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PAEDIATRIC ORTHOPAEDICS

RESIDENT TEACHING

Perthes

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6 year old limping boy

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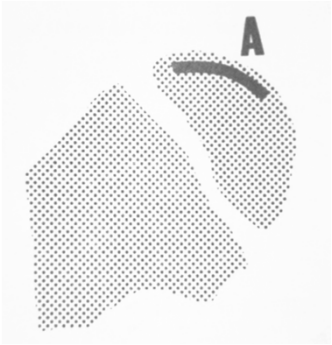
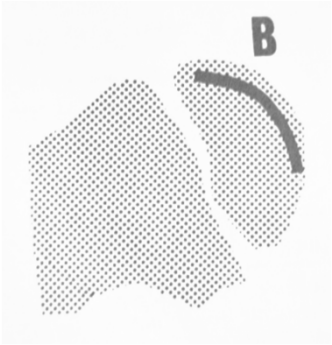
Salter Thompson Classification

Class A: Crescent sign involves less than ½ of femoral head
Class B: Crescent sign involves more than ½ of femoral head





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8 year old limping boy

Reading Xrays for Perthes

Epiphyseal collapse

- Which column
- Extent of collapse if in fragmentation

Bone matrix and size of epiphysis

- Sclerosis, small head with increased joint space
- Small head with subchondral fracture (classify – Salter-Thompson)
- Lucencies (classify – Herring/ Catterall)

Signs at risk of irreversible damage- hinge abduction

Outcome staging - Stulberg

Signs at risk

1. Gage's sign – V lucency at lateral epi
2. Calcification lat to epiphysis
3. Lat femoral subluxation
4. Horizontal plate
5. Metaphyseal lucencies

crescent sign

Waldenstrom

Stage	Description	Time horizon
Stage 1	Ischemia /necrosis • Small sclerotic head • Increase joint space	6-12 months
Stage 2	Fragmentation • Early - Crescent sign • Late – Lucencies	12-17 months
Stage 3	Resolution and Reossification	6-12 months
Stage 3	Healing and Remodelling • Coxa magna • Coxa brevis • Coxa plana • Sagging rope sign	

Modified Herring Lateral Pillar classification

**Herring Group	Description
A	The lateral pillar is uninvolved, with full height maintained
B	Greater than 50% of lateral pillar height maintained
B/C	(B/C 1) Greater than 50% of lateral pillar height with narrow column width (2–3mm). (B/C 2) Approximately 50% of lateral pillar height maintained, with poor ossification. (B/C 3) 50% lateral pillar height maintained, but depressed relative to central pillar
C	Less than 50% of lateral pillar height maintained

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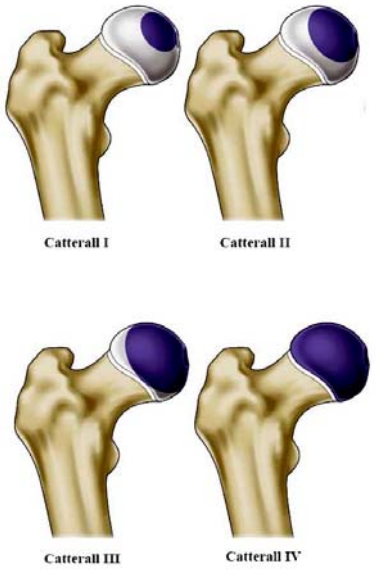
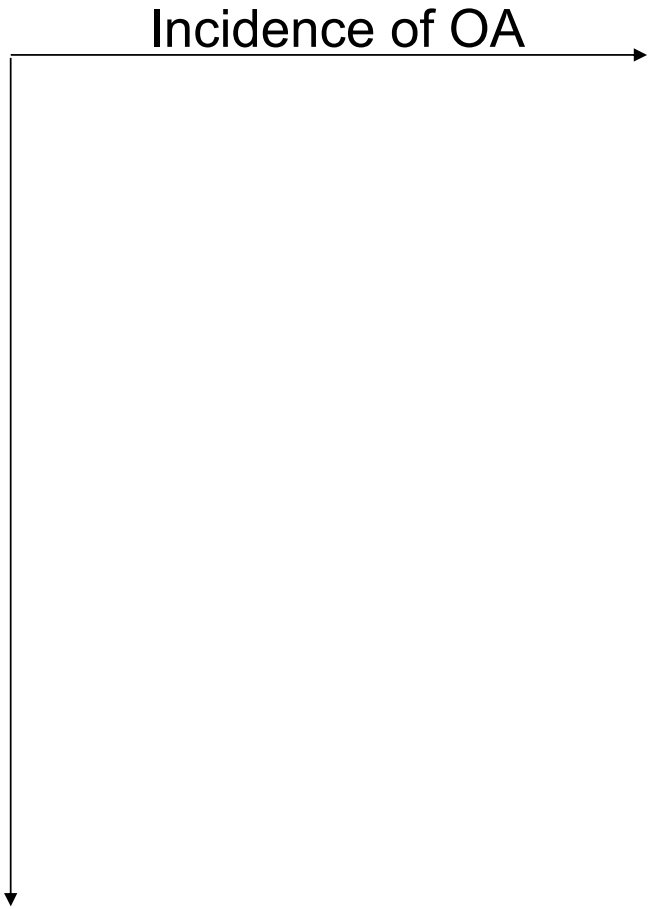
Modified Catterall Classification

