Epiphyseal Injuries in Junior Rock Climbers

The mind is stronger than the finger

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Anatomy

- The growth plate (physis) is located between the epiphysis and metaphysis.
- This is where the endochondral ossification takes place.
Anatomy

- Proliferating Zone: Bone growth through proliferation of cells. Fracture here = normal growth is inhibited.
- Hypertrophic zone: between the cartilage cells extracellular matrix is produced which then calcifies leading to a pillarlike structure. Fractures occur most often between the uncalcified and calcified areas.
- Ossification zone: Bone and cartilage cells are being remodelled, removed and replaced by secondary spongiosa.
Basics

• Epiphyseal cartilage is more prone to fracture than adult cartilage and the bone next to it\textsuperscript{1,2}.
• Furthermore it is weaker than the other tissue around it\textsuperscript{3}.

\textbf{=> Thus, an injury leading to a ligament tear or a luxation of a joint in adults, will lead to an epiphyseal fracture in children}
Basics

• In animal studies the growth plate was weakest during puberty\(^3\).

• Results in humans comparable\(^4\)\(^-\)\(^6\).

• Reasons:
  – Heightened growth leads to thicker and more fragiles growth plates\(^4\)
  – Mineralisation probably lacks behind linear growth\(^7\)
  – Whether or not a more pronounced muscle tension as a consequence of growth is important controversial\(^8\)

• Most fractures occur during puberty, during the growth peak\(^9\),\(^10\).
Classification

I  Proliferation  Zone not involved

II  Fracture Through Metaphysis

III  Fracture Through Epiphysis

IV  Fracture Metaphysis, Epiphysis, And Physis

V  Compression Of the physis With Premature Closure and End to further growth
Pathophysiology

• Cause: Repetitiv trauma

• Consequence:
  – Decreased metaphyseal blood flow
  – Mineralisation of hypertrophic chondrocytes hindered\(^{11}\)
  – However growth is unperturbed\(^{11}\)

• Normally this is only temporary as the blood flow is only decreased over short periods of time

• When decreased blood flow is maintained:
  – Necrosis of the bone
  – Bone growth disturbed
  – Imbalanced: Assymetric growth
  – Balanced: Retardation or even End of growth
Little League Shoulder
Pathomechanism
Guidelines

• Pitching only for two innings per game

• Shoulder problems lead to end of pitching and taking up another position

• No Home-Training

• No Curve Balls

• Medical control on local and national level
Radius in Gymnastics
Radius in Gymnastics

Mainly Salter Harris V
Lower extremity

• Mainly running
  – Long distance
  – Running as a consequence of the sport (Basketball, Soccer, Football)

• Sports involving kicking
  – Rugby
  – Soccer
Climbing
Presentation

- No real Trauma
- Pain increased slowly over time
- Flexion and extension of finger limited
- Pain upon pressure over the dorsal aspect of the finger middle joint
- Overall 60 fractures, 24 described in detail, of which there were 23 boys, 1 girl
- X-ray: Mainly Salter Harris III.
- When X-Ray was normal often Salter Harris I – II in MRI
Study on epiphyseal fractures of the finger

• Over the last ten years: 19 adolescents with finger pain of which 18 had chronic epiphyseal fractures in 22 fingers.

• 15 boys and 4 girls

• All were 14.4 months in average after onset of puberty (thelarche in girls, pubarche in boys)

• All were climbing at a high and/ or competition level (UIAA 9 and up)
Presentation

- Swelling of the finger
- Pain over the dorsal aspect
- Gets worse during training
- Slow onset till sudden event
Imaging
Results

• The middle finger was concerned in 21 of 22 fingers (95%)
• The main grip form at the moment of injury was the crimp grip (64%), which was also the preferred handhold (71%)
• 86% of the patients were participating in bouldering competitions
• 18 fractures were Salter Harris III, two were grade I and two grade V
• 71% stated they had warmed up properly
• Campus board was done by almost no subjects (0.2 h/week), most were climbing (3.6 h/week) or bouldering (3.2 h/week) for training
• 13 adolescents remembered an acute event leading to the trauma
Therapie and Outcome

- Rest from climbing for a minimum of 6 weeks and control MRI
- With Compliance good Outcome
- 2 athletes did not follow our advice and now have ulnar deviation of the finger in one case and a rotated finger in the other case. Both fingers are not fully functional
Outcome
Aternative Therapy

- Two athletes (not from the study) did not recover within 3 months => Epiphysiodesis
Gender distribution

Testosteron
Literatur

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Thank you for your attention