Legg-Calvé-Perthes Disease
Introduction

First three reports 1910:

Georg Clemens Perthes (Germany)

Jacques Calvé (France)

Arthur T. Legg (USA)
Introduction

M. Perthes is a idiopathic avascular necrosis of the femoral epiphysis in children
Epidemiologie

0.2 - 19.1 / 100'000 children, highest in white children

Between 2 and 12 years, highest between 5-6 years

Male to female ratio: 5:1

10 - 15 % bilateral

Seyed MM et al; Current Concept Review; Evolution in diagnosis and treatment of Legg-Calve-Perthes disease;
AB&JS 2014;2(2):86-92
Etiology

Unknown

The Children tend to have a short stature and delayed bone maturation.

Disruption in vascular supply

Exposure to tobacco smoke

Coagulation abnormalities

Daniel AB et al.; Environmental tobacco and wood smoke increase the risk of Legg-Calvé-Perthes disease; Clin Orthop Relat Res 2012; 470(9):2369-2375.
Clinical manifestation

(painless) limping

Pain (groin, thigh or knee)

Hip stiffness (abduction und IR)

Trendelenburg gait

Limb length discrepancy
Differential diagnosis

Transient synovitis

Septic arthritis

Slipped capital femoral epiphysis (SCFE)

Proximal femoral osteomyelitis
Imaging

Simple radiographs

MRI

Arthrogramm
Stages (Waldenström) - Initial
Stages (Waldenström) - Fragmentation
Stages (Waldenström) - Reossification
Stages (Waldenström) – Healing/Remodeling
Classification

Lateral Pillar (Herring)

Has best interobserver agreement
Prognostic relevant

Kathleen M et al.; Classifications in Brief the herring lateral pillar classification for Legg-Calvé-Perthes Disease; Clin Orthop Relat Res (2013) 471:2068–2072
# Classification

## Catterall

<table>
<thead>
<tr>
<th>Group I</th>
<th>Anterior 1/4 epiphysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II</td>
<td>Anterior 1/3 - 1/2 epiphysis</td>
</tr>
<tr>
<td>Group III</td>
<td>only a small part is not involved</td>
</tr>
<tr>
<td>Group IV</td>
<td>total head involvement</td>
</tr>
</tbody>
</table>

Classification

Catterall

At risk signs

- Gage sign
- **Calcification lateral to the epiphysis**
- **Lateral subluxation of the femoral head**
- Horizontal proximal femoral physis
- Metaphyseal cyst formation

Classification

Stulberg

Prognostic factors

Poor prognosis:

Older age (bone age > 6 years)
Female sex
Lateral column C
Decreased hip ROM
Calcification lateral to the epiphysis
Lateral subluxation of the femoral head
Treatment

Goal is to obtain and maintain containment of the involved femoral head.

Protects the femoral head from deforming stress.
Treatment

Nonsurgical (mostly)

• Non-weight-bearing or partial weight-bearing
• NSAID’s
• Physical therapy
• abduction bracing (Thomas splint)

Higher success rate in patients younger than 6 years and lateral pillar A
Treatment
Treatment

1 year later

8 years later
Treatment - Containment surgery

Operative Versus Nonoperative Treatments for Legg-Calvé-Perthes Disease: A Meta-Analysis

Nhu-An T. Nguyen, BS,* Guy Klein, DO,† Godwin Dogbey, PhD,* Jessica B. McCourt, PA-C,‡ and Charles T. Mehlman, DO, MPH‡

Patients < 6 years same likelihood for good results.

Patients > 6 years surgery is almost twice as likely to result in a successful result.
Treatment

Surgical

Containment surgery

vs.

Salvage surgery
Treatment - Containment surgery

No consensus exists about the type of surgical containment

Proximal femoral varus osteotomy vs.

Pelvic osteotomy

Treatment - Containment surgery

Indication

Age between 6 to 10 at clinical onset
• Catterall III or IV
• Herring B, B/C, C
• Head at risk sign
• Loss of containment

Treatment - Containment surgery

Proximal femoral varus osteotomy

Disadvantages
• Trochanteric prominence
• Change in biomechanics
• Shortening, Coxa brevis

Contra-Indication
• Abduction less than 30° or hinge abduction

Copeliovitch L; Femoral varus osteotomy in Legg-Calve-Perthes disease.; J Pediatr Orthop. 2011 Sep;31(2 Suppl):S189-91
Treatment - Containment surgery

Norwegian prospective study

70 patients (unilateral LCPD) Catterall 3 & 4, older 6 years

Treatment - Containment surgery

Pelvic Osteotomy (PAO, Salter, Tripple etc.)