* Modified Catterall Group	Description
A	Femoral head necrosis <50%
B	Femoral head necrosis >50%
+ www.unmcradiology.net/boneage/ (Adapted from Greulich and Pyle, 1950)	



STULBERG CLASSIFICATION

I	Normal hip Spherical
II	Spherical femoral head, same concentric circle on anteroposterior and frog-leg lateral views, but with one or more of the following: coxa magna, shorter than-normal neck, abnormally steep acetabulum Spherical
III	Ovoid, mushroom-shaped (but not flat) head, coxa magna, shorter-than-normal neck, abnormally steep acetabulum Aspherical
IV	Flat femoral head and abnormalities of the head, neck, and acetabulum Aspherical
V	Flat head, normal neck and acetabulum Aspherical incongruency



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DEFINITION

Legg-Calvé-Perthes Disease (LCDP)

Avascular event affects capital head

↓

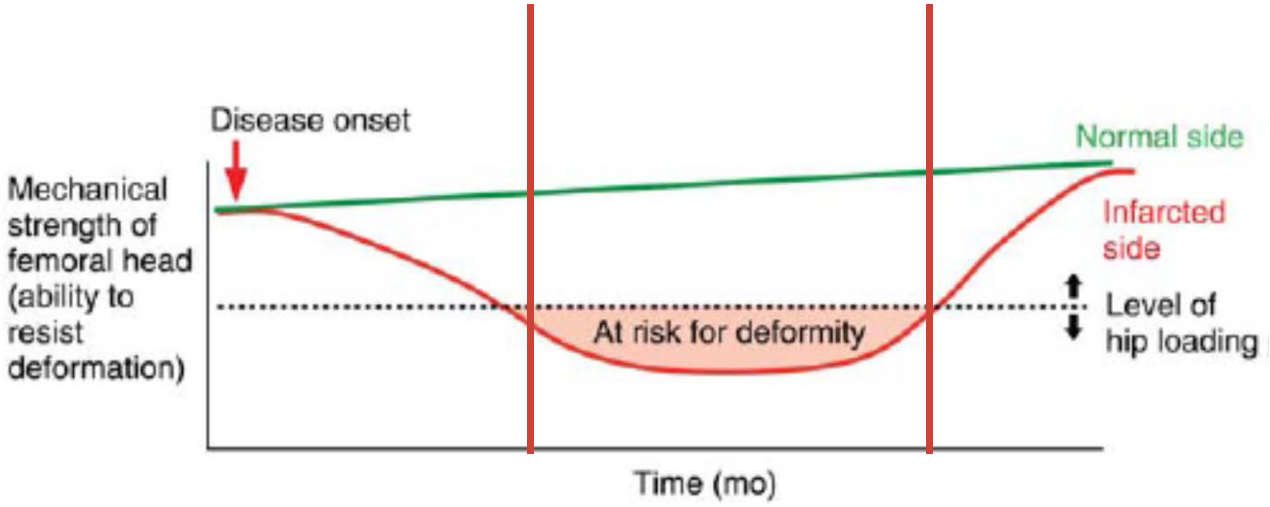
Growth of ossific nucleus stops and replaced by new bone

↓

Head flatten and enlarge due mechanical changes subjected to femoral head

↓

Head remodels until skeletal maturity



Graphic representation of the mechanical changes in the necrotic femoral head versus a normal hip. The extent of head involvement, degree of imbalance between bone resorption and formation, duration of healing, and level of hip loading likely affect the deformity. The potential to remodel the deformed head, as seen in young patients, offsets the deformity produced in the acute phase.

