Case Based Discussions: Peri-prosthetic hip fractures

DENNIS KOSUGE FRCS (TRAUMA & ORTHOPAEDICS)

CONSULTANT

THE PRINCESS ALEXANDRA HOSPITAL NHS TRUST

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Objectives

ISCP Curriculum

Diagnostic and guided injections

Radiological investigations to assess the hip

Management of periprosthetic fractures around prostheses and implants

Failed arthroplasty and soft tissue surgery

Principles of revision surgery for failed arthroplasty

Case Based Discussions

Cover the above curriculum

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

Why are peri-prosthetic hip fractures important?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Epidemiology

Increasing incidence of primary hip arthroplasties

	NJR
2014	98 279
2015	98 211
2016	101 651
2017	105 306
2018	106 116

https://reports.njrcentre.org.uk/hips-all-procedures-activity

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

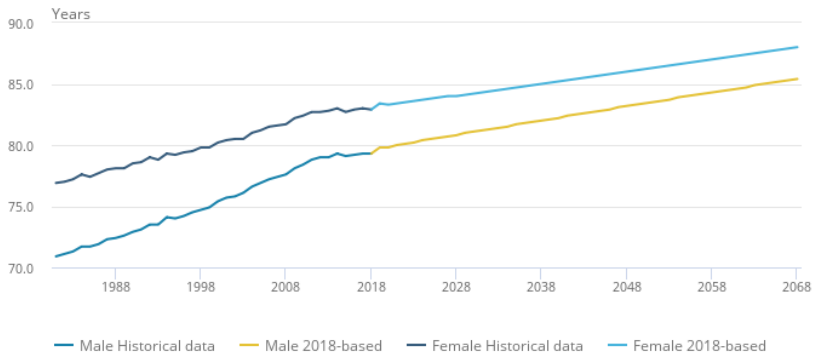
Epidemiology

Increasing life-expectancy

Baby boys born in the UK in 2018 can expect to live on average to age 87.6 years and girls to age 90.2 years, taking into account projected changes in mortality patterns over their lifetime.

Figure 1: Period life expectancy at birth is projected to increase by six years for males and five years for females by 2068

Male and female period life expectancy at birth, historical data and 2018-based projection, United Kingdom, 1981 to 2068



Source: Office for National Statistics

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Epidemiology

Incidence of revision THR increasing

Reason for revision	All recorded revisions (%)
Aseptic loosening	50,375 (43.5)
Pain	19,541 (16.9)
Lysis	16,164 (14.0)
Implant wear	14,634 (12.6)
Dislocation/subluxation	16,646 (14.4)
Infection	15,923 (13.8)
Periprosthetic fracture	11,662 (10.1)
Malalignment	5,691 (4.9)
Implant fracture	3,787 (3.3)
Head/socket size mismatch	757 (0.7)
Other indication	8,170 (7.1)
Adverse reaction to particulate debris*	9,477 (8.2)

Table 3.20 (a) Number of re-revisions by year.

Year of first revision in the NJR*	Number of first revisions	Number of first revisions (%) with the associated primary recorded in the NJR
2003	1,411	44 (3.1)
2004	2,641	143 (5.4)
2005	3,753	306 (8.2)
2006	4,499	462 (10.3)
2007	5,893	826 (14.0)
2008	6,333	1,158 (18.3)
2009	6,578	1,516 (23.0)
2010	7,105	1,952 (27.5)
2011	7,971	2,652 (33.3)
2012	9,038	3,337 (36.9)
2013	8,255	3,045 (36.9)
2014	8,101	3,092 (38.2)
2015	7,675	3,227 (42.0)
2016	7,219	3,180 (44.1)
2017	6,990	3,217 (46.0)
2018	6,453	3,253 (50.4)
Total	99,915	31,410 (31.4)

16th Annual NJR Report 2019.

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

When do peri-prosthetic fractures occur?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Epidemiology

Intra-operative (12%)

Uncemented – 19%

Cemented – 6%

Post-operative (11% 20-year probability)

No difference between uncemented and cemented

Risk Factors – Male; Age <70

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Epidemiology

■ HIP

Epidemiology of periprosthetic femoral fractures in 5417 revision total hip arthroplasties

A 40-YEAR EXPERIENCE

M. P. Abdel,
M. T. Houdek,
C. D. Watts,
D. G. Lewallen,
D. J. Berry

From Mayo Clinic, Minnesota, United States

Take home message: In revision THA, intra-operative periprosthetic femoral fractures occur three times more often with uncemented stems. Many are non-displaced diaphyseal fractures treated with cerclage fixation. While postoperative fracture risks are equivalent between uncemented and cemented components, they occur at notably different time periods based on stem fixation type.

