LIMB LENGTH DISCREPANCIES

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OBJECTIVES

• Evaluate the patient with a possible limb length difference (LLD)
• Understand general treatment principles when managing limb length differences
• Understand indications for limb lengthening surgeries and the basic method in which they are performed

PATIENT HISTORY

• Trauma
• Infection
• Tumor
• Obvious at birth?
• Skin abnormalities
• Neuro abnormalities
• Current functional issues
• Current pain issues
PHYSICAL EXAMINATION

• Evaluate limb girth
• Evaluate skin
  – Birthmarks
  – Surgical/trauma scars
  – Dimples in limbs
  – Amniotic bands
• Count toes
• Babies –
  – Check for differences in foot size

PHYSICAL EXAMINATION

• The lower limb is made of the following segments:
  – Pelvis
  – Thigh
  – Leg
  – Foot
• Therefore, standing will provide the most accurate details

PHYSICAL EXAMINATION

• Wooden blocks or equivalent to level pelvis while standing
  – Ensure knees are straight
• Galeazzi Test
• “Reverse/Prone” Galeazzi test
• Adolescents –
  – Screen for scoliosis once pelvis is level with blocks
STANDING TEST

NO BLOCK
STANDING ON 1" BLOCK

GALEAZZI TEST

• Assess length of femur (pelvis to knee) by aligning pelvis, and then flexing knees
• Visualize the difference in knee heights

PRONE GALEAZZI TEST

• Lie patient prone on exam table
• Assess tibia and foot height be flexing knees 90 degrees, and dorsiflexing ankles to neutral position
TREATMENT PRINCIPLES

Children's Healthcare of Atlanta

GENERAL RECOMMENDATIONS FOR LLD TREATMENT

• PROJECTED DISCREPANCY:
  — < 2 cm: observation
  — Between 2 – 5 cm: contralateral epiphysiodesis
  — > 5 cm: lengthening of short limb

• But ....

MANAGING LLD

2 cm LLD is not the same for everyone!
CASE PRESENTATION

- CC: limb length discrepancy
- HPI: 15 month old female presents for initial consultation for evaluation of LLD, L>R
- No PMH/PSH
- Physical Exam:
  - No abnormal facies
  - No upper extremity abnormalities
  - Right lower extremity:
    - Apex anterior bowing of midshaft tibia w/ skin dimple at level of bowing
    - 4 ray foot
    - Fixed equinovalgus foot deformity
    - 20 arc of forefoot range of motion
    - Full ROM of hip and knee
    - Knee stable

INITIAL RADIOGRAPHS

CURRENT MEASUREMENTS:

<table>
<thead>
<tr>
<th></th>
<th>RIGHT</th>
<th>LEFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMUR</td>
<td>15.1 cm</td>
<td>16.6 cm</td>
</tr>
<tr>
<td>TIBIA</td>
<td>9.9 cm</td>
<td>14.2 cm</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25 cm</td>
<td>30.8 cm</td>
</tr>
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Current LLD: 5.8 cm

If current LLD is 5.8 cm, what will the difference be at skeletal maturity?
PREDICTING LLD

- Multiple ways to do this
  - Review Green-Anderson Charts
  - Mosely Straight Line Graph
  - Multiplier Method
- Easiest way is with multiplier method:
  - Must know skeletal age for all of these methods
- Prior to puberty assume skeletal age = chronological age

LOWER LIMB MULTIPLIERS

<table>
<thead>
<tr>
<th>LOWER LIMB</th>
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<tbody>
<tr>
<td>Multiplier for BOYS</td>
<td>Multiplier for GIRLS</td>
</tr>
<tr>
<td>Age [yr]</td>
<td>R</td>
</tr>
<tr>
<td>0</td>
<td>1.50</td>
</tr>
<tr>
<td>1</td>
<td>1.45</td>
</tr>
<tr>
<td>2</td>
<td>1.40</td>
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<tr>
<td>3</td>
<td>1.35</td>
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<td>4</td>
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<td>5</td>
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<tr>
<td>6</td>
<td>1.20</td>
</tr>
<tr>
<td>7</td>
<td>1.15</td>
</tr>
<tr>
<td>8</td>
<td>1.10</td>
</tr>
<tr>
<td>9</td>
<td>1.05</td>
</tr>
<tr>
<td>10</td>
<td>1.00</td>
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- Quick, convenient, and accurate prediction method
- For Shapiro Type I pattern of progressive LLD
- Overall - twenty data bases were analyzed (Anderson and Green included)
  - Age and gender related multipliers were calculated
  - No significant differences were found between
    - Percentile groups
    - Femur or tibia
    - Gender
**Formula for Congenital LLD**

\[ L_m = L_{\text{current}} \times M \]
Length at maturity = current length x multiplier

\[ \Delta_m = \Delta_{\text{current}} \times M \]
Difference at maturity = current difference x multiplier