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MANAGEMENT OF PERTHES IS PREVENTIVE

Prognosis

- Gender
- Age of onset
- ROM
- Disease involvement
- At risk signs

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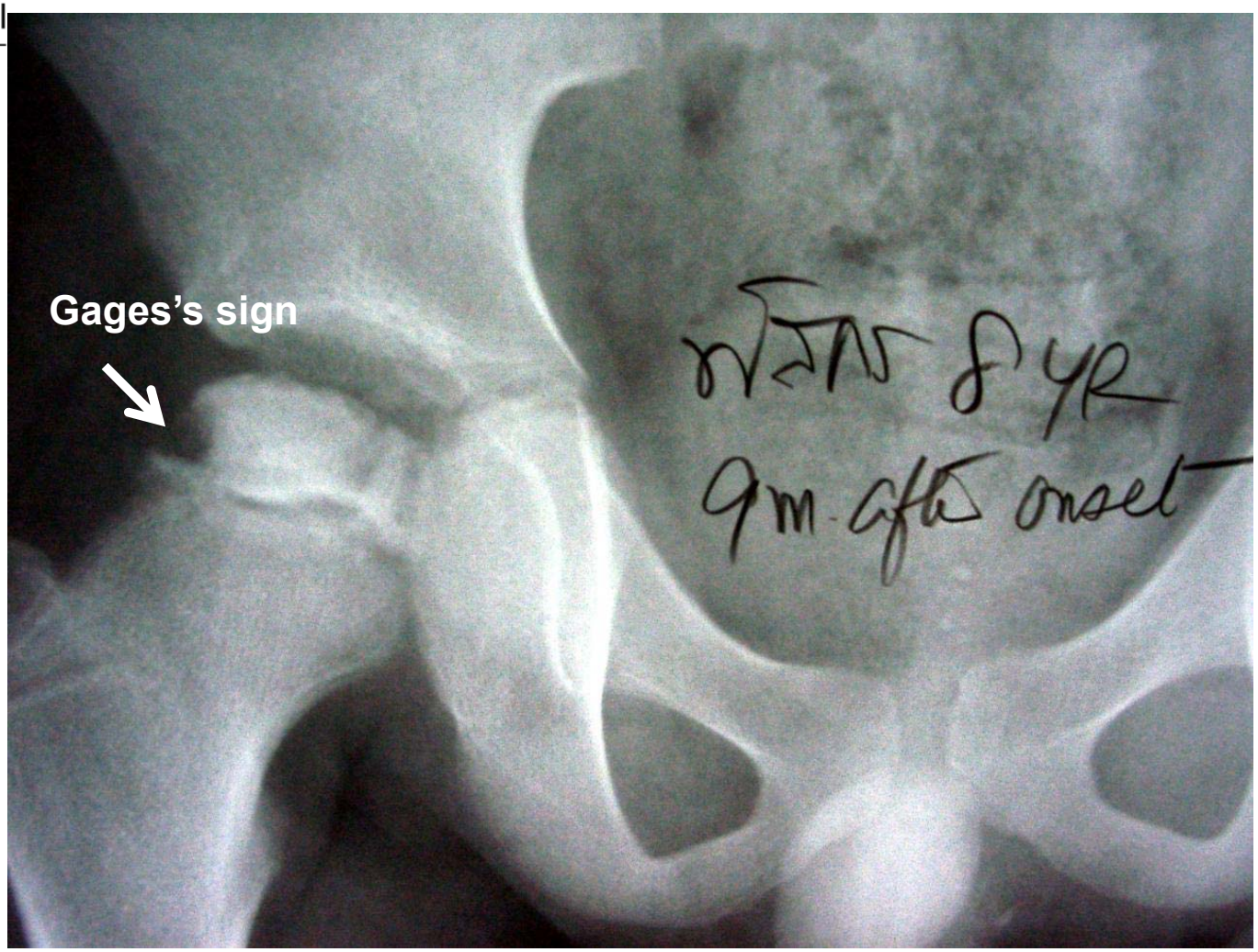

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Management

Containment during fragmentation stage only.