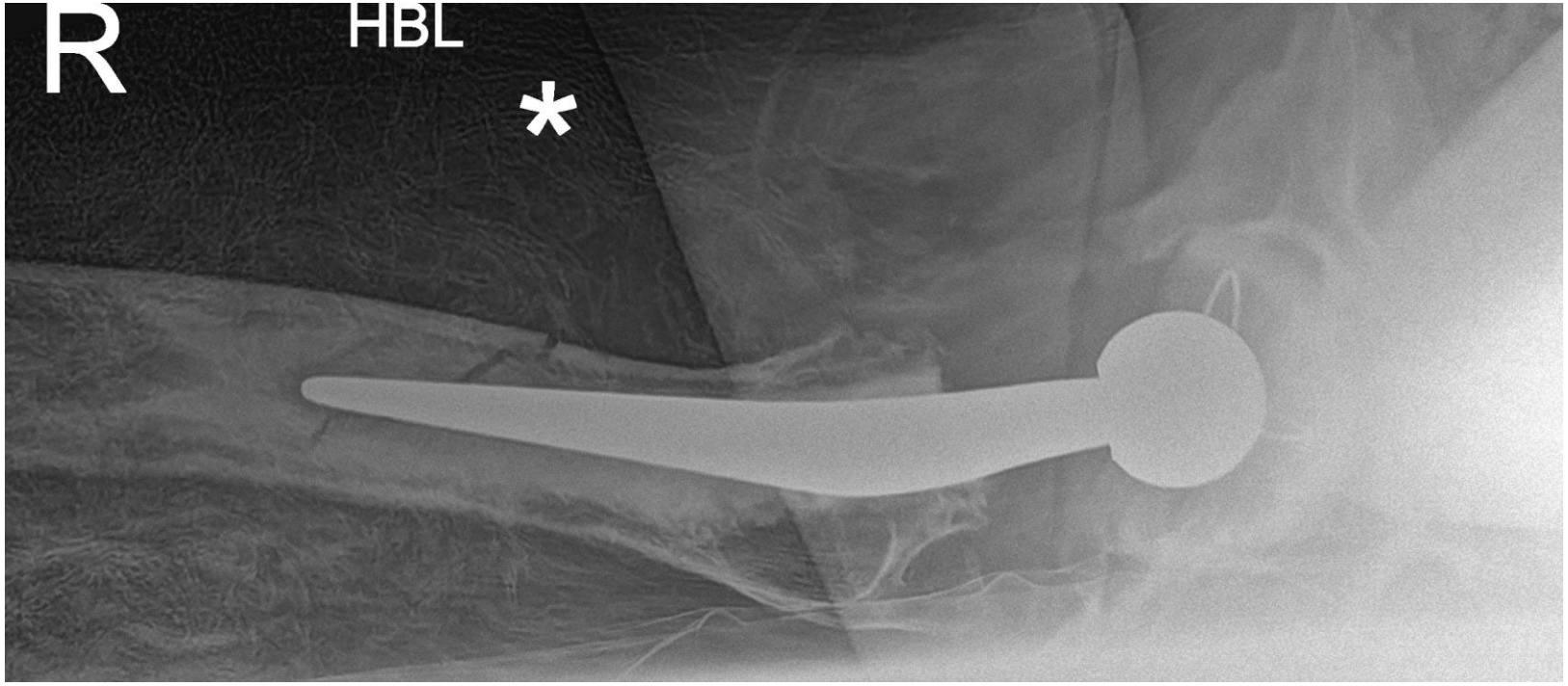
Bone Joint J. 2016;98-B(4):468-74.

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 1

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 1



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

How would you manage this peri-prosthetic fracture?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Peri-prosthetic Fracture

Principles of management

Patient Profile

Aim – pain-free, (mobile) patient with stable implant

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 1

86F PMH Hypothryroidism

THR 2007

Slipped in Garden – moderate to severe pain on movement

Lives with son

Mobilises independently with no aids

Independent ADLs

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

What are the principles of fixation?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Surgical Principles for ORIF

