Fractures of the fingers

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Recent Fractures

Definitions

Large bone fragment

Delay < 3 weeks
The more frequent complications:

- Stiffness
- Pain

PIP Stiffness = global hand disability

Young patients → Functional and professional impairment
Early mobilization

Synovial fluid nutrition
Tendon gliding
Removal of waste products

Salter 1980
Mecanism of injury

- Flexion/ extension
- Lateral stress
- Compression
- Temporary dislocation
Clinical examination

Observation
- Deformity
- Swelling
- Ecchymosis
- Range of motion
- Associated injury (skin, tendons, multilevel)

Stress Testing?
- After X-Ray
- Under Local Anesthesia
Clinical examination
X Ray examination

- Fracture lines
- Displacement
- Impaction
- Articular congruency

AP
True Lateral
3/4
CT Scan ?
Fractures of the Base of the Proximal Phalanx

- Surgical approach: dorsal or palmar
Fractures of the base of the Proximal Phalanx
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Fractures of the Proximal Phalanx
De quel côté mettre la plaque?
Fractures of the Proximal Phalanx
Fractures of the Proximal Phalanx
Fractures of the Proximal Phalanx
Fractures of the Proximal Phalanx
Vis

- Large abord
- Meilleure tenue
- Pas d’ablation
Combinaisons de circonstance…
CLOUS-PLAQUES

Pour les fractures distales
Fractures fermées avec lésions associées

- Fracture spiroïde de P1
- Section complète de l’appareil extenseur
Fracture fermée
avec
Section de l’appareil extenseur
Fractures fermées avec lésions associées
Amputations trans P1

- Unidigitale : Pas de replantation
- Pluridigitales
Fractures of the Proximal Phalanx
Conservative treatment

- Cast of Thomine
Traitement orthopédique des fractures de P1

Appareillage de Thomine
Appareillage de Thomine

MP en flexion
IPP libres
Syndactylie dynamique
Appareillage de Thomine

MP en flexion
IPP libres
Syndactylie dynamique
Fracture diaphysaire comminutive et ouverte

Instabilité majeure
Surveillance cutanée
Brochage temporaire
MP en flexion

Equivalent de
l’appareillage de Thomine
Résultat du brochage temporaire MP en flexion
Classification of P1 condylar fractures

- Grade I: little displacement no instability
- Grade II: unstable fractures
  - Type IIa: small fragment
  - Type IIb: large fragment
- Grade III: Comminutive - Pilon

London 1971

O’Rourke 1989
Classification

of

P1 condylar fractures

Grade I: no instability

Type IIa: unstable small fragment

Type IIb: unstable large fragment

London (1971)

Type III
Another classification of P1 condylar fractures

Weiss & Hastings 1993

- Class 1: oblique volar
- Class 2: long sagittal
- Class 3: dorsal coronal
- Class 4: volar coronal

60% 20% 10% 10%
Class 1: oblique volar

Weiss et Hastings 1993

Distraction force
Through collateral ligament
With an element of rotation
But, Juxta condylar ...

...Can become intra-articular
Classifications of the fractures of the middle phalanx

Based on

- Localisation
- Degree of comminution
- Number of fragments
- Impaction
- Subluxation

Lateral X Ray:
false negative
Proximal phalanx
Classification of Seno (1997)

• Type 1 : fragment on the palmar side

• Type 2 : fragment on the dorsal side
  (extensor tendon insertion)

• Type 3 : « Pilon fracture »  dorsal and palmar fragments

• Type 4 : Extra-articular

• Type 5 : Not classifiable
Type 1:

One fragment on the palmar side

(Continuity of the fragment with the palmar plate)
Type 2

Fragment on the **dorsal side**
(proximal extensor tendon insertion)

Seno 1997
Type 3

**Pilon fracture**

High energy Axial loading

**Two main fragments**

On palmar and dorsal sides
No continuity with the shaft
Widening of the base
Central impaction