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10 year old Boy

- Complains of limping

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LEGG-CALVÉ-PERTHES DISEASE

PART II: PROSPECTIVE MULTICENTER STUDY OF THE EFFECT OF TREATMENT ON OUTCOME

BY JOHN A. HERRING, MD, HUI TAEK KIM, MD, AND RICHARD BROWNE, PHD

Investigation performed at Texas Scottish Rite Hospital for Children, Dallas, Texas

Background: The treatment of Legg-Calvé-Perthes disease has been based on uncontrolled retrospective studies with relatively small numbers of patients. This large, controlled, prospective, multicenter study was designed to determine the effect of treatment and other risk factors on the outcome in patients with this disorder.

Methods: We enrolled 438 patients with 451 affected hips in a prospective multicenter study in which each investigator applied the same treatment method to each of his or her patients*. The five treatment groups consisted of no treatment, brace treatment, range-of-motion exercises, femoral osteotomy, and innominate osteotomy. All patients were between 6.0 and 12.0 years of age at the onset of the disease, and none had had prior treatment. Three hundred and forty-five hips in 337 patients were available for follow-up at skeletal maturity. All hips were classified with the modified lateral pillar classification and the system of Stulberg et al.

Results: There were no differences in outcome among the hips with no treatment, those treated with bracing, and those treated with range-of-motion therapy. There were also no differences between the hips treated with a femoral varus osteotomy and those treated with an innominate osteotomy. Treatment did not have a significant effect on children who had a chronologic age of 8.0 years or less or a skeletal age of 6.0 years or less at the onset of the disease. In the lateral pillar B group and B/C border group, the outcomes of surgical treatment were significantly better than those of nonoperative treatment in children over the age of 8.0 years at the onset of the disease ($p \leq 0.05$). Patients who were 8.0 years old or less at the onset of the disease in lateral pillar group B did equally well with nonoperative and operative treatment. Hips in lateral pillar group C had the least favorable outcomes, with no differences between the operative and nonoperative groups. The lateral pillar classification ($p < 0.0001$) and the age at the onset of the disease ($p = 0.0001$) were both strong prognostic factors. Female patients did significantly worse than male patients if they were over the age of 8.0 years at the onset of the disease ($p = 0.004$).

Conclusions: The lateral pillar classification and age at the time of onset of the disease strongly correlate with outcome in patients with Legg-Calvé-Perthes disease. Patients who are over the age of 8.0 years at the time of onset and have a hip in the lateral pillar B group or B/C border group have a better outcome with surgical treatment than they do with nonoperative treatment. Group-B hips in children who are less than 8.0 years of age at the time of onset have very favorable outcomes unrelated to treatment, whereas group-C hips in children of all ages frequently have poor outcomes, which also appear to be unrelated to treatment.

Level of Evidence: Therapeutic study. Level II-1 (prospective cohort study). See Instructions to Authors for a complete description of levels of evidence.

Opinions about the treatment of Legg-Calvé-Perthes disease vary widely. The earliest treatment programs arose from the methods used to treat tuberculosis of the hip. Those methods included spica cast immobilization, bed rest, traction, and walking with a weight-relieving caliper. Surgical methods were also employed in the early years, with Legg, Calvé, and Waldenstrom eventually coming to the conclusion that treatment had little effect on the outcome[1-3]. Some modern authors have recommended nonoperative means such as bracing and cast immobilization and have reported satisfactory outcomes for most patients[4-7]. Many authors have reported good results with femoral varus osteotomies[10-14]. Others have recommended the Salter innominate osteotomy as an effective treatment alternative[10,15-18]. Still others have advocated more complex surgical intervention,

