Specific Management of Periprosthetic Tibial Fractures

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Disclosure

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- 2nd Vice President of Asia Pacific Orthopaedic Association (APOA) 2022 - 2023

- Past President of Arthroplasty Society in Asia (ASIA) 2019 - 2022
- Past President of Asia Pacific Knee Society (APKS) 2019 - 2022
- Past President of Asia Pacific Arthroplasty Society (APAS) 2020 - 2022

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- Editorial Board / Reviewer : CORR, Bone Joint Journal, J Arthroplasty, AJSM, VJSM, BJO, KSSTA, JISAKOS, Knee, OJSM, JOS, KSRR, The Hip & Knee Journal, JOSR

Periprosthetic Tibia Fracture

Why our colleagues rarely speak on this topic ?

- Uncommon
- Incidence :
  - 0.4 - 1.7 % after primary TKA
  - 0.9 % in revision TKA

Very few publications on this topic
Small population size on the available studies

TKA increase by 673% by 2030 so this complication will rise accordingly

Incidence - up to 38 % after revision

Periprosthetic Fracture

A Problem on the Rise

- Presented with new, difficult fracture patterns
- Elderly patients with grossly deficient bone
- Struggles to rehabilitate after such injuries

Inconsistent treatment strategies

Rate of re-operation post ORIF 13 % - 23 %

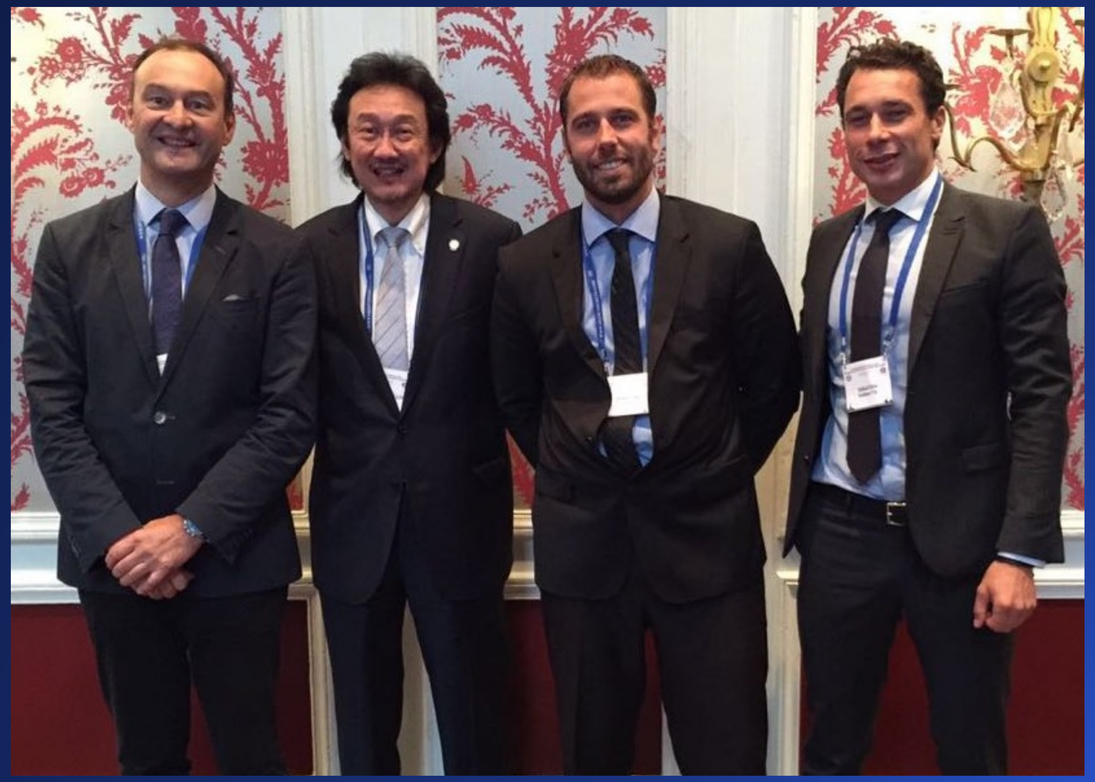
The Problem

- Almost always occur around a loose tibial component
  - 19 % of fractures caused intraoperatively during implantation of prosthesis
- Revision arthroplasty is usually indicated

By the time it happens : “You are not well prepared”

Periprosthetic fx around proximal tibia

- **Incidence 0.4 % - 1.7 %**
  - Intraoperatively
  - Postoperatively
- **Risk factors**
  - Malposition
  - Cementless TKA
  - Ligamentous imbalance
  - Joint stiffness
  - Infection



Incidence : Intra op and Post op

Variables	Primary TKA	Revision TKA
Intra op		
Tibia	0.07 – 0.67%	0.35 – 0.8%
Patela	NA	0.2%
Post op		
Tibia	0.39 – 0.4%	0.48 – 0.9%
Patela	0.61 – 1.19%	0.15 – 2%

Technical Risk Factors - Intra-operative

- Varus fixation correlated with medial plateau fracture
- Care should be taken not to place the tibial component in the excessively lateral aspect of the knee

Lotke & Ecker, JBJS-A, 1977

Technical Risk Factors - Revision

- Forceful retraction of well-fixed tibial component
- Eccentric cement removal
- Trial reduction / preparation of stem tibial component
- Aggressive impaction of tibial component
- Performing tibial osteotomy

Management

- Diagnostics
- Classification & Planning
- Surgical technique
- Rehabilitation

Wayne Paprosky, 2015

No Rush, Be Prepared

“Fail to Prepare is Prepare to Fail”

Treatment Guiding Factors

- Pre-fracture ambulatory status
- Fracture pattern
- Vascular injury
- Quality of bone stock
- Stability of knee prosthesis
- Type of knee prosthesis

Classification and Planning

- Felix classification
- Unified Classification System (UCS)

Combined with Orthopaedic Trauma Association (OTA) is helpful in planning process for reduction & fixation