*Seno 1997

*Stern 1991
Bipolar avulsion

Seno 1997

Pilon ?
Classification of Seno

Sub-classification

- a : avulsion
- b : separation
- c : impaction

Seno 1997
Percentage of articular impaction (type 1c)

< 30%

30 to 50%

> 50%

Dorsal instability is directly proportional to the degree of impaction
The joint is always unstable over > 40%

Loss of Ligamentous support and Articular buttress
Bony loss of substance
Associated lesion

- Skin loss
- Extensor tendon
- Multilevel injuries
Anesthesia

Prefer Axillary bloc

- Arm tourniquet

- Sensory and motor bloc
Surgical approach

- **Dorsal or Lateral approach**
  - More direct
  - Trough extensor tendon

- **Palmar approach**
  - More distant
  - Spares flexor tendons
Dorsal or Lateral approaches

Lateral skin incision: Avoid

- radial side of the index finger
- ulnar side of the little finger
Dorsal skin incision

Avoid Lazy S

Prefer Longitudinal
Crossing extensor tendon

Between lateral and central slip
Through the central slip (Chamay’s approach)

Stronger repair than transverse section
Crossing extensor tendon

Through the transverse retinacular ligament
**Dorso-lateral approach**

**Intra-articular exposure**

Proximal release of

- Collateral ligaments
- Palmar plate

*Büchler 1996*

**TATA approach?**

*Saffar 1983*
Anterior approach: Shotgun

Brüner type incision centered on the PIP joint
Anterior approach: Shotgun

1. Opening of the flexor sheath
2. Retraction of the flexor tendons
3. Dissection of the pedicules
Anterior approach: Shotgun

- **Release**
  of the palmar plate

- **Excision**
  of the lateral ligaments
Anterior approach
Shotgun

The middle phalanx is « Shoe-horned » over the head of the proximal phalanx
Shotgun Anterior approach

Closure
Treatment modalities for PIP fractures

- Extension-Block splinting
- Extension-Block pinning
- Temporary K wire fixation
- Internal fixation
- Volar plate arthroplasty
- Dynamic external fixator
- Vascularized transfer
- Radical procedures
Extension-Block splinting
Extension-Block splinting

• Dorsal splint
• Incorporated in a gauntlet
  – Metacarpo-phalangeal flexion
  – Progressive PIP extension

MCElfresh 1972
Extension-block pinning
« Doorstop procedure »

- Inoue 1991
- Viegas 1992
- Twiman 1993

Sugawa 1979
Extension-block pinning
« Doorstop procedure »

Technique

• Under Fluoroscopy
• 1.2 mm K-Wire
• On one side of the central slip
• Full flexion before wire insertion to avoid any tenodesis effect

Sugawa 1979
Extension-block pinning
Extension-block pinning
« Doorstop procedure »

**Advantages**
- Simple
- Poorly invasive
- Avoids recurrent subluxation (>30%)

**But**: infection is potentially severe (intra-articular)
- Daily pin care
- Regular follow-up

Removal after 3 to 8 weeks
Trans articular pin fixation
or static external fixator

Bunnell 1956
Boyes 1964
Spray 1966
Milford 1971

Stabilization in 20 to 40° flexion
Retained for 3 weeks

Propensity to stiffness

Good results at 16 years
Mean 85°

Newington 2001
Trans articular pin fixation
or static external fixator

• For protection of a internal fixation
Trans articular pin fixation
or static external fixator

Pitfalls:

- Incomplete reduction
- Insufficient DIP mobilisation
- Too late removal
Essential guidelines for Internal fixation:

- Specialized surgery
- Protection of the skin
- Protection of the extensor tendon
- Preservation of bone vascularization
Essential guidelines for Internal fixation:

- Open surgery
- K wires
- Screws
- Plates
Essential guidelines for Internal fixation:

Closed K-Wire fixation
Bone grafts
Volar plate arthroplasty

Eaton 1980
Volar plate arthroplasty

- Release of the palmar plate
- Excision of the lateral ligaments
Volar plate arthroplasty