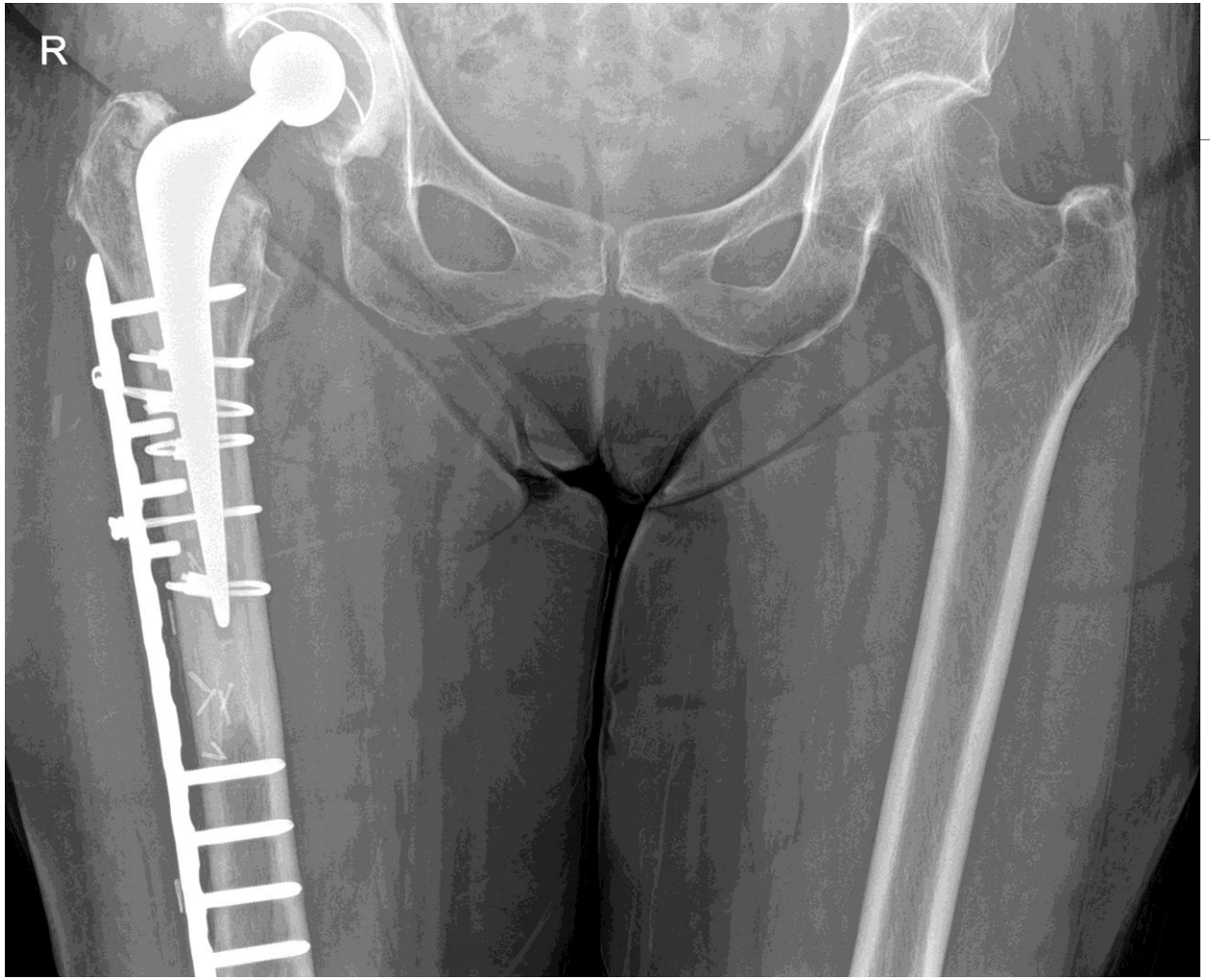
Approach

Reduction

Fixation

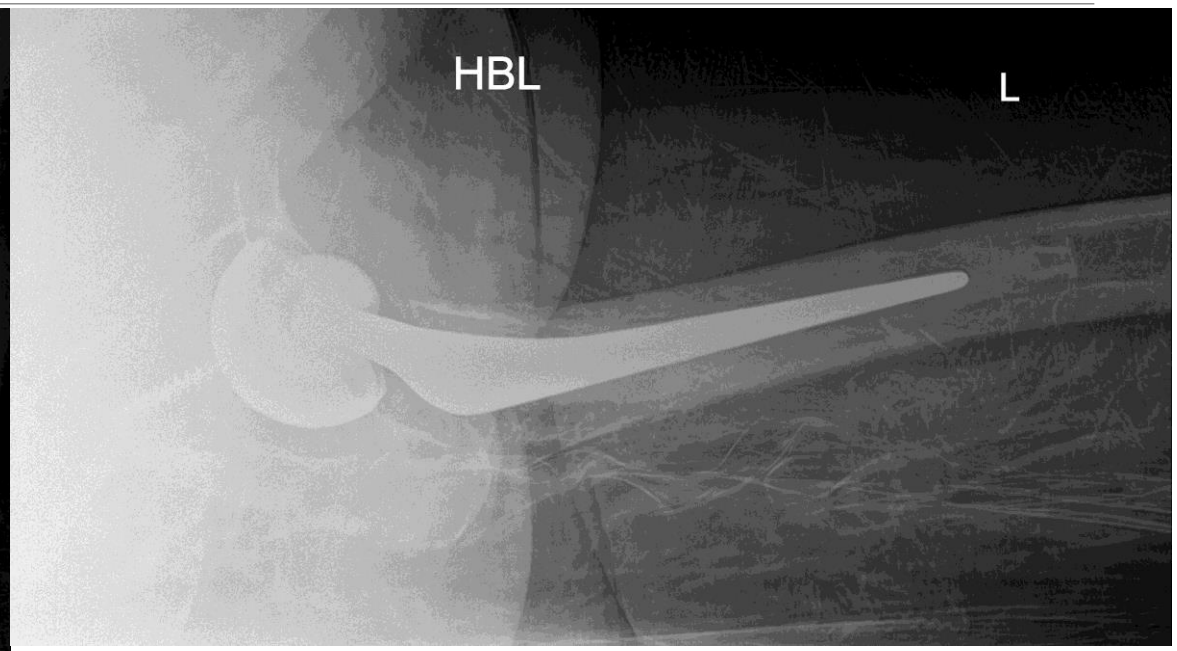
- Primary or secondary healing
- Fixation technique
- Proximal fixation concepts