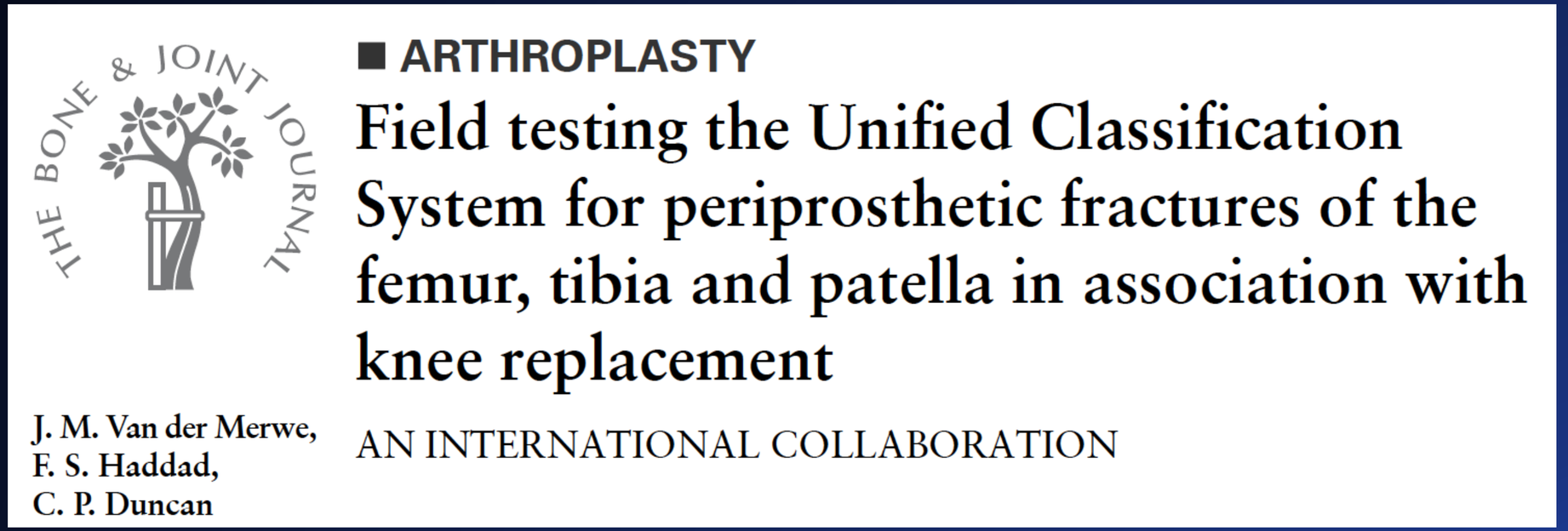
Correct Classification is Important

High complication & failure rate due to :

Incorrect classification → pre-op radiology not reliable, need to check stability of fixation intra-op

A senior surgeon decides the best operative method only after the fracture is seen in the operating room, despite all the classifications available

Unified Classification System (UCS)



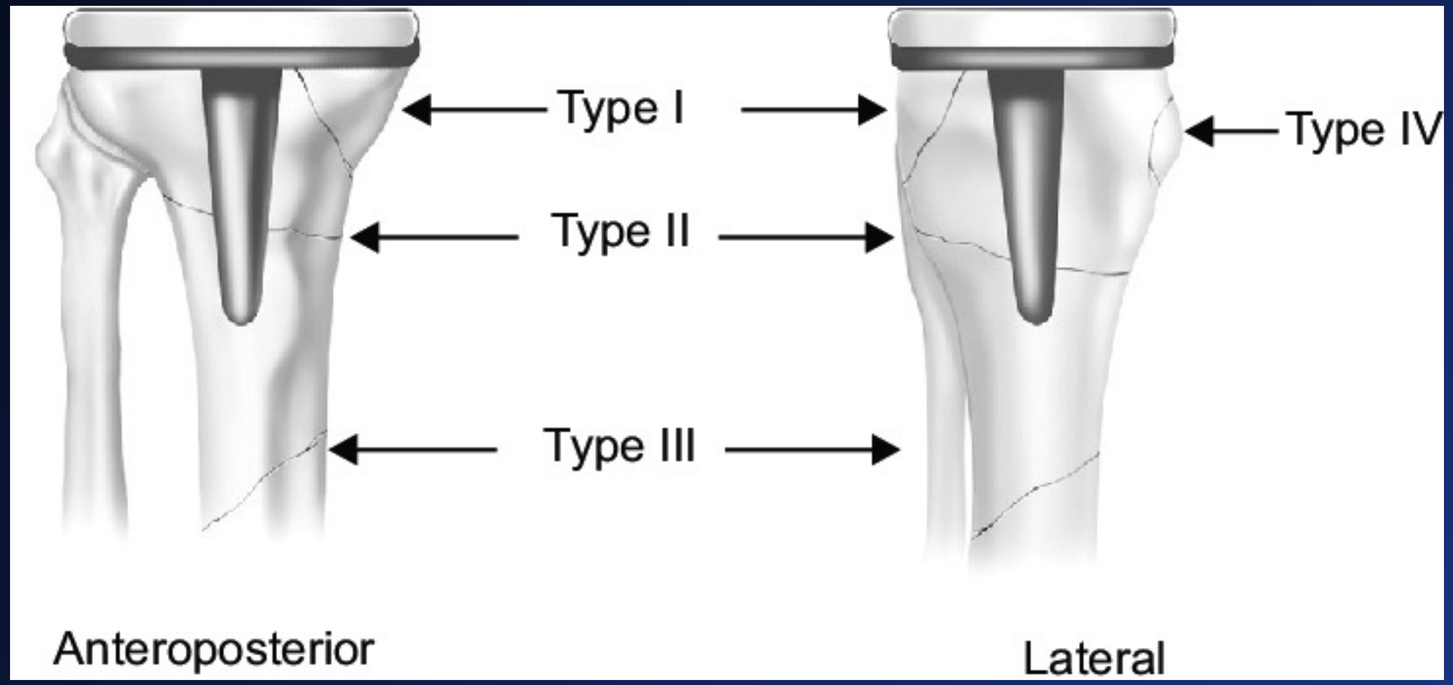
Conclusion :

UCS has substantial & “near perfect” inter-observer reliability when used for periprosthetic fractures of knee replacement in the hands of experienced & inexperienced users

Unified Classification System (UCS)

