Lower Extremity Alignment: Genu Varum / Valgum

Arthur B Meyers, MD
Nemours Children’s Hospital & Health System
Associate Professor of Radiology, University of Central Florida
Clinical Associate Professor of Pediatric Radiology, Florida State University
Disclosures

• Author/editor for Amirsys/Elsevier, receiving royalties
Outline

• Definitions
• Normal knee alignment during development
• Genu Varum
• Genu Valgum
Outline

• Definitions
• Normal knee alignment during development
• Genu Varum
• Genu Valgum
Varus  Valgus
Varus

- Distal to angulation –

Valgus

- Distal to angulation –
Varus
- Distal to angulation –
- Apex of angulation –

Valgus
- Distal to angulation –
- Apex of angulation –
Varus
- Distal to angulation –
- Apex of angulation –

Valgus
- Distal to angulation –
- Apex of angulation –

Right

Midline

Left
Varus
- Distal to angulation –
- Apex of angulation –

Valgus
- Distal to angulation –
- Apex of angulation –
Varus
• Distal to angulation – **deviates to midline**
• Apex of angulation –

Valgus
• Distal to angulation –
• Apex of angulation –

Right  Midline  Left
**Varus**
- Distal to angulation – deviates to midline
- Apex of angulation – **points from midline**

**Valgus**
- Distal to angulation –
- Apex of angulation –

![Diagram showing varus and valgus knee alignment](image)
Varus
• Distal to angulation – deviates to midline
• Apex of angulation – points from midline

Valgus
• Distal to angulation –
• Apex of angulation –

Midline
Right
Left
Varus
- Distal to angulation – deviates to midline
- Apex of angulation – points from midline

Valgus
- Distal to angulation –
- Apex of angulation –
**Varus**
- Distal to angulation – deviates to midline
- Apex of angulation – points from midline

**Valgus**
- Distal to angulation – deviates from midline
- Apex of angulation – points to midline

Right  |  Midline  |  Left

![Diagram showing knee anatomy for varus and valgus angles](image-url)
Varus
- Distal to angulation – deviates to midline
- Apex of angulation – points from midline

Valgus
- Distal to angulation – deviates from midline
- Apex of angulation – points to midline

Midline

Right

Left
Normal Knee Alignment
Tibiofemoral angle
Tibiofemoral angle

- On standing radiograph
Tibiofemoral angle

- On standing radiograph

- Angle between lines parallel to:
  - Mid femoral diaphysis
  - Mid tibial diaphysis
Tibiofemoral angle

Tibiofemoral angle

- 0-1 yr - 10-17 varus

Tibiofemoral angle

- 0-1 yr - 10-17° varus
- 1-2 yrs 0-10° varus

Tibiofemoral angle

- 0-1 yr - 10-17° varus
- 1-2 yrs 0-10° varus
- 2-3 yrs 0-10° valgus

Tibiofemoral angle

- 0-1 yr - 10-17° varus
- 1-2 yrs 0-10° varus
- 2-3 yrs 0-10° valgus
- 3-4 yrs 8-12° valgus

Tibiofemoral angle

- 0-1 yr - 10-17° varus
- 1-2 yrs 0-10° varus
- 2-3 yrs 0-10° valgus
- 3-4 yrs 8-12° valgus
- 4-13 yrs ~6° valgus

Developmental changes

1-year-old

3-year-old

13-year-old
Developmental changes

1-year-old

3-year-old

13-year-old

Varus
Developmental changes

1-year-old
Varus

3-year-old
Valgus

13-year-old
Developmental changes

1-year-old
Varus

3-year-old
Valgus

13-year-old
Mild Valgus
Genu varum
Genu varum / Bowing

- Angular deformity at the knee
  - Apex of the deformity points away from the midline.
  - Leg (below knee) deviates toward the midline.

- Common referral to orthopedic clinics
Genu varum / Bowing

• **Angular deformity at the knee**
  – Apex of the deformity points away from the midline.
  – Leg (below knee) deviates toward the midline.