DENNIS KOSUGE
ORTHOPAEDIC SURGEON



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Fix or Revise?



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Fixation with Cables only

56F

THR – February 2017

Recovered well

Hit by reversing car – September 2017

ORIF – Cables

Radiographs – May 2019

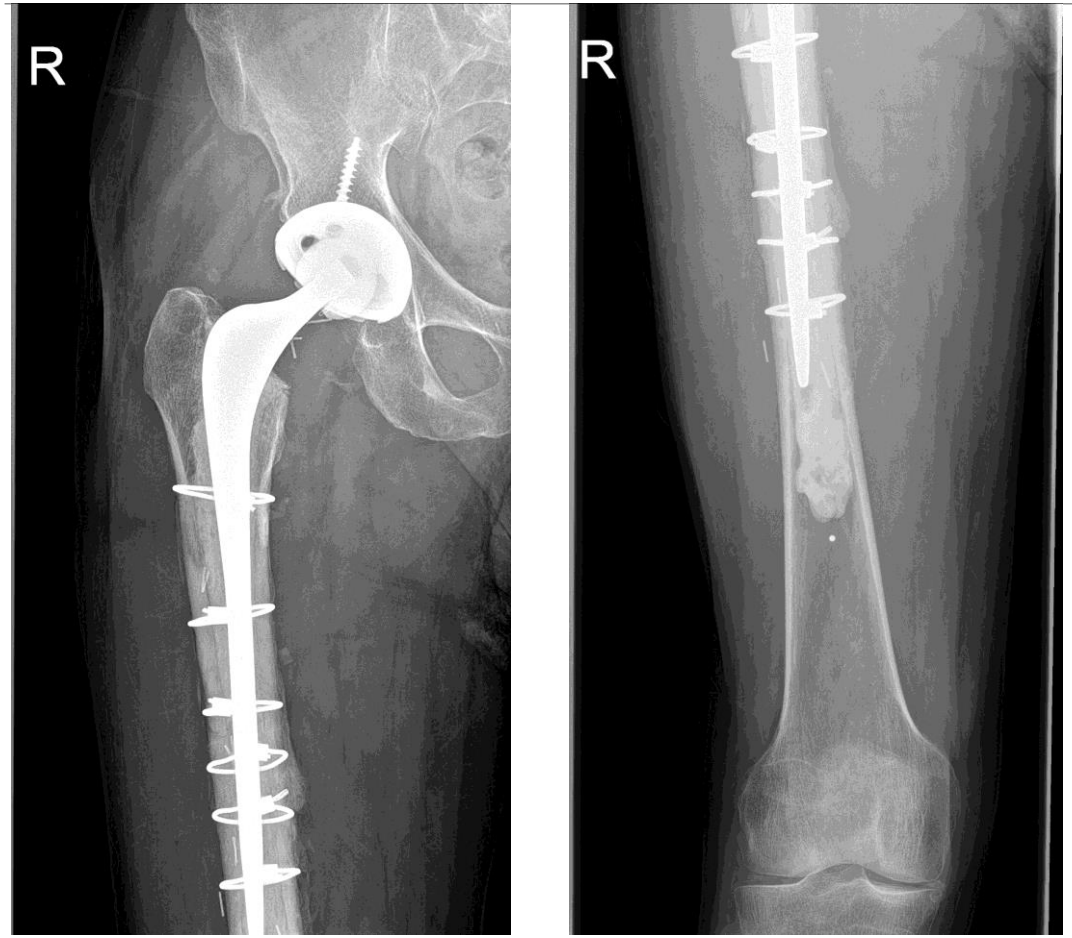
Recovered well

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Fix or Revise?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Revision with long stem after ORIF



68F

THR for hip # – September 2017

Recovered well

Fell in garden – November 2017

Revsion after ORIF

Radiographs – February 2019

Recovered well

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

What is your surgical decision-making algorithm for peri-prosthetic fractures?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Peri-prosthetic Fracture