Type		V.3 Femur, distal	V.4 Tibia, proximal	V.34 Patella
A *Apophyseal* or extraarticular/ periarticular	**A1** Avulsion of	Lateral epicondyle	Medial or lateral plateau, nondisplaced	Disrupted extensor, proximal pole
	A2 Avulsion of	Medial epicondyle	Tibial tubercle	Disrupted extensor, distal pole
B *Bed* of the implant or around the implant	**B1** Prosthesis stable, good bone	Proximal to stable stem, good bone	Stem and component stable, good bone	Intact extensor, implant stable, good bone
	B2 Prosthesis loose, good bone	Proximal to loose stem, good bone	Loose component/ stem, good bone	Loose implant, good bone
	B3 Prosthesis loose, poor bone or bone defect	Proximal to loose stem, poor bone, defect	Loose component/ stem, poor bone, defect	Loose implant, poor bone, defect
C *Clear* of or distant to the implant	–	Proximal to the implant and cement mantle	Distal to the implant and cement mantle	–
D *Dividing* the bone between two implants or interprosthetic or intercalary	–	Between hip and knee arthroplasties, close to the knee	Between ankle and knee arthroplasties, close to the knee	Between ankle and knee arthroplasties, close to the knee
E *Each* of two bones supporting one arthroplasty or polyperiprosthetic	–	Femur and tibia/patella		
F *Facing* and articulating with a hemiarthroplasty	–	Fracture of femoral condyle articulating with tibial hemiarthroplasty	–	Fracture of the patella that has no surface replacement and articulates with the femoral component of the total knee arthroplasty

Felix Classification



- A - well fixed prosthesis
- B - loose prosthesis
- C - intraoperative fractures

Felix Classification

- Type I traumatic events 22 %
- Subtype A and B postoperatively
- Type III traumatic events 58 %

- A - 18.8 %
- B - 43.8 %
- C - 37.4 %

World J Orthop. 2015 Sep 18; 6(8): 649–654. PMCID: PMC4573510
Published online 2015 Sep 18. doi: 10.5312/wjo.v6.i8.649

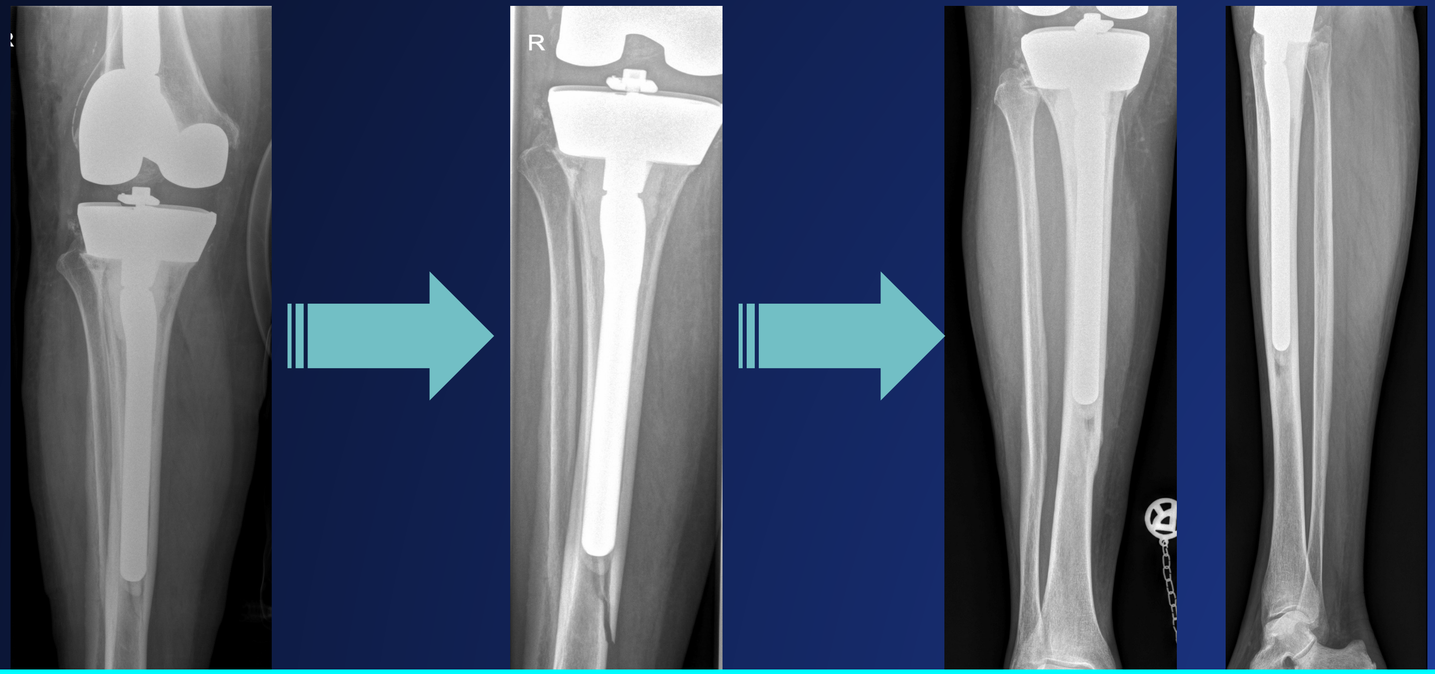
Systematic review of periprosthetic tibia fracture after total knee arthroplasties

Nabil A Ebraheim, Joseph R Ray, Meghan E Wandtke, Grant S Buchanan, Chris G Sanford, and Jiayong Liu

Type	Incidents	Percentage	Subclass	Incidents	Percentage
1	62	55.36%	A	27	18.75%
2	24	21.43%	B	63	43.75%
3	24	21.43%	C	54	37.5%
4	2	1.79%			
Total	112	100.00%	Total	144	100%

Non-Operative Treatment

- Appropriate for minimally displaced fracture with stable component
- Typically in a brace or cast for 6 weeks



Type 3A or 3C considered for internal fixation - high risk for pseudoarthrosis

In 2024 ……

All periprosthetic fractures **should be operated**

Unless :

- Patient too medically unfit
- Fracture completely undisplaced

Operative Management

Surgical technique :

- Stable implants (type A & C) → plates & cerclage
- Loose implant (type B) → hinged revision
- Reduction :
  - Open technique
  - Mini open technique (direct reduction by cerclage or lag screw & percutaneous plate)
  - Minimally invasive technique (indirect reduction & percutaneous fixation)

Ruchholtz et al, Eur Orthop Traumatol, 2013

Surgical Treatment

Well fixed tibial component (I-III)

↓

Internal fixation

↓

Proximal fragment often small and of poor bone quality

Loose tibial component ±poor bone quality (B2, B3)

↓

Revision arthroplasty

Surgical Treatment

Large segmental bone defects

↓

Long stem + sleeves / structural allograft

(tumor prosthesis ?)

