & V



- 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.

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| 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. |

Children with pure ataxia or athetosis at GMFCS levels II-III and without deterioration noted during the clinical examinations may be excluded from further radiographic examinations - provided that the first radiographic examination is normal.