15 years follow-up of 45 patients:

only 2 with osteoarthritis (1 with THA)

<table>
<thead>
<tr>
<th>Stulberg I</th>
<th>6 (14 %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stulberg II</td>
<td>19 (44 %)</td>
</tr>
<tr>
<td>Stulberg III</td>
<td>11 (25.5 %)</td>
</tr>
<tr>
<td>Stulberg IV</td>
<td>6 (14 %)</td>
</tr>
<tr>
<td>Stulberg V</td>
<td>1 (2.5 %)</td>
</tr>
</tbody>
</table>

Treatment

In cases with hinge abduction?

It affects 44 % in Catterall 4

Figure 1: Preoperative arthrograms in the neutral (A) and abducted (B) positions demonstrating hinge abduction with medial dye pool formation.

Treatment - Salvage Surgery

Valgus femoral osteotomy

Shelf acetabuloplasty

Relative Neck Lengthening and Intracapital Osteotomy

Treatment - Salvage Surgery

Valgus femoral osteotomy

Indications:
• hinge abduction
• joint congruity improves with adduction

Contra-Indications:
• best congruity in abduction
• irreductible stiff hip

Yoo WJ et al.; Valgus femoral osteotomy for non containable perches hips: prognostic factors of remodeling; J Pediatr Orthop Volume 33, Number 6, September 2013
Kim HT et al.; Does valgus femoral osteotomy improve femoral head roundness in severe Leg-Calvé-Perthes disease; J Pediatr Orthop Volume 33, Number 6, September 2013
Treatment - Salvage Surgery

Valgus femoral osteotomy

advantages:

• Correction of abnormal hinge movement
• Correction of the shortening of the neck
• Improvement in the abductor
• Producing favorable remodeling
• Increase the weight-bearing surface

In Ho Choi et al.; The role of Values Osteotomy in LCPD; J Pediatr Orthop Volume 31, Number 2 Supplement, September 2011
Yoo WJ et al.; Valgus femoral osteotomy for non containable perches hips: prognostic factors of remodeling; J Pediatr Orthop Volume 33, Number 6, September 2013
Kim HT et al.; Does valgus femoral osteotomy improve femoral head roundness in severe Leg-Calvé-Perthes disease; J Pediatr Orthop Volume 33, Number 6, September 2013
Treatment - Salvage Surgery

Kim HT et al.; Does valgus femoral osteotomy improve femoral head roundness in severe Leg-Calvé-Perthes disease; J Pediatr Orthop Volume 33, Number 6, September 2013
Treatment - Salvage Surgery

16 Patients with hinge abduction treated by Valgus OT

Average follow-up 6.5 years

Improve in pain, ROM and Iowa hip score

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>After surgery (2–5 months)</th>
<th>Follow-up</th>
<th>Normal side</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck-shaft angle</td>
<td>128° (100°–136°)</td>
<td>142° (128°–160°)</td>
<td>140° (130°–155°)</td>
<td>140° (135°–145°)</td>
<td>0.000</td>
</tr>
<tr>
<td>Sharp angle</td>
<td>43° (42°–46°)</td>
<td>43° (40°–46°)</td>
<td>41° (40°–44°)</td>
<td>41° (38°–44°)</td>
<td>Non-significant</td>
</tr>
<tr>
<td>Center-edge angle (Wiberg)</td>
<td>31° (10°–46°)</td>
<td>36° (18°–46°)</td>
<td>46° (32°–50°)</td>
<td>43° (40°–46°)</td>
<td>0.000</td>
</tr>
<tr>
<td>Lateral femoral subluxation</td>
<td>3.1 (2–5)</td>
<td>2.2 (1–3.3)</td>
<td>1.4 (0–3.3)</td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>% acetabular coverage</td>
<td>20.6 % (0–35 %)</td>
<td>19.5 % (0–38 %)</td>
<td>13.2 % (0–25 %)</td>
<td></td>
<td>0.029</td>
</tr>
</tbody>
</table>

* Between preoperative and follow-up values

Treatment - Salvage Surgery

Relative Neck Lengthening and Intracapital Osteotomy

Leunig M. and Ganz R.; Relative neck lengthening an Intracapital Osteotomy for severe Perthes and Berthes-like Deformities; Bulletin of the NYU Hospital for Joint Diseases 2011;69(Suppl 1):S62-7
Treatment - Salvage Surgery