↓

Internal fixation

↓

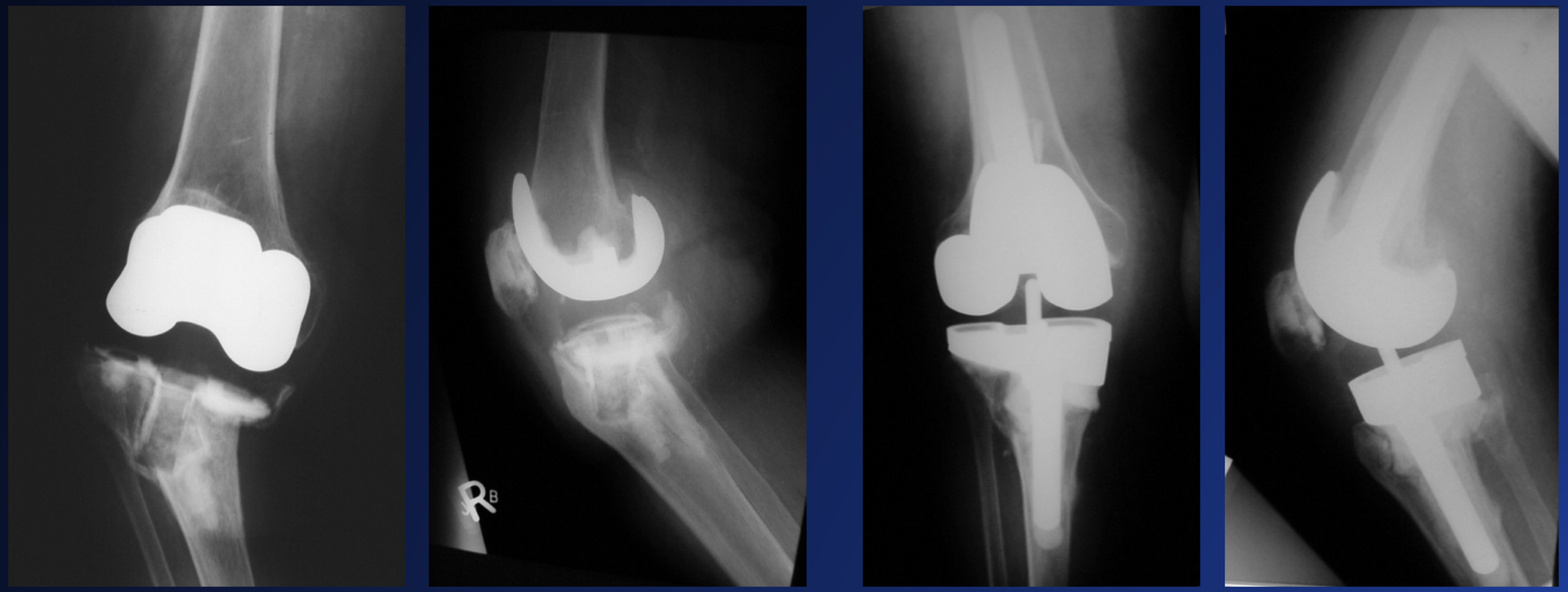
Replacement of loose prosthesis

Surgical Treatment Tips

Due to relatively thin soft tissue layer, percutaneous fixation of the distal plate to the diaphysis after “mini open” or “minimally invasive” reduction is easy to achieve & allows a maximum preservation of the local blood supply

Risk of soft tissue complication including
DEEP INFECTION IS MUCH HIGHER THAN ON THE DISTAL FEMUR

Operative Management



Type 2B corrected by revision

Operative Management

Beware of femoral implant loosening

Operative Management

- Intra-op fissure & insufficient osteosynthesis
- Tilting & loosening
- Sufficient ligaments
- Revision LCCK / PS
- Impacting grafting & cementless stem

Be careful of insufficient osteosynthesis

Courtesy of Sebastien Parratte

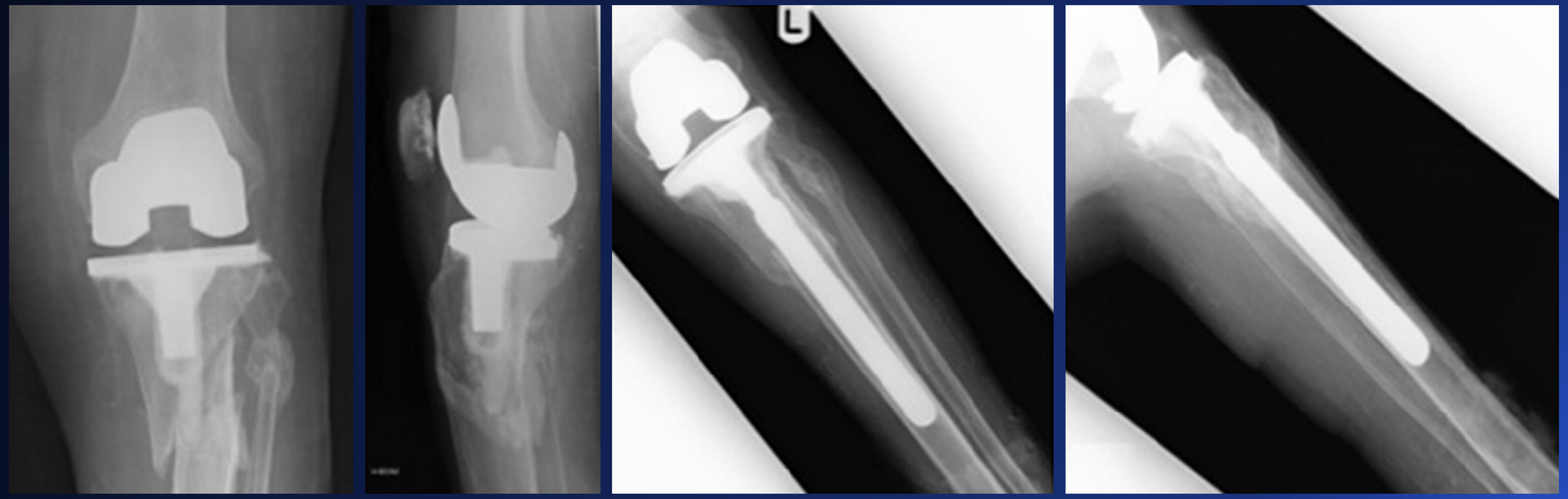
Operative Management

Revision Total Knee Arthroplasty for Failure of Primary Treatment of Periprosthetic Knee Fractures

