

Management of Infected Fractures



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1975 to 2008

Please note that I will be discussing the management of infected fractures, not fresh or even contaminated fractures.

VARIATIONS OF INFECTION AND ASSOCIATED PATHOLOGY

Cellulitis, haematoma abscess

Wound dehiscence and skin edge necrosis

Soft tissue necrosis and/or infection:

Skin abrasion, laceration, contusion, crush

Ingrained grit, grime, grass and gravel

Early infection

Arising within 6 weeks

**After ORIF for
Closed fracture**

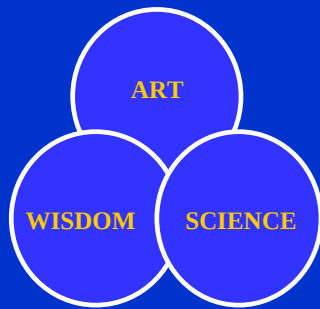
Management

- Give narrow spectrum antibiotic for gram positive cocci
- Immobilise
- If abscess/haematoma evacuate, debride, closed irrigation/suction
- Retain fixation
- Wait and see

Late Infection - longer than 6 weeks

Infection now firmly established and unlikely to respond to systemic therapy.

The radical surgery required is likely to impede union of the fracture.



You need to consider:

THE PATIENT

THE LIMB

THE INJURY

THE BACTERIA

THE PATIENT

General Health
Metabolic and
Auto immune disease
Immune competence
Need radical and aggressive treatment

POLYTRAUMA

Cardio pulmonary
Renal Hepatic
Other Overwhelming Infections

IMPAIRED LIMB PERFUSION

Pre-existing arterial and venous disease
Vascular trauma (laceration, thrombosis),
Compression, Needing Fasciotomy

The Limb

OVERALL VIABILITY OF LIMB

- prognosis for residual function
- MESS score & other trauma scores

The Bacteria

INTENSITY OF SYSTEMIC SIGNS OF INFECTION

CLINICAL AND LABORATORY PARAMETERS

CARDINAL INDICATORS FOR ANTIBIOTICS

MICROBIOLOGICAL FAUNA AND FLORA

- Commensals and contaminants
- Colonists and invaders
- Virulence and toxins
- Antibiotic sensitivity

•RATIONALE OF ANTIBIOTIC THERAPY

- Always determine bacterial identity and sensitivity
- Choose narrow spectrum antibiotic
- Systemic for systemic and well perfused
- Local for poorly perfused tissues
- Surgery for necrosis

ANTIBIOTICS CANNOT ACCESS
BACTERIA WITHIN NECROTIC
OR POORLY PERFUSED TISSUE
OR UNDER GLYCOCALYX

FRACTURE MANAGEMENT

Alignment and fixation
Functionally splint joints

WOUND MANAGEMENT

- Protect from contamination
- Bug exchange at each LOOKSEE
- Await demarcation then
- Debride thoroughly and definitively
- Simply cover bone and tendon
- Demarcation up to 3 months
- Warm moist environment
- Cover granulation tissue with split skin

Wound management

Beware of frequent “LOOKSEE”
Every exposure invites new bugs
Expose only under theatre conditions

Debridement

Only when clearly demarcated

Skin fat muscle	± 1 week
Tendon ligaments	± 4 weeks
Tendo Achilles	± 12 weeks
Bone	+ 12 weeks

EARLY PRIORITIES IN INFECTION OF FRACTURES

1. # Alignment and fixation
2. Excise demarcated necrosis
3. Simple skin cover
4. Use antibiotics judiciously
5. Infection not high priority

Bare bone

Leave alone till demarcated
or covered by granulation
Provide closed damp (not soggy)
environment while still pink

**Apply expendible
split skin graft
when covered by
granulation tissue**

**Avoid complicated
composite grafts
and distant flaps
with bone infection**

Once skin covered
(despite dry bone or sinus)
patiently await union



LATE (ESTABLISHED) INFECTION

Priorities

- Maintain alignment and fixation of bone
- Maintain functional joint position
- Promote callus and union
- Put up with infection
- NO antibiotics or antiseptics
- Simple seldom dressings
Soap, stream, sneesdoekies
Sanitary pads, socks or masking tape

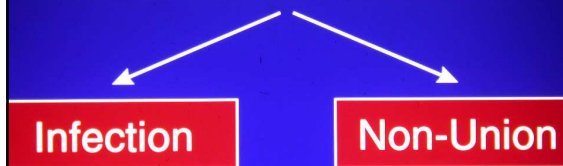
Reduce and immobilise

Retain existing functioning
external/internal fixation.

