Management of Complications

1. Non-union
2. Malunion
3. Infection
4. Synostosis
5. Ulnar Wrist Pain
6. Contractures

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Concept of FOREARM

A Functional Unit
Joint

Center of rotation

Axis of rotation
Radius rotating around Ulna
A Functional Unit

Functional Joint
Proximal Radioulnar joint

Interosseous membrane

Distal Radioulnar joint

TFCC
Forearm Rotators

- Supinator
- Pronator teres
- Radius
- Ulna
- Pronator quadratus
Functional Joint

Anatomy

Biology

Stability

Function
Anatomy
Stability
Mal-Union = Union in Mal-position/Faulty position

Forearm Rotation Stiffness Pain
Elbow Joint Pain
Stiffness
Instability
Ulnar Wrist Pain
Stiffness
Instability
Non-Union = Permanent failure of fracture healing

Biology Stability
Synostosis = Union of adjacent Bones that are Normally distinct
Volkman’s Ischaemic Contracture
Fibrotic Scar Contracture
complications
Historically ......

Poor Results in 92%

Alignment difficult to align & maintain

Marked loss of motion

High rate of nonunion, malunion, synostosis

Burwell HN et al. JBJS 1964.
Knight RA et al. JBJS 1949.
Hughston JC. JBJS Am 1957.
Matthews LS et al. JBJS Am 1982.
Evans EM. JBJS 1945.
Advancement of surgical techniques

Implants Development
complications
Relatively Uncommon
Relatively Uncommon

Non-Union Rate: 2%  
< 2%  
Anderson LD et al. JBJS Am 1975.  

Infection Rate: 0 – 1%  
Anderson LD et al. JBJS Am 1975.  
Crush, high energy trauma, open fractures conditions
Non-Union rate: x 2
Infection rate: 3%
Synostosis rate: x2

Moed BR et al. JBJS Am 1986.
Non-Union

= Permanent failure
Of fracture healing
Non-Union

Failure to demonstrate progressive changes in radiographic appearance for 3 months beyond the anticipated duration for healing constitutes a nonunion.
Non-Union

Hypertrophic 9%

Atrophic 91%

Some Facts About Non-union ......
• Compression plate:
  – Overall union rate: 98%
  • Anderson LD et al. JBJS Am 1975.

  – Non-union rate 4%
  • Compression plate not used
• **Stern & Drury.** Clin Orthop 1983.
  
  – Non-union rate 17%
  
  • Only 4 screws used
• *Anderson LD* et al. JBJS 1975. (330 fractures)

  – 4 out of 7:
  
  • Plate of inadequate length
  • Failure to center plate properly over fracture
  • Insertion of screw too close to fracture line

  – 3 out of 7:
  
  • Infection
Causes of Non-union......
Causes of Non-union

**Surgeon Factors**
- Not biologically friendly to soft tissue
- Not adhere to principle of internal fixation

**Patient Factors**
- Smoking

**Injury Factors**
- Fracture displacement
- Multiple injuries
- Fracture comminution
- Fracture at junction at mid & distal 1/3

Dodge HS et al. JBJS Am 1972.
Anderson LD et al. JBJS 1975.
Case Example 1

- 45 yr old man
- Chronic smoker
- Fracture shaft of radius & ulna 7 months ago
- Persistent pain at fracture site
- Limited forearm rotation range
How to Manage?
Identify the Problems!
Mal-alignment

Anatomy
Poor surgical Technique

Stability
Smoker

At injury: Bone loss, Soft tissue injury
Poor surgical technique: soft tissue stripping
→ Atrophic Nonunion

**Biology**

Rule Out Infection

Clinical
Radiological
Intraoperative
Anatomy  Stability  Biology
Hypertrophic Non-union

Stability
Anatomy
Biology
Biology
Anatomy
Stability

Atrophic
Non-union
Biology
Anatomy
Stability

Case Example 4
Infected
Non-union
Plates removed
Dead, Infected bone debrided
Gap left ~6cm
Temporary External Fixator
Free Vascularized Fibular Graft to Radius
Replate Ulna
Mal-Union

= Union in Mal-position/
Faulty position
How Much Mal-union Can We Accept?
How Much Forearm Motion Do We Need?
Morrey BF et al. JBJS 1981.

Pronation 50 deg
Supination 50 deg
• Deformity < 10 deg $\rightarrow$ minimal limitation of forearm rotation

• Angulation $\geq 15$deg significantly affect forearm supination & pronation

• Any rotational deformity significantly affect forearm rotation

Matthews LS et al. JBJS Am 1982.
Evan EM et al. JBJS 1945.
Radio-ulnar Synostosis

= Cross-Union Btw Radius & Ulna
Incidence:

(2381 forearm fractures)

(167 forearm fractures)
• Higher Incidence:
  
  – Type IV Monteggia fractures

- Radial head dislocation
- Both forearm bone fractures
– Head Trauma
  – Incidence 18%

– High energy trauma open fractures

– Infection

– Delay surgery
Surgical Errors

- Use of too long screws

Surgical Errors:

- Narrowing interosseous space by non-anatomical reduction
Surgical Errors:

- Bone graft left in IOM
• **Excision + interposition of**
  
  — Silicone, muscle, fat
  
  • Rotation 55deg
    

• **+ RT**

  — Better range


• **Early Surgery (6mths)**

  — Rotation 139deg

• Resect 1 cm section of proximal radius distal to synostosis
  • Rotation 98 deg
Scar Contractures

Splintage
Physiotherapy
Surgery:
Scar Release
Volkman’s Ischaemic Contractures

Splintage
Physiotherapy
Surgery:
  Release
  Muscle slide
  Tendon Lengthening
  Tendon transfer
IOM Contractures
Elbow Contractures

Heterotopic ossification
Ulnar Wrist Pain

Malunion Associated Wrist Injury
1. Non-union
2. Malunion
3. Infection
4. Synostosis
5. Contractures
6. Ulnar Wrist Pain
THANK YOU !!!!!!