Ammar M.I. Abbas, FRCS (Tr & Orth), Rhidian L. Morgan-Jones, FRCS (Tr & Orth)

Cardiff and Vale University Health Board, University Hospital Llandough, Cardiff, UK

The Journal of Arthroplasty 29 (2014) 1996–2001



Consider revision arthroplasty for union complication

Fractures of the Tuberosity

Fractures of the tuberosity (type 4) :

- Isolated lag screws (big fragments)
- Plates and screws

Surgical Treatment Tips

- Important to restore neutral mechanical axis
- A tibial component with stem long enough to extend distal to the fracture should be used in all cases :
  - Press fit or cemented stems are effective
- Osseous defects managed with :
  - Metal augmentation
  - Stepped sleeves
  - Trabecular metal cones

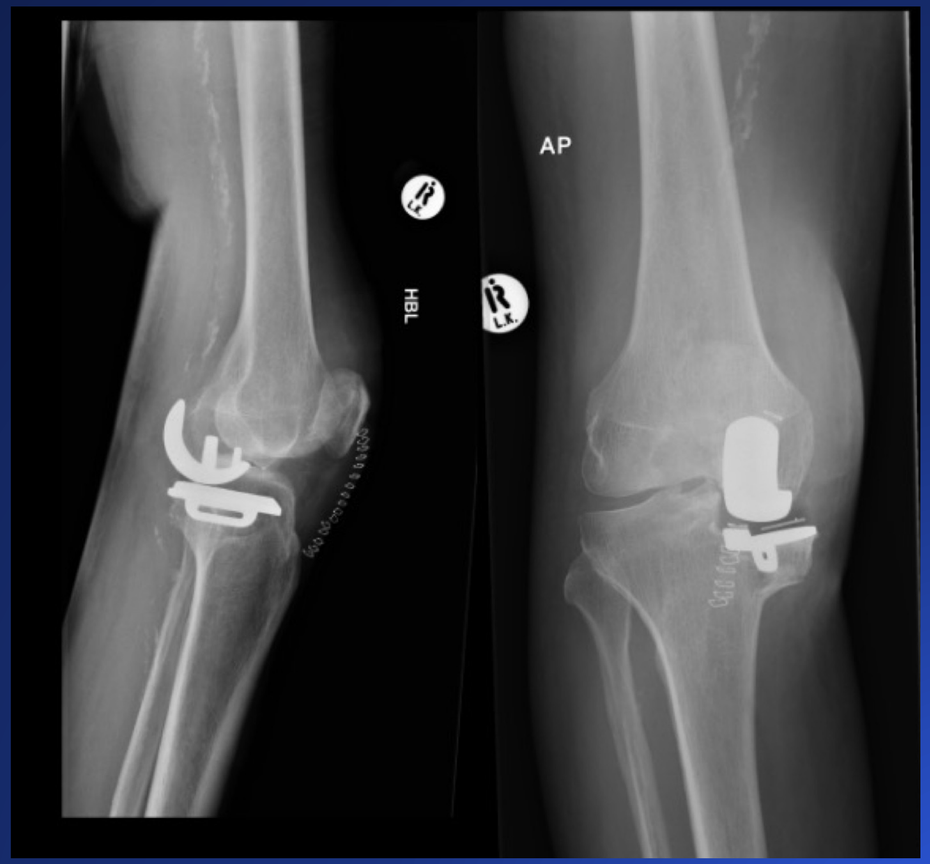
Reasons for Post-Op Complications

- Poor bone quality due to pre-existing osteoporosis
- Stable fixation difficult to achieve in areas of intramedullary implant
- Fracture healing is significantly delayed in aged patients
- Prosthesis loosening facilitate the resulting fracture