• **Common referral to orthopedic clinics**
Genu varum / Bowing

• Differential diagnosis:
  – Exaggerated ‘physiologic’ bowing
  – Blount disease
  – Abnormal bones
    – Metabolic bone disease
    – Skeletal dysplasias
  – Physeal/metaphyseal injury

Up-to-date, 2017
Genu varum / Bowing

• Differential diagnosis:
  – Exaggerated ‘physiologic’ bowing
  – Blount disease
  – Abnormal bones
    – Metabolic bone disease
    – Skeletal dysplasias
  – Physeal/metaphyseal injury

Up-to-date, 2017
Exaggerated Physiologic Bowing
Exaggerated Physiologic Bowing

- Exaggeration of the normal age-related bowing
- Birth – 2yrs
- Bilateral & symmetric
- Normal stature
  - $\leq 2$ sd of mean height for age & sex
Exaggerated Physiologic Bowing

- Radiographs
Exaggerated Physiologic Bowing

• Radiographs
  – Varus angulation

20° varus
1-2 years
nl = 0-10° varus
23-month-old
Exaggerated Physiologic Bowing

• Radiographs
  – Varus angulation
  – Medial tibial metaphysis
    • Mild enlargement / depression
    • Mild beaking
    • No fragmentation
Exaggerated Physiologic Bowing

- Radiographs
  - Varus angulation
  - Medial tibial metaphysis
    - Mild enlargement / depression
    - Mild beaking
    - No fragmentation
Exaggerated Physiologic Bowing

- **Radiographs**
  - Varus angulation
  - Medial tibial metaphysis
    - Mild enlargement / depression
    - Mild beaking
    - No fragmentation
  - Mild thickening of the medial tibial cortex
Exaggerated Physiologic Bowing

- Radiographs
  - Varus angulation
  - Medial tibial metaphysis
    • Mild enlargement / depression
    • Mild beaking
    • No fragmentation
  - Mild thickening of the medial tibial cortex
  - Normal metaphysial-diaphysial angle
Metaphyseal Diaphyseal Angle

- MDA – the angle between:
Metaphyseal Diaphyseal Angle

- MDA – the angle between:
  - Line drawn along the proximal tibial metaphysis
Metaphyseal Diaphyseal Angle

• MDA – the angle between:
  – Line drawn along the proximal tibial metaphysis
  – Line perpendicular to the long axis of the tibia
Metaphyseal Diaphyseal Angle

• MDA – the angle between:
  – Line drawn along the proximal tibial metaphysis
  – Line perpendicular to the long axis of the tibia

• MDA values
  – Physiologic bowing
    • MDA typically ≤ 11°
  – Blount disease
    • MDA typically > 11°
  – Borderline 8-11°
Exaggerated Physiologic Bowing

Initial

7 months later
Blount Disease
Blount Disease (Tibia Vara)

- Developmental disorder with disrupted endochondral ossification of the medial proximal tibial physis
  - Abnormal development of the proximal, medial tibial epiphysis/metaphysis
Blount Disease (Tibia Vara)

• Developmental disorder with disrupted endochondral ossification of the medial proximal tibial physis
  – Abnormal development of the proximal, medial tibial epiphysis/metaphysis

• Angular deformities:
  – Genu varum
  – Procurvatum
  – Internal rotation of the tibia
Blount Disease (Tibia Vara)

• Developmental disorder with disrupted endochondral ossification of the medial proximal tibial physis
  – Abnormal development of the proximal, medial tibial epiphysis/metaphysis

• Angular deformities:
  – Genu varum
  – Procurvatum
  – Internal rotation of the tibia

• Limb shortening
  – Leg length discrepancy if asymmetric or unilateral
Blount Disease

• Risk factors:
  – Early ambulation
  – Obesity
  – African or Scandinavian descent
Blount Disease

• Risk factors:
  – Early ambulation
  – Obesity
  – African or Scandinavian descent

