WHEN TO BE CONCERNED: Leg Bowing, Intoeing and Flat Feet.

Understanding normal childhood development and recognizing signs of pathology.

WHAT IS NORMAL?

Very important: “the average” and “normal” are not the same thing!
A Little bit of History..

Doctors in history treated their patients (and parents!) with braces, shoes and orthotics (named after themselves...) and patients “grew straight”...

Lynn Staheli did a “Natural History” study and didn’t treat his patients and they “grew straight”...

“The art of Medicine consists of amusing the patient while nature cures the disease”.... Voltaire
NORMAL DEVELOPMENT

- At Birth: Bowed legs, flat feet
- Second Year: Straight legs, flat feet
- Fourth year: Maximal genu valgum (up to 15˚), with in-toeing
- Sixth year: Normal genu valgum (7˚)

EVALUATION

- Angular Profile:
  - Intermalleolar distance (knock knees/genu valgum)
  - Intercondylar distance (bow legs/genu varum)
GENU VARUM

- Extremely common deformity
- Need to distinguish physiological genu varum from tibia vara (Blount’s disease) because prognosis and treatment differs

PHYSIOLOGICAL GENU VARUM

- Tibiofemoral angle of at least 10°
- Normal physis
- May have delayed ossification of medial femoral and tibial ossification centres
TIBIA VARA (BLOUNT’S DISEASE)

- Growth retardation of the medial proximal growth plate
- Leads to a progressive tibia vara and internal rotation
- Infantile Tibia vara <3 years
- Juvenile Tibia vara 3-10 years
- Adolescent Tibia vara >10 years

TIBIA VARA (BLOUNT’S DISEASE)

- Etiology is unknown
  - Seen more commonly in children walking early and overweight
- Clinically
  - Above 95th percentile weight
  - Severe internal rotation of the tibia
  - Lateral thrust
TIBIA VARA (BLOUNT’S DISEASE)

- Metaphyseal-diaphyseal angle (Drennan’s)
  - <10° → 95% will resolve
  - >16° → 95% will progress
PHYSIOLOGICAL GENU VARUM

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TREATMENT

- Surgical
  - Proximal tibial osteotomy

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GENU VALGUM

- Children aged 3-4 may have up to 20° genu valgum
- Genu valgum should not increase after 7 years of age
- After 7, valgus should not be more than 12° with intermalleolar distance <8 cm

Standing X rays should be done to measure genu valgum angle and also to exclude other pathologies (metaphyseal dysplasia, Multiple exostosis, Multiple enchondromatosis etc.)
GENU VALGUM

- Treatment
  - Bracing is ineffective!!
  - Correction is indicated if mechanical axis falls in the outer quadrant of tibial plateau (or beyond) in children older than 10 years

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GENU VALGUM

Rotational profiles change during childhood, but vary widely among healthy children of the same age.

Causes:
- Femoral Anteversion
- Tibial Torsion
- Metatarsus Adductus

INTOEING

Rotational profiles change during childhood, but vary widely among healthy children of the same age.

Causes:
- Femoral Anteversion
- Tibial Torsion
- Metatarsus Adductus
FEMORAL ANTEVERSION

- Intoeing with medially rotated patella’s = femoral anteversion
- Prevalent cause of intoeing 3-6 years
- At birth: normal 30˚-40˚
- At skeletal maturity: 15˚
- Girls:boys 2:1, and often hereditary
- Not directly correlated to degenerative changes in hip and knee
- M sitting

TIBIAL TORSION

- Most evident 1-2 years
- Usually resolves by 6 years
- Measured as angle between:
  - Transmalleolar axis (ankle)
  - Bicondylar axis (knee)
- Normal: 20˚ ext rotation
METATARSUS ADDUCTUS

- “Kidney” shaped foot
- Medial deviation of forefoot
- Normal alignment of hindfoot
- 12% of newborns
- ? Due to intrauterine position
- Assess active correction by tickling foot

EVALUATION

- Rotational Profile:
  - Foot Progression Angle
  - Femoral version (Ryder’s angle)
  - Tibial torsion (Trans-Malleolar angle)
  - Foot Assessment (Bleck’s line)
  - Thigh foot angle
Management of Deformities

- Femoral Anteversion:
  - Generally: Monitor progression
  - *Only* were indicated: Derotational osteotomy
- Tibial Torsion:
  - Generally: Monitor progression
  - *Only* were indicated: Derotational osteotomy
- Metatarsus Adductus:
  - Generally: Monitor progression (95% correct by age 5)
  - Mild deformity: stretches
  - Moderate deformity: serial casting
  - *Only* were indicated: incl. open wedge medial osteotomy and closed wedge lateral osteotomy

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FLAT FEET

- Exact incidence unknown but probably one of the most common “deformity”
- “Usual in infants, common in children, and within the normal range in adults” Staheli

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FLAT FEET

- Clinical examination
  - Heel usually in severe valgus with a diminished medial arch. Medial arch also seems “longer” than lateral
  - Forefoot seems abducted – “too many toes “sign
  - Check overall alignment of legs especially genu valgum

FLAT FEET

- Clinical examination
  - With child standing on his/her toes
    - Heel moves into varus
    - Medial arch reconstitute
  - Mobile “normal looking “foot
FLAT FEET

- Standing AP X ray
  - Uncoverage of talus
  - Talocalcaneal (Kite’s) angle
- Standing lateral X ray
  - Meary’s angle
  - Talocalcaneal angle
  - Calcaneal pitch decreased
- Rule out other pathology

No treatment is indicated in an asymptomatic mobile flat foot
For a symptomatic mobile flat foot always conservative treatment first
- Achilles stretching
- Tibialis posterior strengthening
- Orthosis/ Hyperpronated running shoes?
FLAT FEET

- Lateral column lengthening

FLAT FEET

- Medial displacement calcaneal osteotomy
FLAT FEET

• Arthroereisis

Pathological flat feet:

• Talipes calcaneovalgus
• Congential vertical talus
• Tarsal coalitions
• Hypermobile flatfoot with tight TA
• Neurogenic
• Accessory navicular bone
TAKE HOME MESSAGE

<table>
<thead>
<tr>
<th>Physiological</th>
<th>Pathological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetrical</td>
<td>Asymmetrical</td>
</tr>
<tr>
<td>Mild-Moderate</td>
<td>Severe</td>
</tr>
<tr>
<td>Regressive (self-limiting)</td>
<td>Progressive (requires treatment)</td>
</tr>
<tr>
<td>Generalised (eg bow legs)</td>
<td>Localised (eg. Blounts)</td>
</tr>
<tr>
<td>Age appropriate</td>
<td>Not age appropriate</td>
</tr>
</tbody>
</table>

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Take Home Message

- Pes Planus /Flatfeet
  - Painful
  - Rigid
- Genu Valgum/Knock knees
  - $> 12^\circ$ and intermalleolar distance $> 8$cm at age of 7
- Genu varum/Bow legs
  - Drennan angle $> 16^\circ$

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Take Home Message

- **Intoeing**
  - Femoral anteversion
    - No external rotation of the hip
    - >12 years
  - Tibial torsion
    - >6 years
    - Negative transmalleolar angle
  - Metatarsus adductus
    - 95% will get better
    - Surgery only after 5 years

THANK YOU