Malunion of long bones

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Definition

A malunited fracture is one that has healed with the fragments in a non-anatomical position.
Acceptability of fracture reduction

alignment

rotation

normal length

actual position of fragments
(least important)
Classification

Based to location
Intrarticular
Metaphsial
Diaphysial

Based to complexity
Simple (one plane) e.g. valgus-varus
Complex (multi planes)
However, some malalignments are better tolerated from the neighboring joints than others (e.g., malunions of the upper extremity)

Also lower leg valgus is more acceptable than varus
This means there are both relative and absolute indications to correct deformities and leg length discrepancies.

**Absolute Indications**

- Presence of disabling pain
- Severe functional disability

**Relative Indications**

- Cosmetic reasons
- No response to nonoperative treatment
The object of surgery for malunion is to restore function

Operative treatment for malunion of most fractures should not be considered until 6 to 12 months after the fracture has occurred.

However, in intraarticular fractures, surgery may be required sooner if satisfactory function is to be restored.
When considering surgical correction of the malunion we should take in account:

1. Age of the patient  
2. Socio-economic factors  
3. The function of the joint  
4. The bone stock and the degree of osteoporosis  
5. The state of the soft tissue envelope
Corrective surgery at the site of malunion is not always feasible.

In some instances, a compensatory procedure may be necessary to restore function; in others, pain may be the predominant symptom and may require fusion of a joint.
Preoperative Planning

X-rays (contralateral normal side), CT imaging/3D reconstruction, MRI scans (measurement of alignment)

Evaluation of the soft tissue and bone condition

Throughout physical examination and history
A new methodology for the planning of single-cut corrective osteotomies of mal-aligned long bones

D.C. Meyer a, K.A. Siebenrock b, B. Schiele c, C. Gerber a,*

Implant Choices

**Plates and screws**
- Grants intrafragmetary compression & anatomical reduction
- Is mandatory to be covered adequately from soft tissues
- The implant of choice in case of periarthritic & metaphysic areas

**External fixation devices**
- Useful to avoid soft tissue irritation,
- Better to be used at the supramalleolar areas & tibial plafond

**Intramedullary devises**
- The implant of choice in case of the diaphysis of the long bone
Proximal Humeral Malunion

**TYPE I**, malposition of the greater or lesser tuberosity of >1 cm;

**TYPE II**, intraarticular incongruity or step-off of the articular surface >5 mm

**TYPE III**, rotational malalignment of the articular segment >45 degrees in the coronal, sagittal, or axial plane

Operative procedures for proximal humeral malunions

1. **acromioplasty** - **osteotomies** of the tuberosities or surgical neck, if the blood supply to the humeral head is maintained and the articular surface is preserved

2. **hemiarthroplasty** or total shoulder arthroplasty

3. **arthrodesis**, rarely, if a severe neurological deficit or previous infection is present
Malunion of the humeral shaft

Malunited humeral shaft fractures rarely needs surgical correction

The same principles are used in correcting this malunion as in those of other long bones:

The deformity is corrected by osteotomy, a compression plate is applied, (Cancellous grafts)
Malunions of the distal humerus

As the result of the following fractures:

(1) supracondylar fractures (more common in children),
(2) T-fractures of the condyles,
(3) fractures of the distal condylar articular surface
The most common is the **cubitus varus deformity** associated with:

- ulnar nerve neuropathy
- snapping of medial head of the triceps
- avascular necrosis of humeral epiphysis,
- elbow instability

Treatment Options

Wedge osteotomy alone

Osteotomy combined with ligament reconstruction
( High demands & severe deformity > 15°)

Total elbow arthroplasty
Proximal radius & ulna malunions

Malunions of the proximal third of the radius and ulna can be classified:

(1) of the radial head
(2) of the radial neck
(3) of the olecranon
(4) with anterior dislocation of the proximal radius (Monteggia fracture)
(5) with synostosis between the radius and ulna.
7-year old girl with a Bado I equivalent lesion 5 months after trauma

reduction of the radial head and fixation of the ulnar osteotomy with a plate
Forearm Shaft Malunions

Malrotation, angulation and loss of the radial bow all have been associated with loss of motion and compromised functional outcomes.

Malunited forearm fractures may lead to disturbances of the distal radioulnar joint, and arthritis of the proximal radioulnar joint.
In a cadaveric study, Matthews et al. found an insignificant reduction in forearm rotation with a 10° angulatory deformity, whereas a 20° angulation caused a functional loss of pronation and supination.

