# SUMMARY OF TALK ON NON-UNIONS FOR CMS UK ANNUAL CONFERENCE 9th MAY, 2007 BRISTOL


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## Definitions

1. **Mal-union**: Fracture united but deformed; either tilted, twisted or shortened. A varus deformity in the leg usually leads to osteoarthritis of the knee or ankle.

2. **Delayed union**: Taking longer to heal than normal.
   Perkins gives a guide as to how long a fresh fracture should take to heal.

| Arm | | Leg |
|---|---|---|
| 6 weeks | Spiral Fracture | 12 weeks |
| 12 weeks | Transverse Fracture | 24 weeks (6 months!) |

   Children: Approx half time

3. **Non-union**: At least nine months from the initial accident.
   No X-rays changes of union over the last three months.
   However some fresh fractures can take 18 months to heal!

## Causes of Non-union (old definition) (the injury, the bone and the patient)

### 1. The Injury:-

Open fracture
Soft tissue loss
High energy injury (e.g. motor-cycle crash)
Soft tissue inter-position (e.g. muscle or periosteum)

2. **The Bone:-**

Poor blood supply – particularly in hip, scaphoid, talus
Infection
Pathological lesion (secondary)
Intact fellow bone (i.e. intact fibula with fractured tibia)

3. **The Patient:-**
   1. Smoking tobacco or cannabis.
   2. Drugs – non steroidal anti-inflammatories; steroids.
   3. Non co-operative patient – i.e. the sportsman!
   4. The surgeon – sub-optimal treatment

**Causes of non-union (new definition)** (mechanical or biological causes)

**1. Mechanical**

Poor surgical treatment
Inadequate internal fixation, (too much movement at the fracture site).

**2. Biological** (Poor blood supply to the bone)

Damage to a large vessel at the time of the injury or surgery
Damage to small vessels - diabetes or smoking
Infection
Cancer – metastasis.
Post radiotherapy
Drugs – Chemotherapy for cancer;
Drugs for rheumatoid arthritis NSAID's, steroids and immunosuppressives (methotrexate)

**Non-weight bearing:-**
The stress of weight bearing produces bone (Wolf's law).
Non-weight bearing slows down fracture healing.
Rarely should a patient be non-weight bearing for more than two months.
No one should be non-weight bearing for more than three months!

## **Other Terms**:-

**Hyper-trophic Non-union**. Lots of callus on x-rays (elephant's foot) This shows that the bone is trying to join. The biology is normal but that the fixation is inadequate.

**Atrophic Non-union -** no callus, (a rat's tail appearance). This shows poor biology from a poor blood supply, with no ability to make callus.

# **Treatment of Non-union**:-

Treatment of the non-union depends on whether the cause is mechanical (from poor surgical fixation) or biological (from a poor blood supply).

**Mechanical** causes can be treated by stronger fixation (either internal or external); alignment must be correct.

**Biological** causes are much more difficult to treat. One has to try to increase the bloody supply to the fracture area.

## **Treatment of mechanical causes of non-union**:-

Stronger and better fixation (internal or external fixation)

1) **Internal Fixation:-**

**A. Leg**

Generally speaking internal fixation to the long bones of the leg is best with a strong intra-medullary nail rather than a plate. The nail keeps the bone correctly aligned. Being more robust than a plate it survives longer, during which time the fracture can usually heal before the fixation actually breaks.

**B**. **Upper Limb**:-

Internal fixation to the bones of the arm is best with a plate rather than by an intra-medullary nail. This is because an intra-medullary nail in a non-weight bearing bone (arm), does not provide compression nor impaction at the fracture site.

**Please Note:-**

Acute humeral fractures treated by an I.M nail have a 10% rate of non-union.
Humeral non-unions treated by an I.M. nail have a 90% failure rate.
Re-nailing of a humeral non-union, is nearly always unsuccessful.

## 2) External Fixation

**The Ilizarov Circular External Fixator** is by far the most effective form of external fixation available.

Non-union of all long bones (arms and legs) can be successfully treated with the Ilizarov external fixator. This technique has a higher success rate than any form of internal fixation. It is also less likely to lead to severe complications such as infection (osteomyelitis) of the bone.

As well as treating non-unions the Ilizarov fixator can be used for treating complex acute fractures, for straightening cases of mal-union, for lengthening bones shortened by injury, and even for treating cases of osteomyelitis. It has revolutionized orthopaedic surgery over the last 20 years.

However Ilizarov treatment may take up to one or two years to work and some patients are not physically nor mentally able to sustain such prolonged rehabilitation. Patients living alone cannot usually cope with an Ilizarov fixator. Some cases of non-union, particularly the severely infected ones, are best treated by **amputation**. This is a quick form of treatment, and can often get the patient back to a relatively normal lifestyle.

## Treatment of bilogical causes of non-union

A. The application of an Ilizarov fixator and division of the bone (osteotomy), increases the bloody supply to the limb by approximately 5 times.

B. Vascularised bone Grafts.
It is possible for a plastic surgeon to replace an avascular non-union, with a free vascularized piece of bone taken from the same patient, attached to an artery and vein in the patient's leg. The opposite fibula is usually the best source of such a bone.

## Additional factors healing biology faults:-

**Bone grafts** increase the success rate of internal fixation slightly. However they also increase the rate of other complications, such as infection.

Bone grafts taken from the same patient (autograft), are more effective at producing bone union than those taken from other patients (allograft).
Even allografts are more effective than bone graft substitutes such as calcium phosphate, hydroxy-apatite, coral, or bioactive glass.

## Research Tools:-

Various new techniques such as the use of bone morphogenic proteins, platelet rich plasma or bone marrow injection into the fracture site, may have a place for speeding up fracture healing. In 2007 the trials on such substances are still inconclusive. These substances will be further developed over the next few years and may eventually be proved useful in the treatment of non-union. At the moment they are still experimental.

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