- Release of the palmar plate
- Excision of the lateral ligaments
Volar plate arthroplasty

Preparation of a symmetric trough
Volar plate arthroplasty

- Lengthening of the Check Reins

Blazar 2001
Volar plate arthroplasty

- Palmar plate advancement and fixation

Anchor or Pull out
Volar plate arthroplasty

• **Reduction** is checked fluoroscopically

• **Complementary stabilisation**
  – Extension-Block splinting
  – Extension-Block pinning
  – Temporary K wire fixation
  – Dynamic external fixator
Dynamic external fixators

- Agee 1978
- Schenck 1986
- Inanami 1993
- Susuki 1994
- Allison 1996
- Duteille 2003
- Syed 2003
Dynamic external fixator

- **Goals of the treatment**
  - No surgical approach (adhesion -vascularization)
  - Concentric joint reduction
  - Ligamentotaxis
  - Early mobilization
  - Remodelling

- No reduction of impaction
« Pins & Rubbers »
Technical procedure

Susuki 1994

- Simple
- Light
- Cheap
- Easily available components
- Allows postop X Ray control
« Pins & Rubbers »
Technical procedure

Susuki 1994

2 parallel K-wires

Axial traction pin : 1,2 mm Center of motion
Hook pin : 1,0 mm
« Pins & Rubbers »
Technical procedure
Susuki 1994

2 parallel K-wires

Axial traction pin : 1,2 mm
Hook pin : 1,0 mm
« Pins & Rubbers »
Technical procedure

Susuki 1994

2 parallel K-wires

Axial traction pin : 1,2 mm
Hook pin : 1,0 mm
Application of the rubber bands
Application of rubber bands

Distraction and reduction

checked radiographically
« Pins & Rubbers »
Technical procedure
Prevention of dorsal subluxation

Reduction pin

Base of the middle phalanx
Immediate mobilization

Daily pin care indoor?  
_Duteille_ 2003

Removal between 3 and 8 weeks
Results

PIP ROM:
> 80° mobility on average

- Chahidi 2003
- Inanami 1993
- Susuki 1994
- Morgan 1995
- De Soras 1997
- De Smet 1998
- Duteille 2003
For P1 fractures?

- De Soras 1997
- Duteille 2003
Inversed Push-pin device

Syed 2003
8 pilon fractures
No infection

Gaul 1998
No rubber-band
Less cumbersome
Unlikely to break
Radical procedures

- Joint fusion
- Arthroplasties
- Silicone arthroplasty
Cartilage defect

• Perichondrial resurfacing
• Non vascularized osteo-chondral grafts?
  – hemiarthroplasties
  – Small fragments
  – Synovial preservation
  – Innervation


• Silicone prosthesis
• Vascularized articular transfer
Vascularized toe transfer
Vascularized toe transfer
Indications for conservative treatment

Proximal phalanx

- Undisplaced Fractures
- Comminutive Fractures
Indications for conservative treatment

Middle phalanx

- Undisplaced fractures
- Impaction < 30% with concentric joint
- Complementary to surgery
Indications for surgery

- Open fractures
- Central slip injury
- Flexor tendon injury

Joint instability
Palmar Base of the middle phalanx

30% to 50% (and unstable)

Attempt to conservative treatment
Palmar Base of the middle phalanx
30 à 50%

Conservative treatment
In case of conservative treatment failure

- Large fragment: internal fixation
- Comminutive fragments:
  - Dynamic external fixators
  - Volar plate arthroplasty
Palmar Base of the middle phalanx
30 à 50%