XFX preferred
(less invasive – wound access)

IFX (dissection foreign body)

FRACTURE MOVEMENT



If movement threatens immobilisation
or causes pain which prevents
obtaining a neutral position

Immobilise adjacent joint in neutral position

MONITOR

- Alignment
- Fixation
- Callus
- Sequestra
- Systemic signs of Infection
- Wait until fracture union is Strong enough without implant
- or Stalemate reached – without union

Use antibiotics only for systemic effects of infection

ANTIBIOTICS CANNOT ACCESS BACTERIA IN NECROTIC OR POORLY PERFUSED TISSUE OR UNDER GLYCOCALYX

The patient vigil

- Simple wound toilet
- Tap water, soap and paper towel
- Clean (not sterile) absorbent dressing

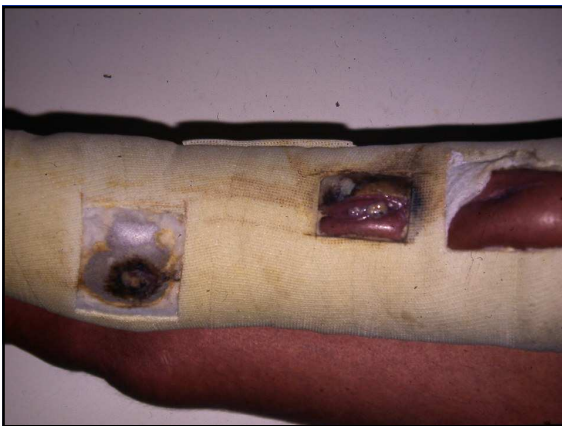
Promote dynamisation

United fibula may inhibit dynamisation and union of tibia



Monitor Blood, X-Ray and
Microbiology two monthly

If supplementary cast needed
leave closed for up to two months



GIVE UP when

- Fracture solidly united
- No further progress
- Patient insists
(economic or social reasons)
- Skin inflammation, itch,
dermatitis ulceration

As union progresses

- Rate of discharge
- and blood parameters improve

When fracture united
drainage may cease
Consider DRI
(debride, ream, irrigate)

if necessary

WHEN FRACTURE UNITED

IF NECESSARY

Treat infection definitively
As union progresses, infection
subsides

Infection more easily eradicated
When fracture united.

Eradication of Infection

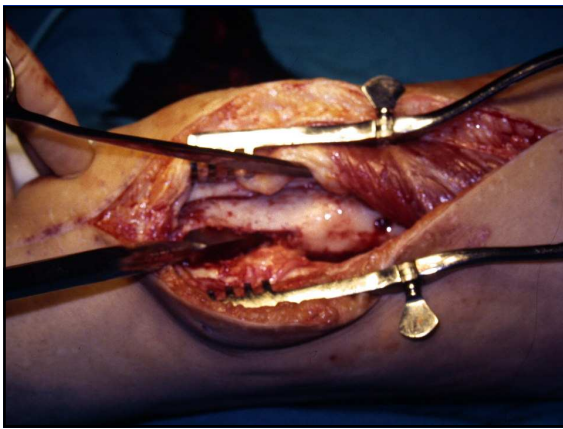
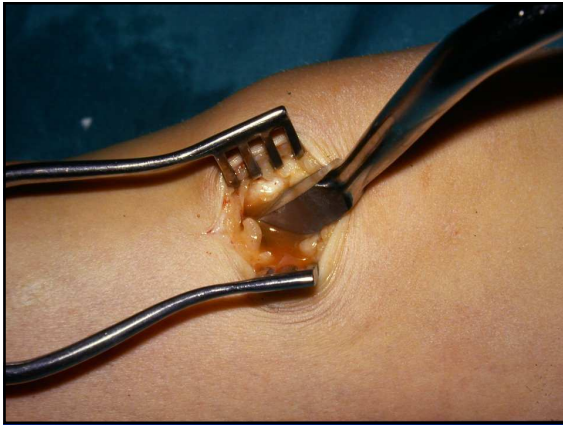
Map extent of pathology
Approach through existing incision
Debride all non viable bone
Remember pin tracks
Debride all scar and granulation

