

Nonunion and Malunion
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Nonunion

Definition

Brief discussion on normal bone healing

Types

- Atrophic
- Hypertrophic
- Oligotrophic
- Pseudarthrosis
- Fibrous union

Risk factors

Host factors

- Infection
- Diabetes
- Tobacco use
- Age
- Nutrition
- Systemic disease
- Metabolic conditions
- Systemic hormone levels
- Medications
 - Corticosteroids
 - NSAIDs
 - Others

Local factors

- Cancellous vs. cortical bone
- Open fractures & severe soft-tissue trauma
- Necrotic tissue
- Prior radiation
- Pathologic fractures
- Segmental fractures
- Periosteal injury
- Major vascular injury
- Disruption of local blood supply
- Compartment syndrome

Surgeon factors

- Surgical technique and its effects on bone healing
 - Exposure & mobilization
 - Choice of implant

Fracture stability

Inadequate fixation

Too much early motion

Alignment

Rotation & angulation

Distraction & residual displacement (loss of apposition)

Interposed soft tissue

Workup

Thorough history and examination

Infection

Imaging studies

Laboratory findings

Aspiration

Surgical cultures

Assessment of stability

Metabolic workup

Techniques

Nonsurgical treatment

Treatment of underlying infection

Wound care

Antibiotic therapy

Time

Tobacco cessation

Bone stimulation

Nutrition

Correction of underlying metabolic abnormalities

Pharmacologic

Adding the helpful ones

Subtracting the detrimental ones

Immobilization

Weightbearing status

Adding it when it helps

Stopping it when it's not

Patient education / compliance

Surgical

Treatment of underlying infection

Debridement

Hardware removal

When to remove

When to leave it in

Soft tissue coverage

Dynamization

External fixation

Intramedullary

- Plate/screw fixation
- Bone grafting
 - Autogenous
 - Olecranon, distal radius
 - Iliac crest – anterior and posterior
 - Distal femur
 - Proximal tibia
 - Calcaneus
 - Allogenic
- Growth factors
 - Platelet-rich plasma
 - Bone morphogenic protein
 - Demineralized bone matrix
 - Other agents
- Combination agents
- Osteotomy
- Arthrodesis
- Arthroplasty

Cases

Malunion

Definition

- Nonarticular fractures
- Articular fractures

Effects

- Cosmesis
- Pain
- Skin compromise
- Gait abnormality, shoe wear & other functional effects
- Arthrosis

Techniques

- Nonsurgical management
 - Patient education
 - Braces / orthoses
 - Injections / medications
- Surgical management
 - Osteotomy / deformity correction
 - Acute correction
 - Gradual correction
 - Arthrodesis
 - Arthroplasty

Cases