• Etiology: unknown (likely multifactorial)
  – Risk factors of early ambulation & obesity suggest biomechanical component
Blount Disease

- Risk factors:
  - Early ambulation
  - Obesity
  - African or Scandinavian descent

- Etiology: unknown (likely multifactorial)
  - Risk factors of early ambulation & obesity suggest biomechanical component

- Two forms:
  - Infantile or early onset < 4 years
  - Late onset >4 yrs
    - Juvenile 4 -10 yrs
    - Adolescent >10 yrs
Langenskiöld Classification of Early Onset Blount Disease

Radiographic findings
Radiographic findings
Standing AP radiograph
Radiographic findings

Standing AP radiograph

- Genu Varum
Radiographic findings
Standing AP radiograph

• Genu Varum

Tibiofemoral angles
~20°

1-2 years
nl = 0-10° varus

15-month-old
Radiographic findings

• Genu Varum (Standing AP radiograph)

• Increased metaphyseal-diaphyseal angle (MDA)
  – Physiologic bowing
    • MDA typically $\leq 11^\circ$
  – Blount disease
    • MDA typically $> 11^\circ$
  – Borderline 8-11$^\circ$
Radiographic findings

- Genu Varum (Standing AP radiograph)
- Increased metaphyseal-diaphyseal angle (MDA)
  - Physiologic bowing
    - MDA typically $\leq 11^\circ$
  - Blount disease
    - MDA typically $> 11^\circ$
  - Borderline $8-11^\circ$
Radiographic findings

- Genu Varum (Standing AP radiograph)
- Increased metaphyseal-diaphyseal angle (MDA)
Radiographic findings

- Genu Varum (Standing AP radiograph)
- Increased metaphyseal-diaphyseal angle (MDA)
- Widened medial tibial physis
- Medial tibial metaphysis
  - Depression
  - “Beaked”
  - Irregular / fragmented
Radiographic findings

- Genu Varum (Standing AP radiograph)
- Increased metaphyseal-diaphyseal angle (MDA)
- Widened medial tibial physis
- Medial tibial metaphysis
  - Depression
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- Widened medial tibial physis
- Medial tibial metaphysis
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- Widened medial tibial physis
- Medial tibial metaphysis
  - Depression
  - “Beaked”
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Radiographic findings

- Genu Varum (Standing AP radiograph)
- Increased metaphyseal-diaphyseal angle (MDA)
- Widened medial tibial physis
- Medial tibial metaphysis
  - Depression
  - “Beaked”
  - Irregular / fragmented
- Medial tibial epiphysis
  - Abnormal/delayed ossification
Radiographic findings

- Angular deformities:
  - Genu varum
  - Lateral subluxation of the tibia
  - Procurvatum
Radiographic findings

• Angular deformities:
  – Genu varum
  – Lateral subluxation of the tibia
  – Procurvatum
Radiographic findings

• Angular deformities:
  – Genu varum
  – Lateral subluxation of the tibia
  – Procurvatum
    • Lateral radiograph

10 year old
Radiographic findings

• Angular deformities:
  – Genu varum
  – Lateral subluxation of the tibia
  – Procurvatum
    • Lateral radiograph
Radiographic findings

• Angular deformities:
  – Genu varum
  – Lateral subluxation of the tibia
  – Procurvatum
    • Lateral radiograph
MRI Findings
MRI Findings
Medial Proximal Tibia
MRI Findings
Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
MRI Findings
Medial Proximal Tibia

- Physis / metaphysis
  - Physeal widening
  - Downsloping / irregularity
MRI Findings

Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
MRI Findings

Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
  – Physeal Bridge
MRI Findings

Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
  – Physeal Bridge
MRI Findings

Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
  – Physeal Bridge

• Epiphyseal cartilage
  – Far medial – thick
  – Central medial - thin
    • Increased joint space
MRI Findings

Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
  – Physeal Bridge

• Epiphyseal cartilage
  – Far medial – thick
  – Central medial - thin
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MRI Findings
Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
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MRI Findings