Principles of management

Patient Profile

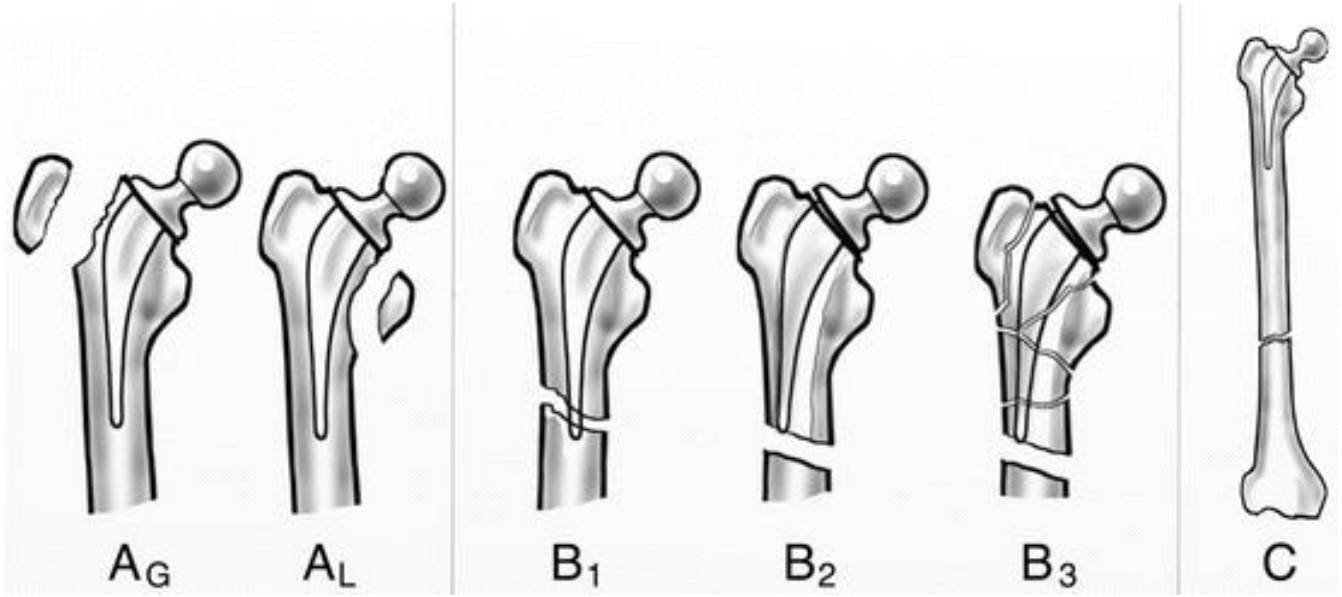
Fracture Pattern

Aim – pain-free, (mobile) patient with stable implant

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Classification

Duncan and Masri



Duncan CP and Masri BA. Fractures of the Femur After Hip Replacement. Instr Course Lect. 1995;44:293-304

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

Do you know of any ‘modification’ to the Duncan and Masri classification system?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

UCS Classification and periprosthetic fractures treatment algorithm.

FRACTURE TYPE	TREATMENT
A *Apophyseal or extraarticular/periarticular* Subtypes A1: Avulsion of (e.g. greater trochanter) A2: Avulsion of (e.g. lesser trochanter)	Depends on displacement and importance of soft tissue attached, e.g.: • greater trochanter, tibial tuberosity, greater humeral tuberosity: surgical treatment • lesser trochanter, coracoid process: conservative treatment
B *Bed of the implant or around the implant* Subtypes B1: Prosthesis stable, good bone B2: Prosthesis loose, good bone B3: Prosthesis loose, poor bone or bone defect	B1: Lower limb: reduction and fixation, LCP and if possible MIPO technique preferred. B1: Upper limb: depends on displacement, conservative treatment preferred. B2: Revision surgery. B3: Revision surgery that may require complex reconstruction (megaprosthesis, allograft/stem composite). Depends on the bone loss and age/activity of the patients.
C *Clear of or distant to the implan*	Same management as no-periprosthetic fracture.

Duncan CP and Haddad F. The Unified Classification System (UCS): Improving our understanding of Periprosthetic Fractures. Bone Joint J. 2014; 96-B(6):713-6

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Classification

D ***D****ividing the bone between two implants or interprosthetic or intercalary*	Decision-making depends on "block-out analysis"*. Subtype A (both prostheses stable): reduction and fixation Subtype B (one stable and one loose): revision surgery Subtype C (both loose):both joint revision surgery, total replacement
E ***E****ach of two bones supporting one arthroplasty or polyperiprosthetic*	Decision-making depends on "block-out analysis"* (e.g. separate assessment of femoral fracture with stem of THA and acetabular fracture with cup)
F ***F****acing and articulating with a hemiarthroplasty*	Depends on displacement, conservative treatment preferred.