*The Legg-Perthes Study Group includes Peter T. Armstrong, John C. Birch, William H. Browning, Alvin H. Crawford, Peter A. DeLuca, Frederick R. Dietz, Anne K. Dias, Keith Gabriel, Neil E. Green, Richard H. Gross, Curtis R. Gruel, William A. Herndon, John A. Herring, Brian L. Hoitch-kiss, James G. Jarvis, Charles T. Johnston II, Vicki Kalen, John D. King, Dayle L. Maples, John B. McIver, Peter L. Moehen, Marc J. Moreau, Raymond T. Morrissy, Colin F. Moseley, Scott J. Mubarak, Richard Nicol, George T. Rab, B. Stephens Richards, Lawrence A. Rinsky, James W. Roach, J. Andy Sullivan, Elizabeth A. Szabo, George H. Thompson, G. Timothy Ward, Hugh G. Watts, Stuart L. Weinstein, Dennis R. Wenger, David A. Yngve, Seymour Zimbler. Diane Ramey was the study coordinator. The eight pediatric orthopaedists in the Pediatric Orthopaedic Study Group included Hugh H. Watts, George H. Thompson, George T. Rab, John A. Herring, W. Timothy Ward, Stuart L. Weinstein, J. Andy Sullivan, and Neil E. Green.

Herring J, Kim H, Browne R:
Legg-Calvé-Perthes disease: Part II. Prospective multicenter study of the effect of treatment on outcome.
J Bone Joint Surg Am 2004; 86:2121.

438 patients with 451 affected hips in a prospective multicenter study

Conclusions:
The lateral pillar classification and age at the time of onset of the disease strongly correlate with outcome in patients with Legg-Calvé-Perthes disease.

Patients who are over the age of 8.0 years at the time of onset and have a hip in the lateral pillar B group or B/C border group have a better outcome with surgical treatment than they do with nonoperative treatment.

Group-B hips in children who are less than 8.0 years of age at the time of onset have very favourable outcomes unrelated to treatment,

whereas group-C hips in children of all ages frequently have poor outcomes, which also appear to be unrelated to treatment.

THE JOURNAL OF BONE & JOINT SURGERY (BRITISH)

Prognostic factors and outcome of treatment in Perthes' disease

A PROSPECTIVE STUDY OF 368 PATIENTS WITH FIVE-YEAR FOLLOW-UP

O. Wiig,
T. Terjesen,
S. Svenningsen

From Ullevål University Hospital, Oslo, Norway

This nationwide prospective study was designed to determine prognostic factors and evaluate the outcome of different treatments of Perthes' disease.

A total of 28 hospitals in Norway were instructed to report all new cases of Perthes' disease over a period of five years and 425 patients were reported and followed for five years. Of these, 368 with unilateral disease were included in the present study. The hips were classified radiologically according to a modified two-group Catterall classification and the lateral pillar classification. A total of 358 patients (97%) attended the five-year follow-up, when a modified three-group Stulberg classification was used as a radiological outcome measure. For patients over six years of age at diagnosis and with more than 50% necrosis of the femoral head (152 patients), the surgeons at the different hospitals had chosen one of three methods of treatment: physiotherapy (55 patients), the Scottish Rite abduction orthosis (26), and proximal femoral varus osteotomy (71). Of these hips, 146 (96%) were available for the five-year follow-up.

The strongest predictor of outcome was femoral head involvement of more or less than 50% (odds ratio (OR) = 7.76, 95% confidence interval (CI) 2.82 to 21.37), followed by age at diagnosis (OR = 0.98, 95% CI 0.92 to 0.99) and the lateral pillar classification (OR = 0.62, 95% CI 0.40 to 0.98). In children over six years at diagnosis with more than 50% of femoral head necrosis, proximal femoral varus osteotomy gave a significantly better outcome than orthosis (p = 0.001) or physiotherapy (p = 0.001). There was no significant difference between the physiotherapy and orthosis groups (p = 0.36), and we found no difference in

J Bone Joint Surg Br. 2008 Oct;90(10):1364-71. doi: 10.1302/0301-620X.90B10.20649.

Prognostic factors and outcome of treatment in Perthes' disease: a prospective study of 368 patients with five-year follow-up.

Wiig O1, Terjesen T, Svenningsen S.

"In conclusion, this study shows that the strongest predictor of outcomes is the modified two-group Catterall classification, followed by age at diagnosis and the lateral pillar
classification.