**Ream full length of bone
from tip to tip
Lay tubes for antibiotic
instillations**

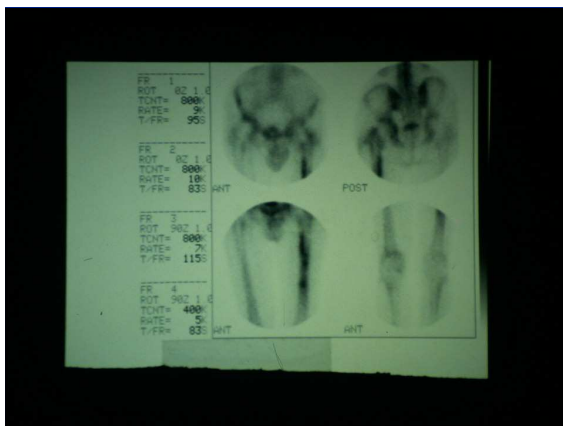
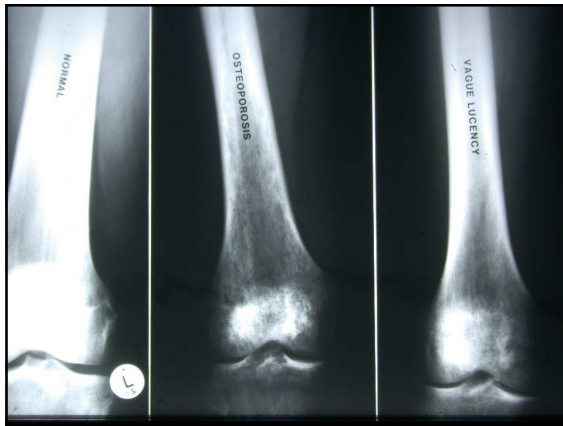
Why ream tip to tip?

Sump Infections
in Long Bones (1988)

Total hip replacements	22
Total knee replacements	14
Haematogenous	20
Intramedullary nails	11
Plated	26
No fixation	<u>23</u>
_____	116



		Infection	
		Distal	Proximal
THR	22	5 (22.7%)	22 (100%)
TKR	14	11 (78.7%)	14 (100%)
Spontaneous	20 - 8 prox	3 (37.5%)	6 (75%)
	- 12 distal	12 (100%)	3 (25%)
IM Nail	11	8 (73%)	8 (73%)
Plated	26	19 (73%)	17 (65%)
No fixation	23	17 (74%)	12 (52%)



Radiology

No abnormality	14	4 Inf	(28.5%)
Osteoporosis	83	56	(67.5%)
Vague Lucency	35	23	(66%)
Definite Lucency	35	30	(86%)
Sclerosis	31	27	(87%)
Periosteal line	33	28	(85%)

STALEMATE PERSISTS INFECTED NON-UNION

Confront infection

Two stage Programme

1. Radical Debridement Reaming and Irrigation
2. Fix and maybe graft or
3. Intimate fibular bypass with fixation (variations)
4. Pappineau graft

Implant and graft may provoke infection

STALEMATE PERSISTS INFECTED NON UNION

Evade infection

- Local sequestrectomy
- Fibular osteotomy
(Dynamisation)
- Pulsed electro magnetic therapy
- Pappineau graft
- Conservative fibular bypass

ILIZAROV PRINCIPLES

Distraction/compression
Bone transport
(Immediate shortening)
Block excision

AFTER SUCCESSFUL

RADICAL DRI

ALL OPTIONS OPEN

EXTERNAL FIXATION IN BONE AND JOINT INFECTION

APPLICATIONS

- FRACTURE FIXATION
- ARTHRODESIS
INTACT JOINT/
POST ARTHROPLASTY
- DEFORMITY CORRECTION
- LIMB LENGTHENING
- NON UNION

PRIORITIES IN INFECTED FRACTURES

1. REDUCE AND IMMOBILISE
2. DEBRIDE NECROTIC TISSUE
when demarcated
3. OBTAIN SKIN COVER
4. antibiotics for systemic effects



ANTIBIOTICS CANNOT ACCESS
BACTERIA WITHIN NECROTIC
OR POORLY PERFUSED TISSUE
OR UNDER GLYCOCALYX

Joint or muscle movement
itself promotes infection

Monitor Progress of
Blood, X-Ray, Bacteria
bi-monthly

GIVE UP when

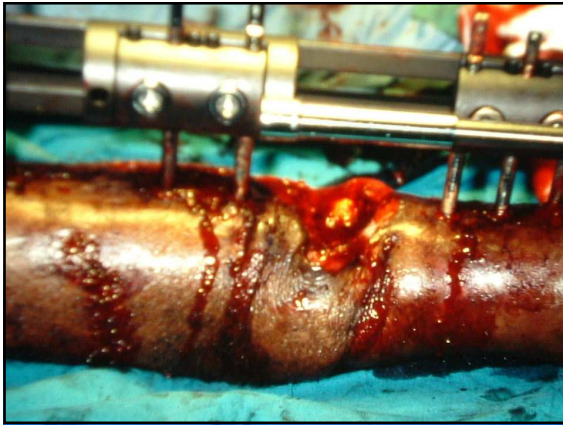
1. Fracture solidly united
2. No further progress
3. Patient insists
(for economic or social reasons)
4. Skin inflammation, itch,
dermatitis ulceration