Medial Proximal Tibia

- Physis / metaphysis
  - Physeal widening
  - Downsloping / irregularity
  - Physeal Bridge

- Epiphyseal cartilage
  - Far medial – thick
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    - Increased joint space

MRI Findings

Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
  – Physeal Bridge

• Epiphyseal cartilage
  – Far medial – thick
  – Central medial - thin
    • Increased joint space

• Medial Meniscus
  – Thickened +/- abnormal signal
MRI Findings

Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
  – Physeal Bridge

• Epiphyseal cartilage
  – Far medial – thick
  – Central medial - thin
    • Increased joint space

• Medial Meniscus
  – Thickened +/- abnormal signal
MRI Findings
Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
  – Physeal Bridge

• Epiphyseal cartilage
  – Far medial – thick
  – Central medial - thin
    • Increased joint space

• Medial Meniscus
  – Thickened +/- abnormal signal
MRI Findings

Medial Proximal Tibia

• Physis / metaphysis
  – Physeal widening
  – Downsloping / irregularity
  – Physeal Bridge

• Epiphyseal cartilage
  – Far medial – thick
  – Central medial - thin
    • Increased joint space

• Medial Meniscus
  – Thickened +/- abnormal signal

• Angular deformities
  – Medial and posterior downsloping
MRI Findings

Other findings:
MRI Findings
Other findings:

• Lateral proximal tibia
  – Physis - widened/irregular
  – Metaphysis
MRI Findings

Other findings:

• Lateral proximal tibia
  – Physis - widened/irregular
  – Metaphysis
MRI Findings

Other findings:

- Lateral proximal tibia
  - Physis
  - Metaphysis - irregular
MRI Findings

Other findings:

• Lateral proximal tibia
  – Physis
  – Metaphysis

• Femur
  – Epiphysis
  – Metaphysis
  – Physis
MRI Findings

Other findings:

- Lateral proximal tibia
  - Physis
  - Metaphysis
- Femur
  - Epiphysis
  - Metaphysis
  - Physis

MRI Findings
Other findings:

• Lateral proximal tibia
  – Physis
  – Metaphysis

• Femur
  – Epiphysis
  – Metaphysis
  – Physis

MRI Findings

Other findings:

- Lateral proximal tibia
  - Physis
  - Metaphysis
- Femur
  - Epiphysis
  - Metaphysis
  - Physis
- Soft tissues
  - Perichondral membrane
    - Thickened
  - ACL - laxity

Treatment of Blount Disease
Treatment

• Conservative
  – Observation
  – Orthosis
Treatment

• Conservative
  – Observation
  – Orthosis

• Surgery
  – Lateral hemiepiphysodeesis
  – Resection of a physeal bar
  – Realignment osteotomy
Treatment

• Conservative
  – Observation
  – Orthosis

• Surgery
  – Lateral hemiepiphysseodesis
  – Resection of a physeal bar
  – Realignment osteotomy
Treatment

• Conservative
  – Observation
  – Orthosis

• Surgery
  – Lateral hemiepiphysiodysis
  – Resection of a physeal bar
  – Realignment osteotomy
Treatment

• Conservative
  – Observation
  – Orthosis

• Surgery
  – Lateral hemiepiphysodeesis
  – Resection of a physeal bar
  – Realignment osteotomy
Genu varum / Bowing

• Differential diagnosis:
  – Exaggerated ‘physiologic’
  – Blount disease
  – Abnormal bones
    – Metabolic bone disease
    – Skeletal dysplasias
  – Physeal/metaphyseal injury
Genu varum / Bowing

- Differential diagnosis:
  - Exaggerated ‘physiologic’
  - Blount disease
  - Abnormal bones
    - Metabolic bone disease
    - Skeletal dysplasias
  - Physeal/metaphyseal injury
Genu varum / Bowing

- Differential diagnosis:
  - Exaggerated ‘physiologic’
  - Blount disease
  - Abnormal bones
    - Metabolic bone disease
      - Rickets
    - Skeletal dysplasias
  - Physeal/metaphyseal injury
Genu varum / Bowing