In a similar study, Tarr, Garfinkel, and Sarmiento showed that angular or rotational deformities of <10° resulted in minimal limitation of forearm rotation; however, with 15° of total deformity, forearm motion was reduced > 27% except in distal-third fractures.
Supination or pronation contractures limiting the use of the forearm can be neutralized by a rotational osteotomy of the ulna, thus creating a more functional position of the forearm.
Malunions of the distal radius

Not all distal radial malunions are symptomatic, especially those in elderly patients with low functional demands. In such patients, no further treatment is indicated.
Indications for surgical intervention

pain and functional deficits severe enough to interfere significantly with daily activities

a young, active patient (< 40 years old) with a deformity that is likely to become symptomatic with time:

- articular step-off of > 2 mm
- carpal instability
- > 20 - 30° of dorsal angulation
- incongruent distal radioulnar joint)
6 months pop
Proximal Femur Malunions

varus and rotational deformities in combination with shortening leading to limping and overuse of the neighboring joints.
Malunited fractures in the **trochanteric region** can be divided into two types:

(1) **those with internal or external rotation, coxa vara, and shortening of about 2.5 cm**

=> Treated with subtrochanteric osteotomy

(2) **those with internal or external rotation, severe coxa vara, and shortening of 5 cm or more**
Intertrochanteric valgization osteotomy for varus deformity. Lateral approach, placement of K-wires for the control of antversion, rotation, and the calculated angle for the seating chisel.

Use of a 120° angled blade plate after repeated reduction using the seating chisel as lever arm until the calculated correction is achieved
- Three-dimensional subtrochanteric lengthening of combined malunion including shortening
- Technically demanding and experience in individual shaping of plates is required
Femoral shaft Malunions

Become significant only if they result in:
- Shortening of > 2.5 cm,
- Angulated > 10°,
- Internally or externally rotated (to the point that the knee cannot be aligned with forward motion during gait)

Malunions of the femur can cause disturbances in gait and posture, which can cause abnormal stresses on the knee and spine (osteoarthritis?)
64 pt (37-traction, 10 plate and 17 IMN) treated between 1970-79

It is concluded that femoral shaft malunion and malalignment does not cause an excess of knee arthritis at **22-year follow-up**.

However, a significant number of this cohort has developed mild symptoms of ipsilateral knee pain or stiffness at a median age of 42 years;
Operative techniques
Fixator-Assisted Plating of Limb Deformities

S. Robert Rozbruch, MD

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Fixator-Assisted Plating of Limb Deformities

S. Robert Rozbruch, MD
The Clamshell Osteotomy: A New Technique to Correct Complex Diaphyseal Malunions

By George V. Russell, MD, Matt L. Graves, MD, Michael T. Archdeacon, MD, MSE, David P. Barei, MD, FRCS(C), Glenn A. Brien Jr., MD, and Scott E. Porter, MD

Distal Femur Malunion

Indications for surgery:
- Malunions in valgus & varus
- ante, or recurvation deformities
- rotation deformities

Treatment: Axial correction by open or close wedge supracondylar osteotomy
Implants of choice:
- The **hip plate 90°** with a displacement potential of 10–20 mm for medial application in valgus deformities

- **condylar plate** fits exactly to the lateral side of the distal femur for varus, antecurvature/recurvation and rotational malunions

**Pearl:** The contra-lateral cortex should remain intact so as to create some intrinsic stability
Proximal Tibia Malunions

Indications for surgery:

- Deformities of the proximal tibia in all three planes
- Intra-articular malunions after monocondylar fractures
- Residual joint impaction in combination with ligamentous instability.
Part 4: Corrective Osteotomies for Lower Limb Deformities

D. Paley
Preoperative planning is difficult but very important:
- Rö studies (AP/Lateral & oblique views, full length, weight bearing)
- CT-scan reconstruction in intra-articular deformities.

The standard device is a 95° blade plate with screws
Fixator-Assisted Plating of Limb Deformities

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Malunion Of the Tibial Shaft

Varus deformities were more poorly tolerated than were valgus deformities

**Surgery is indicated** for:
- valgus deformity of $> 12^\circ$
- varus deformity of $>6^\circ$
- external rotation deformity of $>15^\circ$
- internal rotation deformity of $>10^\circ$
- $> 2.5$ cm of shortening
Several choises of treatment:

Simple opening wedge, closing wedge, or dome-shaped osteotomies

Oblique osteotomies can be used to correct multiplanar deformities