If not united

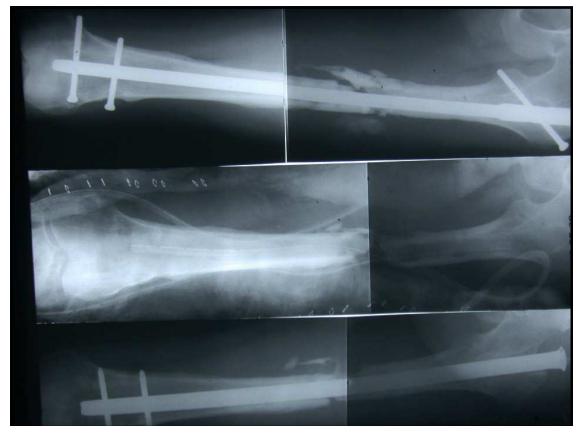
- Debride, ream and irrigate
including pin tracks
- Monitor bacteria twice weekly
- No safe period twist XFX and ORIF

Bone Loss and Shortening

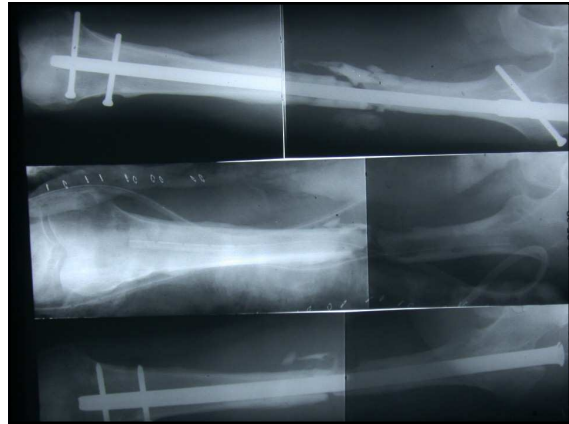
More important in lower limb
2 cm loss – no impairment
+ 10% bone length loss = weakness



If fracture well fixed
and large sequestrum
DON'T PANIC



- Close skin and fascia
- Splint to align and immobilise
- Over irrigation x 3 weeks



Rehabilitate

- Oedema
- Joint function
- Muscle contraction
- Mind set
- Economy

When united lengthen over nail
Simple single clamp top and bottom

If infection recurs

SO WHAT!

Fracture will still unite,
then repeat DRI

Then

lengthen over nail
as before

**Problems of external fixation
with infection**

External fixation works best

with hard, healthy,
young adult bone
recently fractured

Infection, immobilisation
Lack of weight bearing

All promote osteoporosis

Soft bone

cannot hold pins firmly
however rigid the construct

Active movement
promotes loosening
of pins and wires

INFECTION
↓ ↑
LOOSENING

Recommend
Supplementary
Splintage



External fixator in moving tissues

+

infection nearby



High risk of loosening and infection



SEVERE TRAUMA AND INFECTION

Associated with

- Arterial damage
- Venous obstruction
- Lymph oedema
- Tissue turgidity
- Inelasticity
- Fibrosis

LEADS TO

- Rigid tissue
- Impaired
Stretching
Perfusion
Healing
Bone formation

LEADS TO

More Pain in infection
Delayed or Non-union
At Callotasis site
Or Fracture Site

Strive for earliest
union of fracture
Equalise lengths later

Pin Track Infection

Definition

- Redness
- Encrustation
- Need for antibiotic
- Seepage-Quantity ?
- Purulence
- Need for exchange

LOGICAL APPROACH TO PIN TRACK INFECTION

ETIOLOGY IS REALLY MULTIFACTORIAL

Ideal Circumstances

Rigid pin passed through
skin, thin subcutaneous tissue
and bone only

Ideal Circumstances

Uni-directional pins in
Neutral axis near joint
Shielded, pre-drilled, self tapping

In these circumstances
With ring of thin keratin

Pin care unnecessary

Crossed k-wires under tension

Essential in cancellous bone
especially near a joint

Trouble Makers

- Flexible pins
- Flabby skin
- Adiposity
- Nearby muscle and tendon
- Or moving joint
- Soft (cancellous) bone
- Pins off neutral axis
- Unshielded direct insertion
- Blunt wire into cortical bone at high speed

Trouble Makers

When pins are used for traction,
distraction, transport

Infection commonly occurs
around them

IN THESE CIRCUMSTANCES

PIN TOILET IS A

FUTILE

SYMBOLIC

RITUAL

**SYSTEMIC AND EVEN LOCAL
ANTIBIOTICS CANNOT LOGICALLY
ADDRESS THE LOCAL PATHOLOGY**