- Differential diagnosis:
  - Exaggerated ‘physiologic’
  - Blount disease
  - Abnormal bones
    - Metabolic bone disease
      - Rickets
    - Skeletal dysplasias
  - Physeal/metaphyseal injury

3-year-old girl with rickets
Genu varum / Bowing

- Differential diagnosis:
  - Exaggerated ‘physiologic’
  - Blount disease
  - Abnormal bones
    - Metabolic bone disease
    - Skeletal dysplasias
      - Achondroplasia
  - Physeal/metaphyseal injury

4-year-old boy with achondroplasia
Genu varum / Bowing

- Differential diagnosis:
  - Exaggerated ‘physiologic’
  - Blount disease
  - Abnormal bones
    - Metabolic bone disease
    - Skeletal dysplasias
      - Achondroplasia
  - Physeal/metaphyseal injury

5-year-old boy with achondroplasia
Genu varum / Bowing

• Differential diagnosis:
  – Exaggerated ‘physiologic’
  – Blount disease
  – Abnormal bones
    – Metabolic bone disease
    – Skeletal dysplasias
  – Physeal/metaphyseal injury
Physeal/metaphyseal injury

- Chronic repetitive (overuse) injuries
- Physeal injury -> Bridge
Physeal/metaphyseal injury

- Chronic repetitive (overuse) injuries
- Physeal injury -> Bridge

Can cause genu varum or valgum
Depending on location of injury
Physeal/metaphyseal injury

- Chronic repetitive (overuse) injuries
- Physeal injury -> Bridge
Physeal/metaphyseal injury

- Chronic repetitive (overuse) injuries
  - Disruption of metaphyseal blood supply
  - Disruption of endochondral ossification
Physeal/metaphyseal injury

- Chronic repetitive (overuse) injuries
  - > Disruption of metaphyseal blood supply
  - > Disruption of endochondral ossification

14-year-old competitive soccer player
2-month follow up after rest
Physeal/metaphyseal injury

Laor T. et. al. Physeal Widening in the Knee Due to Stress Injury in Child Athletes. AJR 2006
Physeal/metaphyseal injury

11 years

Laor T. et. al. Physeal Widening in the Knee Due to Stress Injury in Child Athletes. AJR 2006
Physeal/metaphyseal injury

Laor T. et. al. Physeal Widening in the Knee Due to Stress Injury in Child Athletes. AJR 2006

11 years

2 year follow up
Physeal/metaphyseal injury

Laor T. et. al. Physeal Widening in the Knee Due to Stress Injury in Child Athletes. AJR 2006

11 years

17 years
Genu valgum
Genu Valgum / Knock Knees

- Angular deformity at the knee
  - Apex of the deformity points toward the midline.
  - Leg (below knee) deviates away from the midline.

- Common referral to orthopedic clinics
Genu Valgum / Knock Knees

• Angular deformity at the knee
  – Apex of the deformity points toward the midline.
  – Leg (below knee) deviates away from the midline.

• Common referral to orthopedic clinics
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
  – Tumors
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
  – Tumors
Exaggerated ‘Physiologic’ Valgum

- Exaggeration of the normal age-related valgus
- Age: 3-5 yrs
- Bilateral & symmetric
- Normal stature
- Absent or mild symptoms
Exaggerated ‘Physiologic’ Valgum

- Exaggeration of the normal age-related valgus
- Age: 3-5 yrs
- Bilateral & symmetric
- Normal stature
- Absent or mild symptoms
Exaggerated ‘Physiologic’ Valgum

- Exaggeration of the normal age-related valgus
- Age: 3-5 yrs
- Bilateral & symmetric
- Normal stature
- Absent or mild symptoms
Genu Valgum