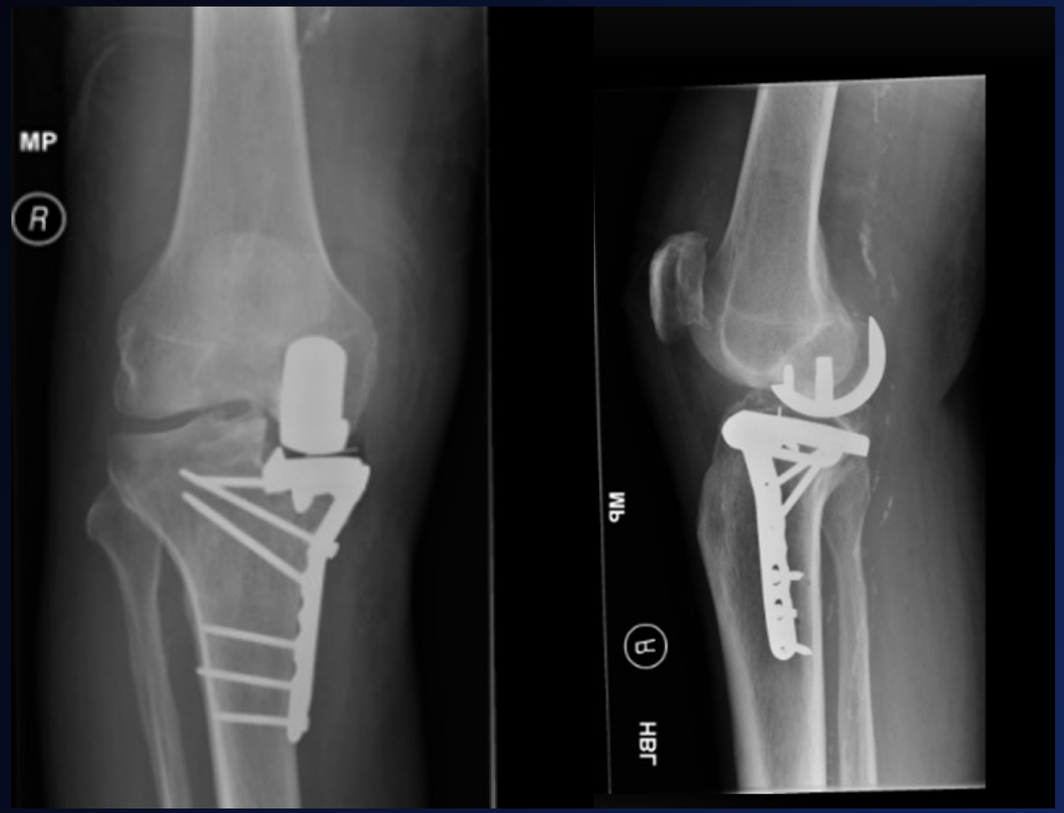
Complication rates up to 41%

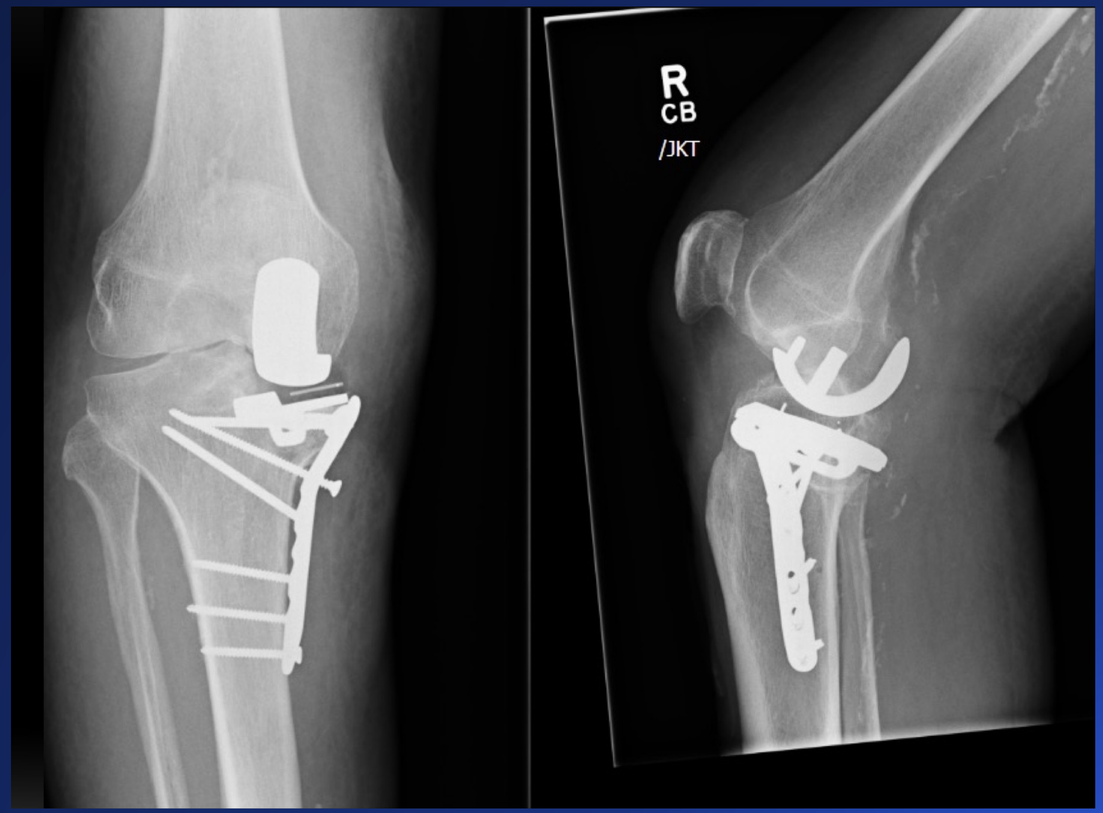
Case 1

- 85 yr old had a UKR done elsewhere
- Had a fall 1 week after surgery



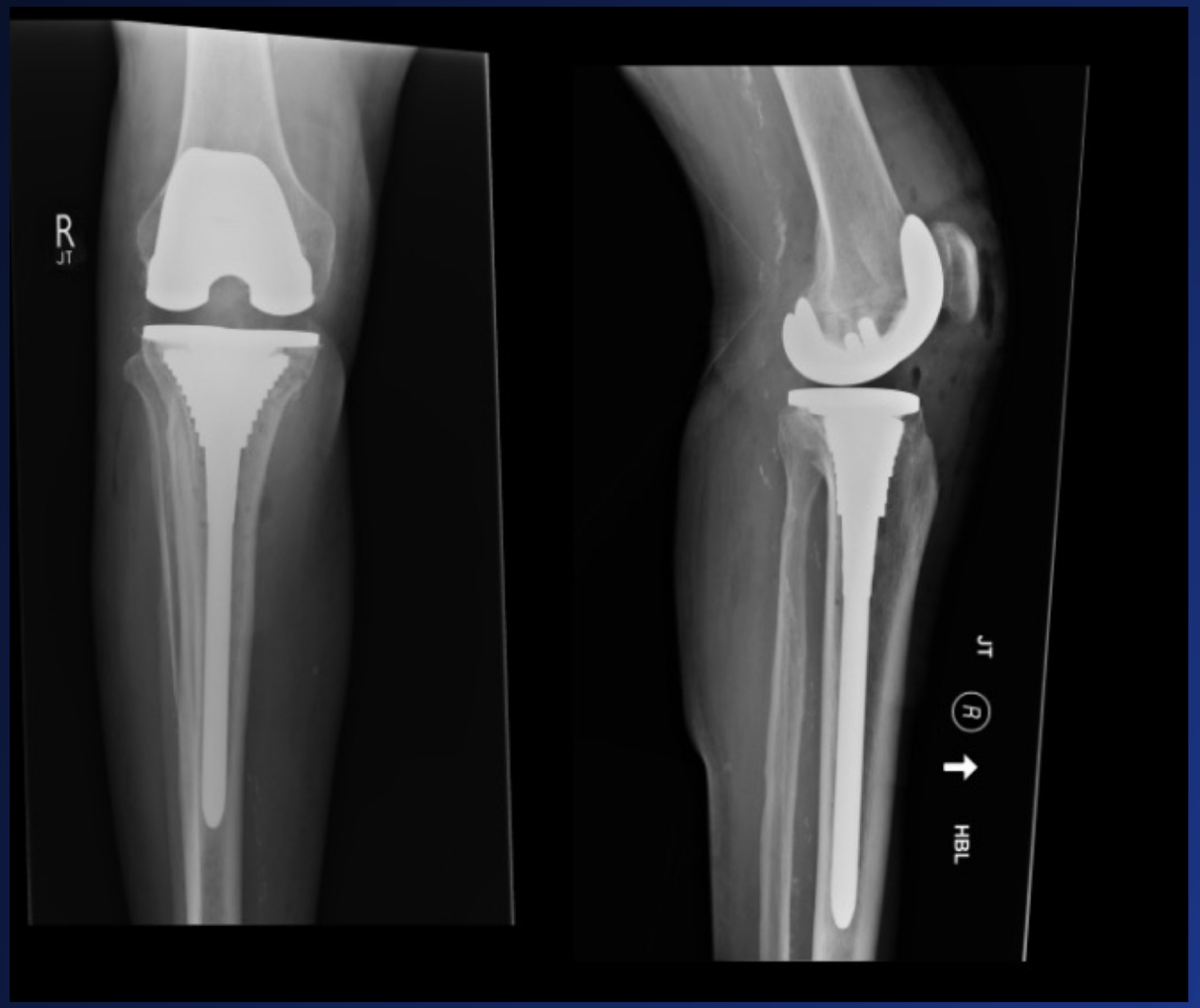
Treated with ORIF, but the fixation failed