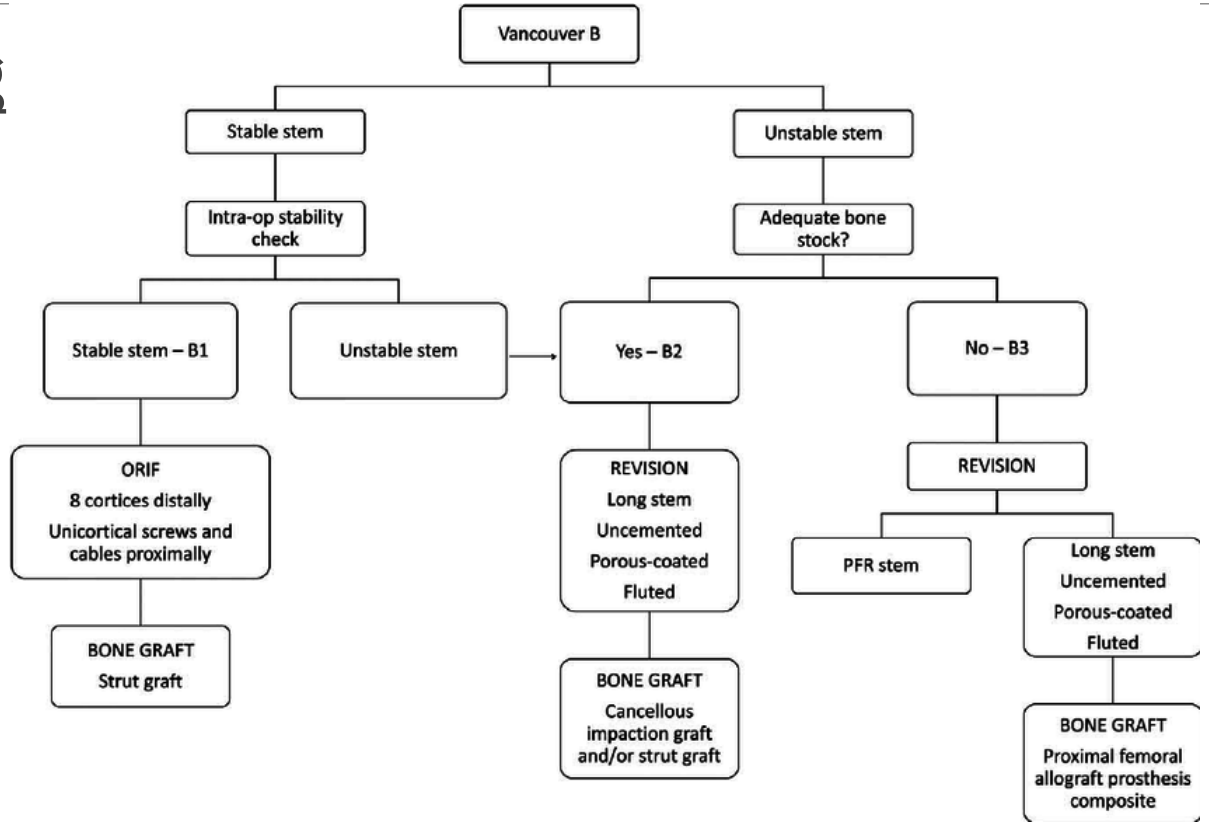
Duncan CP and Haddad F. The Unified Classificaiton System (UCS): Improving our understanding of Periprosthetic Fractures. Bone Joint J. 2014; 96-B(6):713-6

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Classification

Crucial Decision Making

B1 or B2/B3?



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

Is there any situation where you may consider fixation in a B2 fracture?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Principle of B2g and B2p

Exception

Criteria

The Journal of Arthroplasty 34 (2019) 1430–1434

Vancouver B2 Peri-Prosthetic Fractures in Cemented Femoral Implants can be Treated With Open Reduction and Internal Fixation Alone Without Revision

Peter J. Smitham, PhD, FRCS(Tr & Orth), FRACS [a, b, *], Tania A. Carbone, BSc [a, b], Scott M. Bolam, FRACS [c], Young S. Kim, MD, PhD [d], Stuart A. Callary, BAppSc, PhD [a, b], Kerry Costi, BA [a, b], Donald W. Howie, MBBS, PhD [a, b], Jacob T. Munro, FRACS, PhD [d], Lucian B. Solomon, MD, PhD, FRACS [a, b]

Cemented polished double tapered stems (e.g. Exeter)