- Differential diagnosis:
  - Exaggerated ‘physiologic’
  - Physeal/metaphyseal injuries
    - Chronic repetitive (overuse) injuries
    - Physeal injury -> Bridge
    - Cozen Phenomenon
  - Abnormal bones
  - Tumors
Physeal Injury -> Bridge

• Causes
  – Trauma – most common cause
  – Other causes:
    • Infection
    • Radiation
    • Medications
    • Tumors
Risk Factors of Bridge Formation

- Severity of injury
- Growth potential
  - Younger / less skeletal maturity
- Anatomic site
  - Contour of the physis & growth rate
Risk Factors of Bridge Formation

Anatomic site:
Risk Factors of Bridge Formation

Anatomic site:

• Distal radius

• Distal femur
Risk Factors of Bridge Formation

Anatomic site:

• Distal radius

• Distal femur
Risk Factors of Bridge Formation

Anatomic site:

- Distal radius – smooth, uniplanar
- Distal femur
Risk Factors of Bridge Formation

Anatomic site:

• Distal radius – smooth, uniplanar

• Distal femur - undulating, multiplanar physis
Risk Factors of Bridge Formation

Anatomic site:

• Distal radius – smooth, uniplanar

• Distal femur - undulating, multiplanar physis
Risk Factors of Bridge Formation

Anatomic site:

- Distal radius – smooth, uniplanar

- Distal femur - undulating, multiplanar physis

- Physeal fx: Radius >>> Femur
- % -> Bridges : Femur >>> Radius
10 year old girl
10-year-old girl with history of a distal femur fracture
Imaging Physeal Bridges

Radiographs

- Directly visualized
- Indirect evidence
  - Narrowing of the physis
  - Growth recovery lines

10-year-old girl with history of a distal femur fracture
Imaging Physeal Bridges

Radiographs

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10-year-old girl with history of a distal femur fracture
Imaging Physeal Bridges

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10-year-old girl with history of a distal femur fracture
Imaging Physeal Bridges

Radiographs

• Directly visualized

• Indirect evidence
  – Narrowing of the physis
  – Growth recovery lines
    • Normal - parallel physis

10-year-old girl with history of a distal femur fracture
Imaging Physeal Bridges

Radiographs

• Directly visualized

• Indirect evidence
  – Narrowing of the physis
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    • Normal - parallel physis

10-year-old girl with history of a distal femur fracture
Imaging Physeal Bridges

Radiographs

• Directly visualized

• Indirect evidence
  – Narrowing of the physis
  – Growth recovery lines
    • Normal - parallel physis
    • Abnormal – Oblique, converge at physeal bridge

10-year-old girl with history of a distal femur fracture
Imaging Physeal Bridges

Radiographs

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10-year-old girl with history of a distal femur fracture
Imaging Physeal Bridges

Radiographs

• Directly visualized
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  – Narrowing of the physis
  – Growth recovery lines
    • Normal - parallel physis
    • Abnormal – Oblique, converge at physeal bridge

10-year-old girl with history of a distal femur fracture
Treatment of Physeal Bridges

- Resection
Treatment of Physeal Bridges

• Resection considered if:
  – Existing or developing deformity
Treatment of Physeal Bridges

• Resection considered if:
  – Existing or developing deformity
  – ≥ 2 years or 2 cm of remaining growth
Treatment of Physeal Bridges

• Resection considered if:
  – Existing or developing deformity
  – ≥ 2 years or 2 cm of remaining growth
  – Bridge occupies < 50% of the physeal area
Treatment of Physeal Bridges

• Resection considered if:
  – Existing or developing deformity
  – $\geq 2$ years or 2 cm of remaining growth
  – Bridge occupies $< 50\%$ of the physeal area
Treatment of Physeal Bridges

- Resection considered if:
  - Existing or developing deformity
  - $\geq 2$ years or $2$ cm of remaining growth
  - Bridge occupies $< 50\%$ of the physeal area

GRE
Treatment of Physeal Bridges

- Resection considered if:
  - Existing or developing deformity
  - $\geq 2$ years or 2 cm of remaining growth
  - Bridge occupies $< 50\%$ of the physeal area
Treatment of Physeal Bridges

