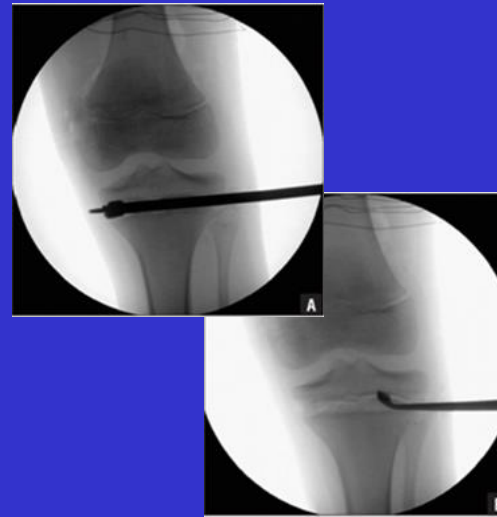


Accuracy of Limb Equalization: Comparison of Epiphysiodesis with Magnetic IM Lengthening Nail System

John E. Herzenberg, MD
Vivian L. Szymczuk, MD
Ahmed I. Hammouda, MD
Martin G. Gesheff, BS
Shawn C. Standard, MD



International Center for Limb Lengthening
Rubin Institute for Advanced Orthopedics
Sinai Hospital, Baltimore, Maryland

Background

Epiphysiodesis

- Inexpensive and commonly used
- Must be skeletally immature
- Depends on accurate LLD predictions at maturity and accurate timing of procedure
- Used to equalize LLD between 2 and 5 cm



Limb Lengthening

- More expensive and higher complication rates
- Do not have to be skeletally immature
- Potentially more accurate than epiphysiodesis
- Used to equalize any amount of LLD

Objective

Dilemma

- Do the advantages, potential inaccuracy, and potential need for subsequent surgical correction when treating with epiphysiodesis outweigh the accuracy and disadvantages/complications of treating with magnetic IM lengthening nails?

Objective

- To compare the complication rates and accuracy when correcting LLD with either epiphysiodesis or magnetic IM lengthening nails

Methods

Retrospective chart and x-ray review:

Epiphysiodesis Group

- 26 patients (14 boys, 12 girls)
- Drilling/curettage technique
- Multiplier Method used to determine age for epiphysiodesis
- Followed until skeletal maturity
- Mean follow-up 3.5 yrs (0.8 - 7.4 yrs)
- Inclusion criteria:
 - Skeletally immature at tx
 - Distal femoral/proximal tibial epiphysiodesis *with the intent* of segment equalization

IM Nail Group

- 24 patients (14 boys, 10 girls)
- Age at lengthening: 14–18 yrs
- Mean follow-up 1.8 yrs (0.4 - 3.5 yrs)
- Inclusion criteria:
 - Underwent femoral/tibial lengthening with magnetic IM lengthening nails
 - Skeletally mature at time of lengthening

Results

Pre- and Post-operative Segment LLD		
Method	LLD before surgery	LLD at maturity
Epiphysiodesis (N = 26)	2.2 cm (0.8 – 4.5 cm)	1.1 cm (0 – 4.0 cm)
IM nail (N = 24)	3.6 cm (2.0 – 4.7 cm)	-0.03 cm (-0.8 to 0.8 cm)

Comparison of Segment LLD Remaining at Maturity after Treatment

LLD Remaining (cm)	Epiphysiodesis, at maturity (N = 26)	IM Nail post-treatment (N= 24)	P value
≥ 1.5	10/26 (39%)	0	0.0007
1 – 1.49	5/26 (19%)	0	0.0300
0.3 – 0.99	5/26 (19%)	2/24 (8%)	0.26
0 – 0.299	6/26 (23%)	16/24 (67%)	0.002
-0.01 to -0.2	0/26 (0%)	3/24 (13%)	0.06
-0.21 to -0.8	0/26 (0%)	3/24 (13%)	0.38

Complications

- **Epiphysiodesis Group:** No complications
- **Magnetic IM Nail Group:**
- 8 complications requiring surgery:
 - 4 delayed / partial-union (stem cell bone graft injection)
 - 1 malunion (fixator-assisted plating)
 - 1 hip contracture (onabotulinumtoxinA injection)
 - 1 peroneal nerve involvement (decompression)
 - 1 anterior compartment syndrome (fasciotomy and delayed primary closure)

11 y.o. girl with Fibular Hemimelia and CFD

2-cm femoral
LLD

Treatment:
Epiphysiodesis
to equalize
femoral segment



15 y.o. boy

3-cm femoral
LLD

Treatment:
Lengthening with
magnetic IM
lengthening nail to
equalize limb



Conclusions

- Epiphysiodesis group had 39% with ≥ 1.5 cm discrepancy compared with 0% from IM nail group.
- Epiphysiodesis group had no complications, but inaccurate correction might require future lengthening.
- One-third of IM nail group had a complication, but amount of lengthening was accurate.
- When both treatments are available, patients/physicians must weigh uncorrected LLD associated with epiphysiodesis at skeletal immaturity vs. potential complications associated with lengthening at maturity.

Author Contact Information:

jherzenb@lifebridgehealth.org

Author Disclosures:

JEH is a consultant for Orthofix, OrthoPediatrics, NuVasive Specialized Orthopedics, and Smith & Nephew; receives research support from NuVasive Specialized Orthopedics; and is on the editorial board of the World Journal of Orthopaedics. SCS is a consultant for NuVasive Specialized Orthopedics and receives royalties from NuVasive Specialized Orthopedics and Pega Medical. VLS, AIH, and MGG do not have any conflicts.