TREATMENT PRINCIPLES OF LEGG-CALVÉ-PERTHES DISEASE (LCPD):

In Ho Choi, MD
SNUCH
Natural History of LCP

• Group influenced by Tx.- 35%
• Group not influenced by Tx.
  Do well- 50%
  Do poorly- 15%
Goal of Treatment

To obtain and maintain **CONTAINMENT**

To prevent **SUBLUXATION** (head extrusion)

To obtain & maintain full or almost full **ROM**

To obtain **SPHERICAL CONGRUENCY**
Prognostic Factors

• Extent of involvement
• Age at onset
• Sphericity & congruency at maturity

Poor Prognostic Group : Tx. indicated

At-risk clinically & radiographically:

- Catterall III & IV
- Salter-Thompson B
- Lateral pillar C, Pillar B (> 8 years)
Stulberg I & II (good)
III (intermediate)
IV & V (poor)

A: 100% good
B: 2/3 good
B/C: 1/4 good
(1/2 interm)
C: 1/8 good
>1/3 poor

Herring JA, JBJS 86-A, 2004 (nonop 226; op 119 hips)
824 pts w/ true LCPD at SNUCH (1985. 11 ~ 2005.11)

Avg. age at onset 6y 4m (17m ~ 14y 3m)

(student t test, p=0.291>0.05)
Spherical head vs. Age at Sx. onset

In Unilateral Cases (n=527)
Collapse & Extrusion starts at anterolateral aspect of femoral head

Initial stage (stage of increased density)

IA

IB

IIA

IIB

1 or 2 vertical fissures

advanced fissures

Fragmentation stage
Stages of LCPD (2)

Subnormal texture
new bone at the periphery; < 1/3 of circumference

Normal texture new bone at the periphery; > 1/3 of circumference

III A III B

Reossification stage

Benjamin Joseph

JPO 23:590-600, 2003; OCNA 2011
Stages & Treatment Strategy

IA
IB
IIA
IIB
IIIA
IIIB
IV

Preventive intervention
(prevent collapse; enhance reossification
e.g. rest, bisphosphonate, core decompression, containment)

Remedial op.
(reduce subluxat.; ROM; enhance moulding.
e.g. containment, STR, hip distract.)

Salvage op.
(congruency; reduce or tx. FAI
e.g.: valgus osteot, FH reshaping)
Brace for Containment?

Disparity in volume of the articular surface btw. femoral head (3/4 of globe) & acetabulum (< 1/2 of globe)
Facts 1: Why is it so difficult to contain?

1. **Anterolateral** part of femoral head is most uncovered in *neutral weight-bearing position*.
   - Acet. inclination & anteversion
   - Fem. anteversion
2. **Anterolateral part** of the femoral head is not contained in the acetabulum during **normal level walking**.  

(Rab GT et al. 1985, JPO)
3. Acetabular coverage of the femoral head: **Mid-acetabular rim < Anterior, or Posterior rim**

*(Janzen DL et al. Skeletal Radiol, 1998)*

**Facts 3:**

Why is it so difficult to contain?
When Will Consider SURGICAL CONTAINMENT

1. Loss of containment by conservative means
   - Progression of epiphyseal change despite conservative tx. (Klisic, JBJS, 65-B, 1983)
     - for serious LCP (Catterall III, IV) containment required for 1 - 2 years

2. Severe disease w/ at-risk signs

3. Non-compliant patients or family

4. Uncontainable hip

5. Certain sequelae
It is time to perform surgical containment!
Treatment Strategy (Early Stage)

Consider

- Age at onset of symptom
- Extent/ location of involvement
- Subluxation:
  - simple eccentrication
  - vs
  - true epiphyseal extrusion
Tx. Strategy (Early Stage)

Age under 5 years:

**Subluxation:**

- Eccentration → No tx.
  - Limit activity if Sx.(+)
  - NSAID
  - ROM exercise
  - Abd. Bracing, Petrie cast

- Epiphyseal Extrusion → CONTAINMENT (STR, FVO)
Tx. Strategy (Early Stage)

Age 5 to < 8 years:

- Lateral Pillar (LP) classification is useful.
- LP A & (B) + Eccentration $\rightarrow$ Conservative tx.
- LP B, B/C, C + Epiphy. Extr. $\rightarrow$ CONTAINMENT STR (Add., Psoas tenot, medial capsulot.)
  
  FVO; rarely, double-level osteotomy or TIO

* Don’t jump to contain if ROM is bad!
Femoral Varus Osteotomy

Preop M/7+3

FVO 5M

Age 15 yrs
Please pay attention to lateral calcification!