- Resection considered if:
  - Existing or developing deformity
  - $\geq 2$ years or 2 cm of remaining growth
  - Bridge occupies $< 50\%$ of the physeal area

Area of Bridge

Total Area of Physis
Treatment of Physeal Bridges

- Resection considered if:
  - Existing or developing deformity
  - $\geq$ 2 years or 2 cm of remaining growth
  - Bridge occupies $< 50\%$ of the physeal area

\[
\frac{\text{Area of Bridge}}{\text{Total Area of Physis}} = \% \text{ of Physis Occupied by Bridge}
\]
Physeal Bridge

• Treatment options:
  – Bridge resection
  – Osteotomy to correct angular deformities
Physeal Bridge

• Treatment options:
  – Bridge resection
  – Osteotomy to correct angular deformities
  – Contralateral epiphysiodesis
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘physiologic’
  – Physeal/metaphyseal injuries
    – Chronic repetitive (overuse) injuries
    – Physeal injury -> Bridge
    – Cozen Phenomenon
  – Abnormal bones
  – Tumors
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘physiologic’
  – Physeal/metaphyseal injuries
    – Chronic repetitive (overuse) injuries
    – Physeal injury -> Bridge
  – Cozen Phenomenon
    • Valgus deformity s/p proximal tibial fx
      – Despite good alignment at fx site

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  – Physeal/metaphyseal injuries
    – Chronic repetitive (overuse) injuries
    – Physeal injury -> Bridge
  – Cozen Phenomenon
    • Most accepted theory
      – Fx -> ↑ vascularity -> medial metaphyseal overgrowth

Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘Physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
  – Tumors
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘Physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
    – Metabolic bone disease
      – Rickets

5-year-old boy with rickets
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘Physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
    – Metabolic bone disease
      – Rickets

5-year-old boy with rickets
Genu Valgum

- Differential diagnosis:
  - Exaggerated ‘Physiologic’
  - Physeal/metaphyseal injuries
  - Abnormal bones
    - Metabolic bone disease
      - Rickets

5-year-old boy with rickets
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘Physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
    – Metabolic bone disease
    – Lysosomal storage disease
      – Mucopolysaccharidosis IV (Morquio syndrome)

Mucopolysaccharidosis IV
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘Physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
    – Metabolic bone disease
    – Lysosomal storage disease
      – Mucopolysaccharidosis IV (Morquio syndrome)
Genu Valgum

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  - Physeal/metaphyseal injuries
  - Abnormal bones
    - Metabolic bone disease
    - Lysosomal storage disease
      - Mucopolysaccharidosis IV (Morquio syndrome)
Genu Valgum

- Differential diagnosis:
  - Exaggerated ‘Physiologic’
  - Physeal/metaphyseal injuries
  - Abnormal bones
    - Metabolic bone disease
    - Lysosomal storage disease
    - Skeletal dysplasias
      - Chondroectodermal dysplasia (Ellis-van Crevald)
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘Physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
    – Metabolic bone disease
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    – Skeletal dysplasias
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    - Skeletal dysplasias
      - Chondroectodermal dysplasia (Ellis-van Crevald)
Genu Valgum

• Differential diagnosis:
  – Exaggerated ‘Physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
  – Tumors
    – Osteochondromas / Multiple hereditary exostosis
Genu Valgum

- Differential diagnosis:
  - Exaggerated ‘Physiologic’
  - Physeal/metaphyseal injuries
  - Abnormal bones
  - Tumors
    - Osteochondromas / Multiple hereditary exostosis
Summary
Summary

• Normal developmental changes at the knee
Summary

• Genu Varum
  – Exaggerated Physiologic
  – Blount
  – Abnormal Bones
  – Injuries

• Genu Valgum
  – Exaggerated ‘Physiologic’
  – Physeal/metaphyseal injuries
  – Abnormal bones
  – Tumors
References