6 months post ORIF

Treated with revision TKR

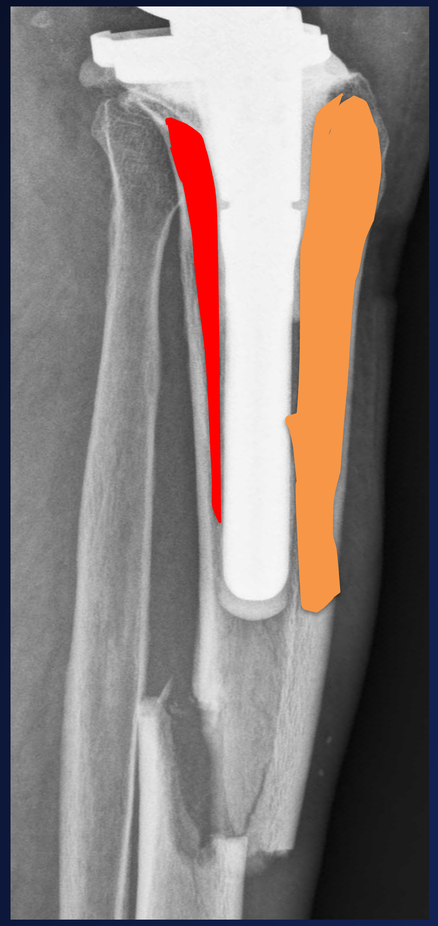


Case 2

Type 3
77/F

Case 2

Little on posterior



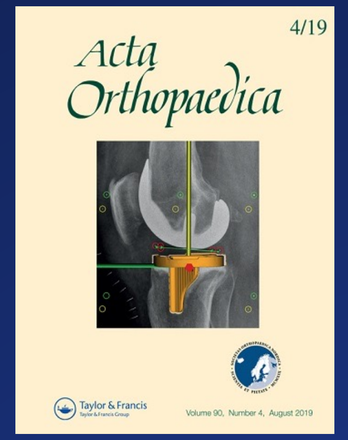
More space on anterior

Anterior proximally

Fixation Modality

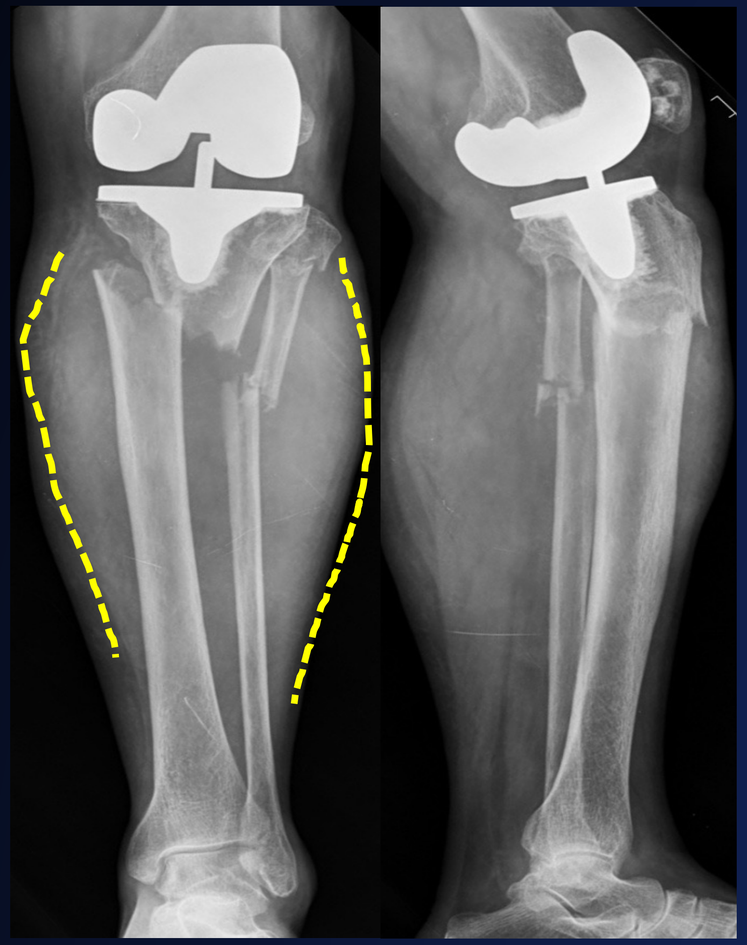
Double plating of unstable proximal tibial fractures using minimally invasive percutaneous osteosynthesis technique

Chang-Wug Oh[1], Jong-Keon Oh[2], Hee-Soo Kyung[1], In-Ho Jeon[1], Byung-Chul Park[1], Woo-Kie Min[1] and Poong-Taek Kim[1]



- Severe comminution of 41C
- High Level fracture of 42A
- Osteoporotic fractures
- **Periprosthetic fractures**