M, 7

C.C: Limping gait

Hip ROM:

- FC 0/0
- Abd(ke) 20/40
- IR 20/30
- FF 140/140
- Abd(90) 45/60
- ER 20/30

2003.6

2004.5.24
2004.6.28  2004.8.17  2005.10.21

Valgus osteotomy
Salter Innominate Osteotomy
Advantages

• No risk of excessive varus
• Not aggravate LLD

Preoperative Prerequisites

• Joint congruency on arthrogram
• No irritable hip
• No signif. restrict. of ROM (abd. to 45°)
  – Rest, traction, soft tissue release
  – Petrie / Broomstick casts
• Spherical head?
Critics on SIO

- Increase joint pressure → Postop. joint stiffness
- May cause impingement:
  Increased pressure + acetabular rim at necrotic segment
- Technically demanding
Post-Salter OP 9m

Hinge abduction
Tx. Strategy (Early Stage)

Age 8 to < 11-12 years:

- Lateral Pillar (LP) classification may not be useful, because fragmentation occurs rather late.
- LP A group is rare.
- Consider *surgical CONTAINMENT* even before apparent subluxation (epiphyseal extrusion).
Tx. Strategy (Early Stage)

Age 8 to < 11-12 years:

• Epiphy. Extr. → surgical CONTAINMENT
  FVO
  Double-level osteotomy
  TIO
  Shelf acetabuloplasty

* consider transphys. multiple drilling > 9-10 yrs.
Combined FVO & Innominate Osteotomy
Triple Innominate Osteotomy (TIO)

F, 9 years  Kim EA
Shelf Acetabuloplasty
Shelf acetabuloplasty for children with Perthes’ disease and reducible subluxation of the hip

PROGNOSTIC FACTORS RELATED TO HIP REMODELLING


From Seoul National University Children’s Hospital, Seoul, Korea


**Prognostic factor**

1. Labral type in hip abduction (Hilgenreiner-Labral Angle)
2. Height ratio of the lat. Pillar vs. contralat. epiphysis

Shelf acetabuloplasty as containment surgery seems to be best indicated for hips in which there is not marked collapse of the epiphysis and in which the extruded epiphyseal segment slips easily underneath the labrum on abduction, without imposing undue pressure on the lateral edge of the acetabulum.
Tx. Strategy (Early Stage)

Age > 11-12 years:

- LP classification is not helpful.
- LP A group is rare.
- Epiphyseal collapse is rapid, prolonged process of revasularization & reossification & very little remodelling.

*CONGRUENCY is important than Containment!
Tx. Strategy (Early Stage)

Age > 11-12 years:

- To improve revascularization & to prevent collapse

  → Core decompression + FVO/ FValO

  **Shelf** acetabuloplasty
  Double osteotomy / TIO

Living fibular BG
Articulated hip distraction
Transtrochanteric rotational osteotomy
Adolescent LCPD

Collapse (-) or minimal

Bisphosphonate

Core decompression + Shelf op, Redirect. osteotomy

Core decompression + Articulated hip distraction

Living fibular bone graft

Transtrochanteric rotational osteotomy

Collapse (+)

Limited ROM

Traction, STR & Restore ROM

+ Impingement

Transtrochanteric rotational osteotomy

Deimpingement ± Core decompression ± Re-contouring ± Valgus-flexion osteotomy ± Articulated hip distraction
Hinge Abduction

Pain & spasm causing flexion-adduction deformity → Subluxation → Indentation (saddle-shaped head)
Valgus femoral osteotomy for hinge abduction in Perthes’ disease

DECISION-MAKING AND OUTCOMES

We studied, clinically and radiologically, the growth and remodelling of 21 hips after valgus femoral osteotomy with both rotational and sagittal correction for hinge abduction in 21 patients (mean age, 9.7 years) with Perthes’ disease. The exact type of osteotomy performed was based on the pre-operative clinical and radiological assessment and the results of intra-operative dynamic arthrography. The mean KOVA hip score was 66 (34 to 76) before surgery and 92 (80 to 100) at a mean follow-up of 7.1 years (3.0 to 15.0). Radiological measurements revealed favourable remodelling of the femoral head and improved hip joint mechanics.

Valgus osteotomy, with both rotational and sagittal correction, can improve symptoms, function and remodelling of the hip in patients with Perthes’ disease.