**Internal fixation**
- Lateral approach with distraction
- or Anterior approach

- Desimpaction +- graft
- Complementary Stabilisation

Difficult operation
When internal fixation is not possible

30 to 50%
or > 50%

Dynamic external fixator

+ Restoration of Congruency

Volar buttress

No Impaction reduction
When internal fixation is not possible
30 to 50%
or > 50%

Volar arthroplasty +- bone graft

+ Restoration of
Congruency
Volar buttress
Shaft fixation + Volar arthroplasty

1. **Dorsal approach**

   ➡️ Shaft internal fixation

2. **Anterior « ShotGun »**

   ➡️ Volar arthroplasty
Shaft fixation + Volar arthroplasty

- Extension block splinting
- Immediate rehabilitation
When internal fixation is not possible

hemi-hamate autograft

13 cases

• Mean follow-up 16 months

• Average ROM : PIP 85  DIP 60

Williams 2003

www.eatonhand.com
Dorsal fractures of the base of the middle phalanx

Internal fixation when:
- > 20% or displaced > 2 mm
P2 Fractures Pilon
no spared dorsal cortical

• Splintage
• Internal fixation
• Dynamic traction
Condylar fractures of the proximal phalanx

- Closed pinning
- Or Internal fixation

2 K-Wires or screws
Condylar fractures of the proximal phalanx

Prefer

< 2 mm screws
2 screws
Bicondylar fractures of the proximal phalanx

Always internal fixation
Basics for rehabilitation

- Early mobilization
- MP and DIP
- Adjacent fingers

Dynamic splint after 3 weeks
Long term results

Complete recovery is exceptional

– Residual swelling
– ROM limitation (PIP and DIP)
– Mal union
– Necrosis
– Non union
– Cold intolerance

Post-traumatic arthritis is rarely symptomatic
Long term results
Conclusion (IPP)

- **Condylar fracture of the proximal phalanx**:  
  - Anatomical repair

- **Palmar base fracture of the middle phalanx**:  
  - Articular surface management  
  - Stabilization and early mobilization
Conclusion

Palmar base fracture of the middle phalanx

1. Reconstruction of the anterior buttress
   - Internal fixation
   - Volar plate arthroplasty
   - Dynamic traction

2. Stabilisation
   - Trans articular pinning
   - Extension -block pinning
   - Extension-block splinting
   - Dynamic traction

Stabilisation ➔ Mobilisation
Middle Phalanx Shaft fracture
Middle Phalanx Shaft fracture
Middle Phalanx Shaft fracture
Middle Phalanx Shaft fracture

Stable bone fixation
Early rehabilitation
Middle Phalanx Shaft fracture
Middle Phalanx Shaft fracture
Middle Phalanx Shaft fracture
Amputations trans P2
DIP fracture - Distal P2

Orthopaedic stabilization
DIP fracture

Surgical fixation
DIP fracture- dorsal instability
DIP fracture - Mallet fracture
DIP fracture - Lateral impaction
Metacarpal fractures

- III & IV: stable
- II & V: unstable
  - Multiple non-displaced: conservative
  - Displaced: bone fixation
Metacarpal shaft fractures
Metacarpal shaft fractures
Metacarpal shaft fractures
Metacarpal shaft fractures
Metacarpal shaft fractures
Base of the fifth metacarpal

• Fracture-dislocation in almost every case
  – Intermetacarpal stabilization
  – Articular reconstruction
Base of the fifth metacarpal
Neck of the fifth metacarpal

- Conservative treatment

- Surgical treatment in selected cases
  - Angulation > 60°
  - Open fractures
  - Rotational displacement
Neck of the fifth metacarpal
Neck of the fifth metacarpal
First metacarpal fractures

- Extra-articular
- Articular
  - Bennet fracture
  - Comminutive fracture
First metacarpal fractures
Advantages of external fixation

No surgical approach
Less bone devascularization
Easy hardware removal
Good stability (Fitoussi 96)
External fixation
Where to put the pins?
FE : indications

- I, II & V easier than III & IV
- Compound fractures
- Bone loss
- Transitory stabilization

Freeland 1987
Shearer 1992
Shehadi 1991
Fricker 1996
Hochberg 1994
Drenth 1998
Pertes de substances osseuses

- Greffe osseuse non vascularisée
- En 1 (ou 2) temps
Pathological fractures
Open fractures
Thank you

Urgences Mains de l'Est Parisien