CB interface intact; SC interface disrupted

Anatomical reduction achievable

Classification – B2g (good) and B2p (poor) cement mantle

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 2

Patient Profile

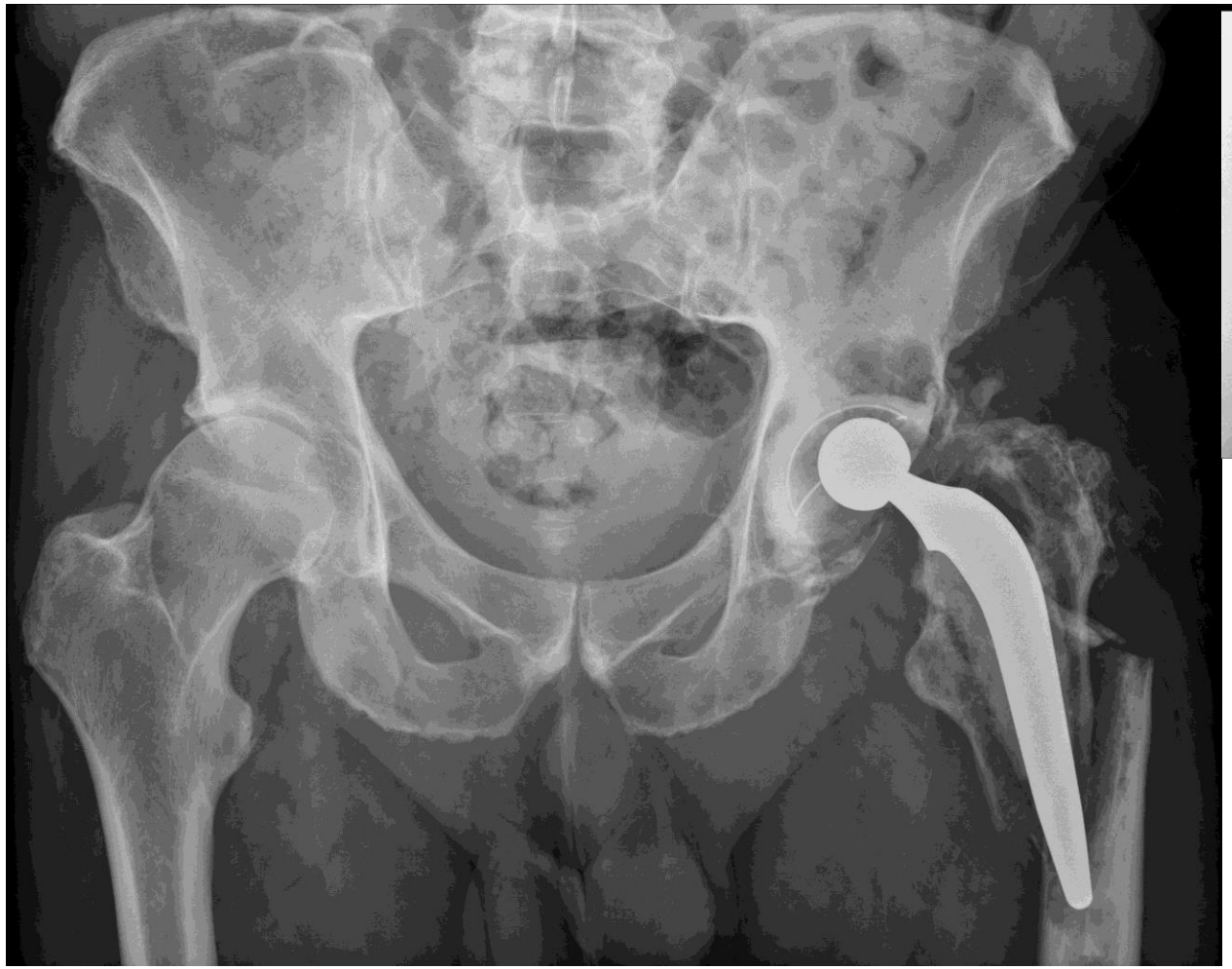
75M PMH nil medical co-morbidities

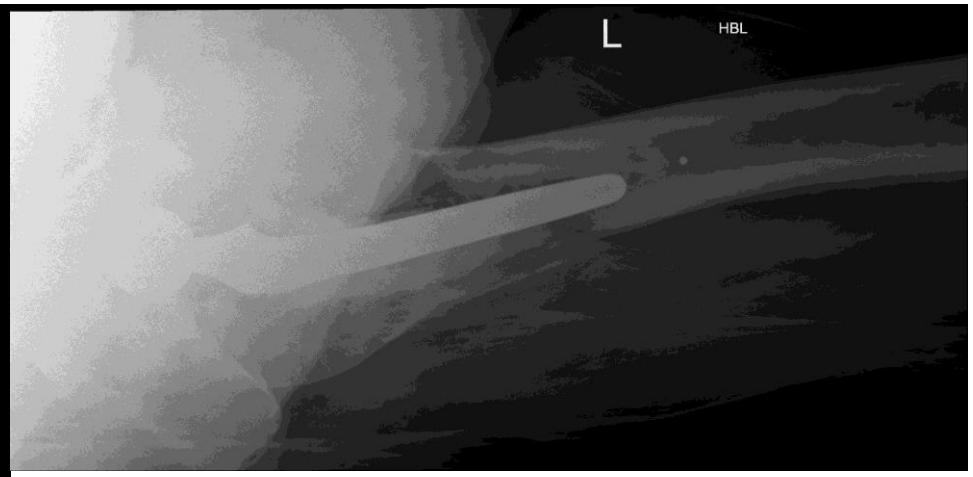
THR 1993

Mobilises independently with no aids

Independent ADLs

DENNIS KOSUGE
ORTHOPAEDIC SURGEON





DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

What is your surgical plan for this peri-prosthetic fracture?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Peri-prosthetic Fracture