We recommend proximal femoral varus osteotomy in children above six years of age at diagnosis with hips having more than 50% femoral head necrosis.

The abduction orthosis should be abandoned in the treatment of Perthes disease."

Treatment Guide

Age of Onset	Herring Classification	Treatment
≤ 8 years old	All	Symptomatic
> 8 years old	A and C	Symptomatic
> 8 years old	B and B/C border	Surgery

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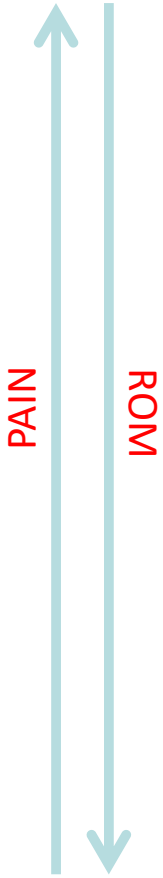
Treatment Principles

Synovitis Muscle spasm	→	Reversible with Nsaids, activity modification and stretching
Secondary contractures Signs at risk	→	Requires soft tissue releases and containment in the fragmentation stage.
Bony changes with Hinge abduction	→	Salvage and removal of mechanical blocks



Symptomatic Treatment

Acute Synovitis

- NSAIDs
- Bed rest

Physiotherapy

- Adductor, Internal rotators and Iliospoas stretches
- Active abduction, External rotation

Activity modification

- Minimise running and jumping

Bracing

- no established role so far

Surgical Options

Containment

- Femoral varus osteotomy
- Salter innominate osteotomy or other redirectional osteotomies (Steele, Triple, Ganz periacetabular)
- Both osteotomies combined (onset after age 9 years).

Surgical Options

Salvage

- femoral valgus osteotomy for established head and acetabular flattening, adducted hip, short leg gait
- Acetabular osteotomies : Shelf or Chiari

Mechanical symptoms

- hip arthroscopy with removal of osteochondrotic fragment,
- Surgical hip dislocation

NEW

Summary

Three names

- Waldenstrom for grading
- Herring/Catterall for classification
- Stulberg for outcome

Management is preventive

- Containment during fragmentation to allow for remodeling in the optimal environment

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MANAGEMENT OF PERTHES DISEASE IN KKH

Perthes Disease Diagnosed

XR Pelvis (AP and Frog Leg Lateral) – Waldenstrom Classification
XR Left Hand – Refer to Digital Atlas[+] for Bone Age

Initial Stage

Conservative Treatment
Excuse Physical Activities
PO Ibuprofen for pain relief
Physiotherapy for ROM exercises
TCU 4 – 6 monthly, Pelvis XOA
Follow-up until skeletal maturity

Fragmentation Stage

Modified Catterall Classification*		Herring Lateral Pillar Classification**		Management
Bone Age[+]	Group	Age	Group	
< 6 years	Any	< 8 years	Any	Conservative
≥ 6 years	A	< 8 years	A or C	Conservative
	B	≥ 8 years	B or B/C	Surgery

Reossification / Remodelling Stage

Conservative Treatment
Excuse Physical Activities
PO Ibuprofen for pain relief
Physiotherapy for ROM exercises
TCU 6 monthly, Pelvis XOA
Follow-up until skeletal maturity

Salvage Surgery (Stulberg III/IV)
Reduce Hinge Abduction
Prevent Secondary Osteoarthritis

* Modified Catterall Group	Description
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C	Less than 50% of lateral pillar height maintained

Prepared by Dr Benjamin Ding (Dec 2018)
Updated by Dr Jonathan Gan (Dec 2020)

*Wiig O, Terjesen T, Svenningsen S. Prognostic factors and outcome of treatment in Perthes' disease: a prospective study of 368 patients with five-year follow-up. J Bone Joint Surg Br. 2008 Oct;90(10):1364-71. PubMed PMID: 18827249.
**Herring JA, Kim HT, Browne R. Legg-Calve-Perthes disease. Part II: Prospective multicenter study of the effect of treatment on outcome. J Bone Joint Surg Am. 2004 Oct;86(10):2121-34. Pubmed PMID: 15466720.

The Shapes of Perthes

- Coxa Magna
- Coxa Plana
- Coxa Brevi
- Sagging rope sign