*fibular hemimelia, congenital femoral deficiency, hemi-hypertrophy, etc.*

**BACK TO OUR PATIENT**

**CURRENT MEASUREMENTS:**

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Current LLD: 5.8 cm
Final LLD: 5.8 x 2.75 = 15.95 cm

** HOW ARE WE GOING TO MANAGE A CHILD WITH A PREDICTED 16 CM LLD??**
**WHAT SHOULD WE DO?**

**ABLATION**
- Amputation + Prosthesis

**RECONSTRUCTION**
- Shorten “normal” side
- Lengthen short side
- Combination of the two
  - Shorten the long bone + lengthen the short bone

**WHAT INFORMATION IS IMPORTANT TO HELP MAKE THIS DECISION?**

- Understand your treatment goals
  - Maximize function
  - Minimize pain
  - Near equal limb lengths at maturity
- Have an idea of how much LLD there will be at maturity
  - 16 cm
- Is the patient a candidate for lengthening?
  - What are indications/contraindications to lengthening?

**INDICATIONS/CONTRAINDICATIONS TO LENGTHENING**

**WHAT YOU NEED**
- Stable joints/Full ROM
- Good support system
  - Medical
  - Familial
- “Reasonable” amount of length to achieve

**WHAT YOU SHOULD NOT HAVE**
- Neurologic disease
- Bad joints
- Bad bones
WHAT SHOULD WE DO?

Options for Management Include:

- Amputation + Prosthesis
- Shorten
- Lengthen
- Combination of the two
  - Shorten the long bone
  - Lengthen the short bone

Either one... but it would take 3 lengthenings to make up a 16 cm difference.

MANAGING LLD

Not every patient is a lengthening candidate.

WHEN TO LENGTHEN A LIMB
INDICATIONS FOR LIMB LENGTHENING AND RECONSTRUCTION

- GOOD PARENTS (FAMILY/SUPPORT)
- GOOD JOINTS
- GOOD BONES

INDICATIONS FOR RECONSTRUCTION:
“Good Parents”

- Lengthening is a childhood-long commitment
- Non-active lengthening stage
  - Bracing/lifts
  - Possibly PT
- Active lengthening
  - Reliable to take to weekly appointments (some live hours away)
  - Physical therapy – 3-4 times per week
  - Educated to perform lengthening daily
  - Administer medications
  - Good communication skills
  - Financial support

INDICATIONS FOR RECONSTRUCTION:
“Good Joints”
**INDICATIONS FOR RECONSTRUCTION:**

"Good Bones"

<table>
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<tr>
<th>GOOD BONES</th>
<th>&quot;NEEDS WORK&quot; BONES</th>
<th>BAD BONES</th>
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**LENGTHENING CONSIDERATIONS**

- The longer the lengthening, the more complications
  - Possible "prep" surgery prior to or during lengthening
  - Pin tract infections
  - Bone infections
  - Joint stiffness
  - Fracture of regenerate (new bone)
  - Joint dislocation
- Typically can lengthen the limb by 20%

**HOW TO LENGTHEN A LIMB**
CASE PRESENTATION

• 15 yr old female had suffered a fracture of her distal femoral physis at age 7
• While in India, she had a bar resection, which did enable her bone to grow
• But at skeletal maturity, her femur is crooked (varus) and remains 6 cm short

TREATMENT RECOMMENDATIONS

• Recommended a limb lengthening surgery with an acute deformity correction

HOW TO LENGTHEN A BONE

• Cut the bone
  – Low energy corticotomy
  – No saw
• Apply some type of daily “stretching” apparatus
  – external fixator
  – internal lengthening nail
• Lengthen at a very specific rate
  – Typically start at 1mm/day
  – May speed up or slow down depending on a multitude of factors
This child had Blount's disease at a young age. The tethering plate failed, and therefore, his growth area was surgically disrupted, and his deformity was corrected and over-lengthened.
16 yr old male had a history of osteomyelitis of his right distal femur at age 11. Now skeletally mature, he has a 5 cm LLD. His limb was lengthened using the internal lengthening nail.

THANKS!!!
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