11 patients

10 with additional containment surgery (PAO, Trippe OT, Varus IO and Valgus IO)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preoperative</th>
<th>Postoperative†</th>
<th>Latest followup‡</th>
<th>p value, overall</th>
<th>p value, pre- versus postoperative</th>
<th>p value, preoperative versus followup</th>
<th>p value, postoperative versus followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head sphericity (%)</td>
<td>72 (64-81)</td>
<td>86 (74-95)*</td>
<td>85 (73-96)*</td>
<td>&lt; 0.001</td>
<td>0.003</td>
<td>0.004</td>
<td>0.286</td>
</tr>
<tr>
<td>Extrusion index (%)</td>
<td>47 (25-60)</td>
<td>21 (12-36)*</td>
<td>20 (3-58)*</td>
<td>0.001</td>
<td>0.003</td>
<td>0.006</td>
<td>0.328</td>
</tr>
<tr>
<td>Lateral center-edge angle (°)</td>
<td>1 (−10 to 16)</td>
<td>20 (−2 to 35)*</td>
<td>26 (4-40)*</td>
<td>0.002</td>
<td>0.004</td>
<td>0.004</td>
<td>0.091</td>
</tr>
<tr>
<td>Shenton’s line (% intact)</td>
<td>64</td>
<td>82</td>
<td>100</td>
<td>0.087</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetabular index (°)</td>
<td>17 (6-37)</td>
<td>12 (1-39)</td>
<td>7 (−7 to 19)</td>
<td>0.078</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centrum-collum-diaphyseal angle (°)</td>
<td>133 (127-144)</td>
<td>132 (117-145)</td>
<td>139 (112-169)</td>
<td>0.081</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axial alpha angle (°)</td>
<td>40 (28-48)</td>
<td>42 (29-52)</td>
<td>42 (31-54)</td>
<td>0.482</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Treatment - Salvage Surgery
Treatment - Salvage Surgery
Treatment - Salvage Surgery
Treatment - Salvage Surgery

Blutung aus lateralem Kopfanteil

Blutung aus medialem Kopfanteil
Treatment - Salvage Surgery
Discussion
Anhang

3. Daniel AB et al.; Environmental tobacco and wood smoke increase the risk of Legg-Calvé-Perthes disease; Clin Orthop Relat Res 2012; 470(9):2369-2375.
9. Benjamin Joseph; Management of Perthes' disease; Indian J Orthop. 2015 Jan-Feb;49(1)
13. In Ho Choi et al.; The role of Values Osteotomy in LCPD; J Pediatr Orthop Volume 31, Number 2 Supplement, September 2011
14. Yoo WJ et al.; Valgus femoral osteotomy for non containable perches hips: prognostic factors of remodeling; J Pediatr Orthop Volume 33, Number 6, September 2013
15. Kim HT et al.; Does valgus femoral osteotomy improve femoral head roundness in severe Leg-Calvé-Perthes disease; J Pediatr Orthop Volume 33, Number 6, September 2013
## Stages (Waldenström)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Name</th>
<th>Radiographic Findings</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Initial</td>
<td>Smaller &amp; sclerotic epiphysis with medial joint space widening, crescent sign</td>
<td>Up to 6 months</td>
</tr>
<tr>
<td>II</td>
<td>Fragmentation</td>
<td>Resorption of the epiphysis</td>
<td>6 months to 2 years</td>
</tr>
<tr>
<td>III</td>
<td>Reossification</td>
<td>New bone formation</td>
<td>1-3 years</td>
</tr>
<tr>
<td>IV</td>
<td>Healing/Remodeling</td>
<td>Bone density normalizes and trabecular patterns appear</td>
<td>Until skeletal maturity</td>
</tr>
</tbody>
</table>
Classification

Lateral Pillar (Herring)

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>Lateral pillar maintains full height</td>
<td>Good outcome</td>
</tr>
<tr>
<td>Group B</td>
<td>Maintains &gt; 50 % height</td>
<td>Poor outcome in Patients &gt; 8 years</td>
</tr>
<tr>
<td>Group C</td>
<td>Less than 50 % of lateral pillar height is maintained</td>
<td>Poor outcome in all Patient</td>
</tr>
</tbody>
</table>

Has best interobserver agreement

Prognostic relevant

### Classification

#### Stulberg

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Features</th>
<th>Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Spherical congruency</td>
<td>Completely normal hip joint</td>
<td>Good</td>
</tr>
</tbody>
</table>
| II    | Spherical congruency; less than 2 mm loss of head shape | Spherical femoral head with a concentric circle on anteroposterior and frog-lateral radiographs, with 1 or more of the following abnormalities:  
- Coxa magna  
- Short femoral neck  
- Abnormally steep acetabulum | Good                      |
| III   | Aspherical congruency; greater than 2 mm loss of head shape | Non-spherical but not a flat femoral head. Ovoid, mushroom-shaped head with 1 or more of abnormalities:  
- Coxa magna  
- Short femoral neck  
- Abnormally steep acetabulum | Mild-to-moderate arthritis |
| IV    | Aspherical congruency             | Flat femoral head with abnormal femoral head, neck and acetabulum.                                  | Mild-to-moderate arthritis |
| V     | Aspherical incongruency           | Flat femoral head with a normal-shaped femoral neck and acetabulum.                                | Severe early arthritis    |

Treatment

Benjamin J; Management of Perthes' disease; Indian J Orthop. 2015 Jan-Feb;49(1)
Treatment - Salvage Surgery