Yoo & Choi et al. JBJS 86-B, 2004 July
“**Hinge abduction** appears to be a complex manifestation of the hinge movement which occurs in the **continuum btw. lateral & anterior impingement.**”

**Anterior impingement**

**Lateral view in hip extension**

**Lateral impingement**

M/15

M/13
1. Anterolateral protrusion w/ small size: No impingement, **Normal FPA**

2. Ant. impingement during flexion: **Out-toeing**

3. Lat. Impingement in stance (w/ downward pelvic obliquity): **In-toeing**
Pathomechanism of Out-toeing and Intoeing

Different head deformity

Different pattern of femoroacetabular impingement during gait

Compensatory rotation of proximal femur to avoid impingement

In-toeing, or Out-toeing
Hinge Abduction

- check stage & reducibility
  - STR
  - 'Reducible'
    - Petrie cast
    - Containment by
      - FVO
      - TIO
      - Shelf
      - Double-level osteotomy
  - 'Irreducible'
    - check congruity in adduction
      - 'Improve'
      - 'No improve'
      - check coverage & stability
        - 'Stiff (+)'
          - Hip distraction
            - PT & Bracing
            - Containment by
              - FVO
              - TIO
              - Shelf
              - Double-level osteotomy
        - check irregularity & maturity
          - 'Valgus osteot. +/- TIO, Shelf, Chiari osteot.(?)'
          - 'Chiari osteotomy
           - Osteochondroplasty
           - Head reshaping(?)'

Choi et al. JPO 31(2) 2011
Femoral Valgus Osteotomy

F, 6 +5 yrs (onset 1 year)
Congruency >> Containment!

2001.2.3  2002.11.19

2005.10.18
M, 7
Conservative tx. (traction, cast, brace) for > 1 year and referred to SNUCH.
19 months later TIO
Chiari Osteotomy
Late Reossification / Residual Stage
FH Deformity at Residual Stage
(Bowen JR)

- Coxa magna 58%
- Coxa breva 21%
- Coxa irregularis 18%
- Osteochondritis 3%
  Dissecance
- Aspherical femoral head
- Coxa magna
- Coxa irregularis

Loss of head sphericity & congruency

Femoroacetabular impingement (FAI)
Secondary acetabular dysplasia

Labral tear, instability, cartilage damage or combined

Early DA
FAI causing Labral tear (MRI-arthrogram)
Tx. Strategy (Residual Stage)

• To restore Congruency
• To reduce or treat FAI, including femoral head reshaping procedure
• If above goals cannot be achieved, consider
  - Arthrodesis
  - Pelvic support osteotomy
  - Hip resurfacing arthroplasty / THRA
Case 1

- M/13 yrs, high BMI
- Brace tx. only for 2 yrs.
- Severe limping w/ painful, stiff hip

initial stage
Typical FAI (global type)
After osteochondroplasty

After valgus (30')

– flexion (30')

osteotomy

17 yrs 6 mos

PO 4 yrs 6 mos

17 yrs 6 mos

PO 4 yrs 6 mos
Case 2

M/12 yrs, average BMI

Neglected tx. for 2 yrs. Flex 10’- 60’, Abd 15’, IR -15’, ER 35’
After osteochondroplasty

After recontouring of articular surface
Pre-operation Hinge abduction

Post-operation Hinge abduction disappeared
Age 16 yrs 2ms
PO 3 yrs 10 mos
Case 3

M/11+4yr.
s/p Multiple drilling, distraction
Post-op 4m, EF removal
PO 1+9yr. (13+1yr.)
Re-contouring procedure

- Core decompression & autologous BG

Valgus-flexion osteotomy
Post-op 26mo
Post-op 26mo
Premature Physeal Closure

- Leg length discrepancy:
  - < 2.5 cm : 91%
  - 2.5 to 3 cm : 7%
  - > 3 cm : 2%

- Coxa brevis

- Trochanter overriding
  - Trendelenburg gait
Osteochondritis Dissecans
Summary: Tx. Principle

1. Early in the course (AVN to early fragmentation stages)

_Under 8 yrs_
Epiphys. Extrusion (-): Conservative
Epiphys. Extrusion (+): ROM regain → CONTAINMENT

_8 yrs or older_
Epiphys. Extrusion(+, -): ROM regain → CONTAINMENT

_12 yrs or older: Prognosis is guarded, treat as in adult(?)_
2. Late in the course (late fragmentation stage or after)

Epiphys. Extrusion (-): Conservative

Epiphys. Extrusion (+): ROM regain → CONTAINMENT VS CONGRUENCY +/- COVERAGE