Case 3



Type 2

77/F

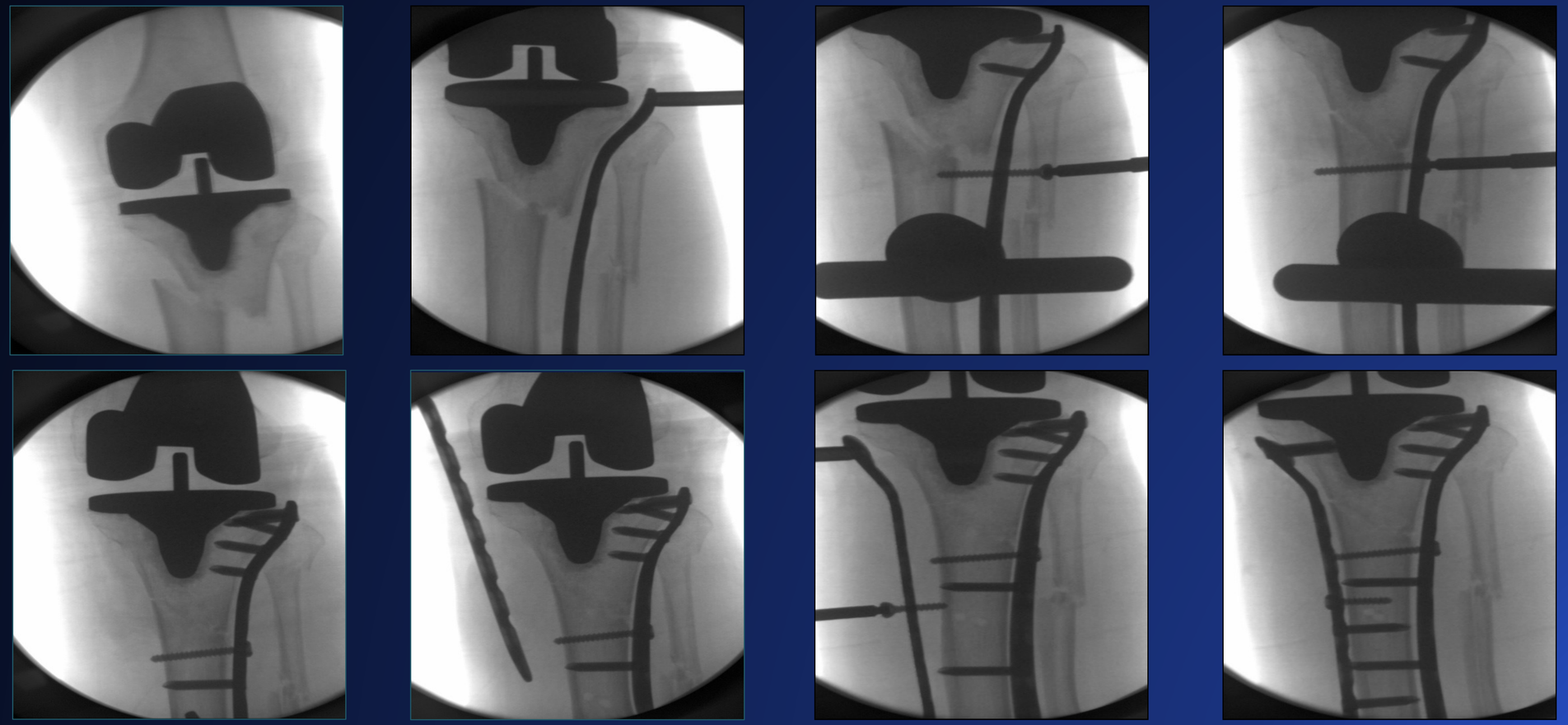
Surgery done 2+ years back

Fell on the staircase

The Issues

- Limited space for proximal fixation
- Weak construct of proximal segment
- Double Plate Fixation ?

Case 3



Case 3

Case 4

Type 2

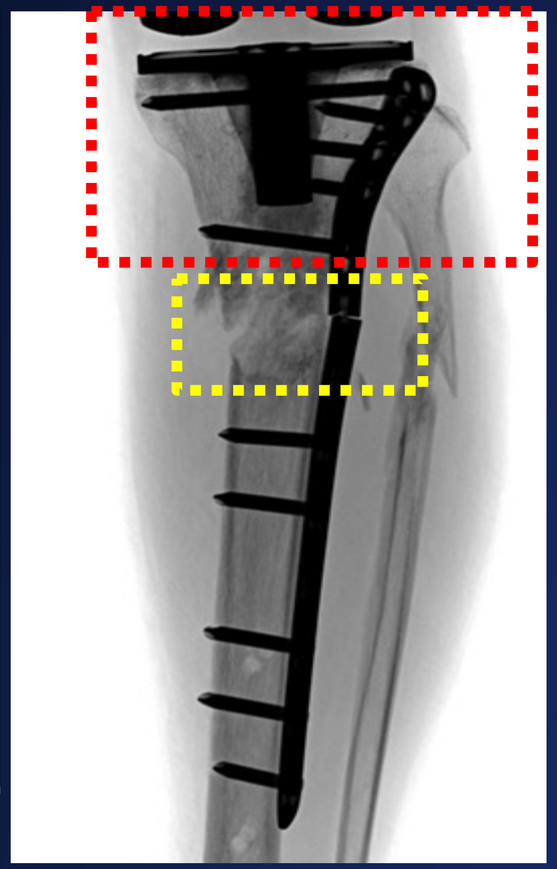
65/F

Surgery done 5 years back

Independent walker

Case 4

Case 4



Limited numbers of screws

Short working length

Case 4

Case 5

Type 2

72/M

Surgery done 6 years back

Independent walker

Severely osteoporotic

Case 5


Lateral fixation


Medial fixation

Case 5

Post Op X-ray

FU 12 months

Conclusion

- Adequate Reduction
- Bridge Plating
- Supplement Medially

Conclusion

Cases which don't need OR may be done by MIPO

Adequate Reduction

Bridge Plating

Supplement Medially

Conclusion

Adequate Reduction

Bridge Plating Should be employed to achieve Relative stability

Supplement Medially

Conclusion

Adequate Reduction

Bridge Plating

In comminution / short segment we should **Supplement Medially**

Summary

Tibial periprosthetic fractures

- Rarely occured
- Too small proximal fragment / poor bone quality
- Loose implants
- Revision usually required

Patellar periprosthetic fractures

- More often than proximal tibial PPF
- Reconstruct extensor mechanism
- Two stage procedure advisable if loose implant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