Principles of management

Patient Profile

Fracture Pattern

THR Profile

Aim – pain-free, (mobile) patient with stable implant

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 2

Leg gave way on stepping backwards whilst playing golf

Intermittent groin and thigh pain preceding this

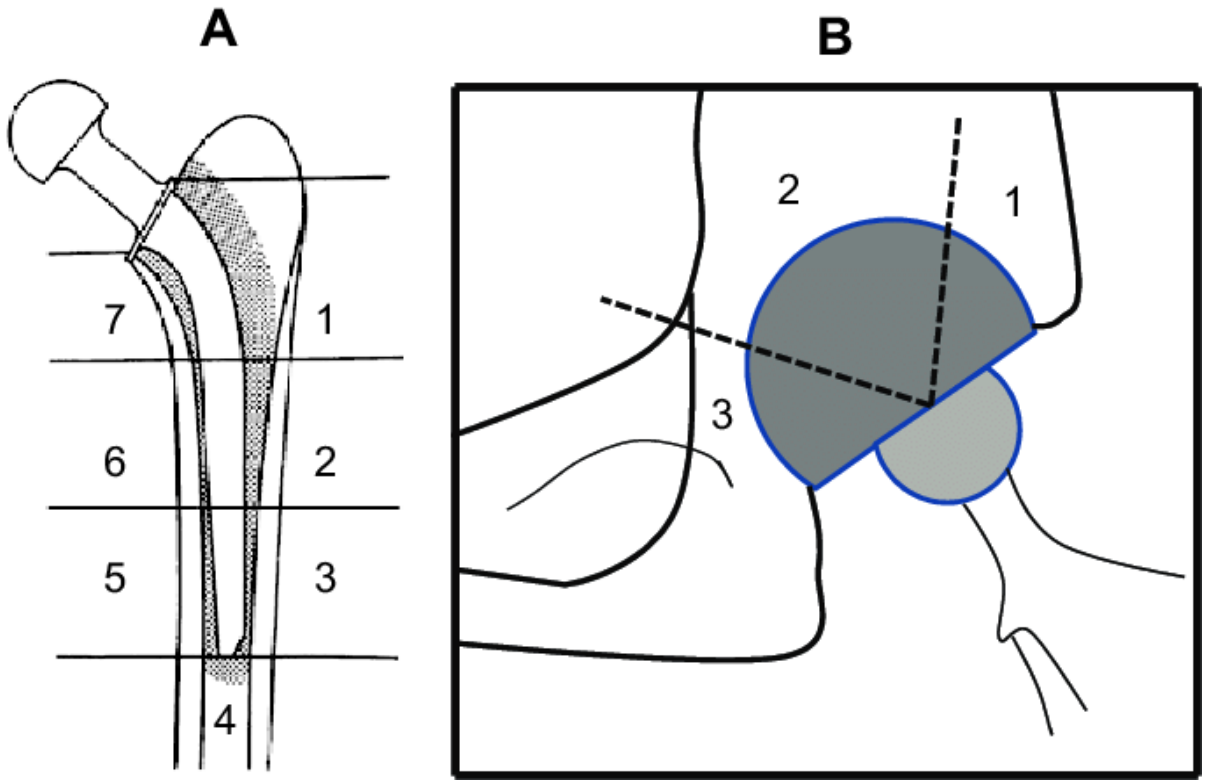
DENNIS KOSUGE
ORTHOPAEDIC SURGEON

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

How would you describe these radiographic findings?

Radiographic Zones



Gruen TA, McNeice GM, Amstutz HC. 'Modes of Failure' of cemented stem-type femoral components: a radiographic analysis of loosening. Clin Orthop Relat Res. 1979;141:17-27.
DeLee JG, Charnley J. Radiological demarcation of cemented sockets in total hip replacement. Clin Orthop Relat Res. 1976;121:20–32

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Loosening – Harris' Definitions

Definite loosening

Probable loosening

Continuous radiolucency at bone-cement interface surrounding entire cement mantle (on AP or lateral view)

Possible loosening

New radioluency at bone-cement interface occupying 50 to 99% of cement mantle (on AP or lateral view)

Harris WH, McCarthy JC, O'Neill DA. Femoral component loosening using contemporary techniques of femoral cement fixation. J Bone Joint Surg Am. 1982;64:1063-7

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

What must you consider in the treatment of any peri-prosthetic fracture?

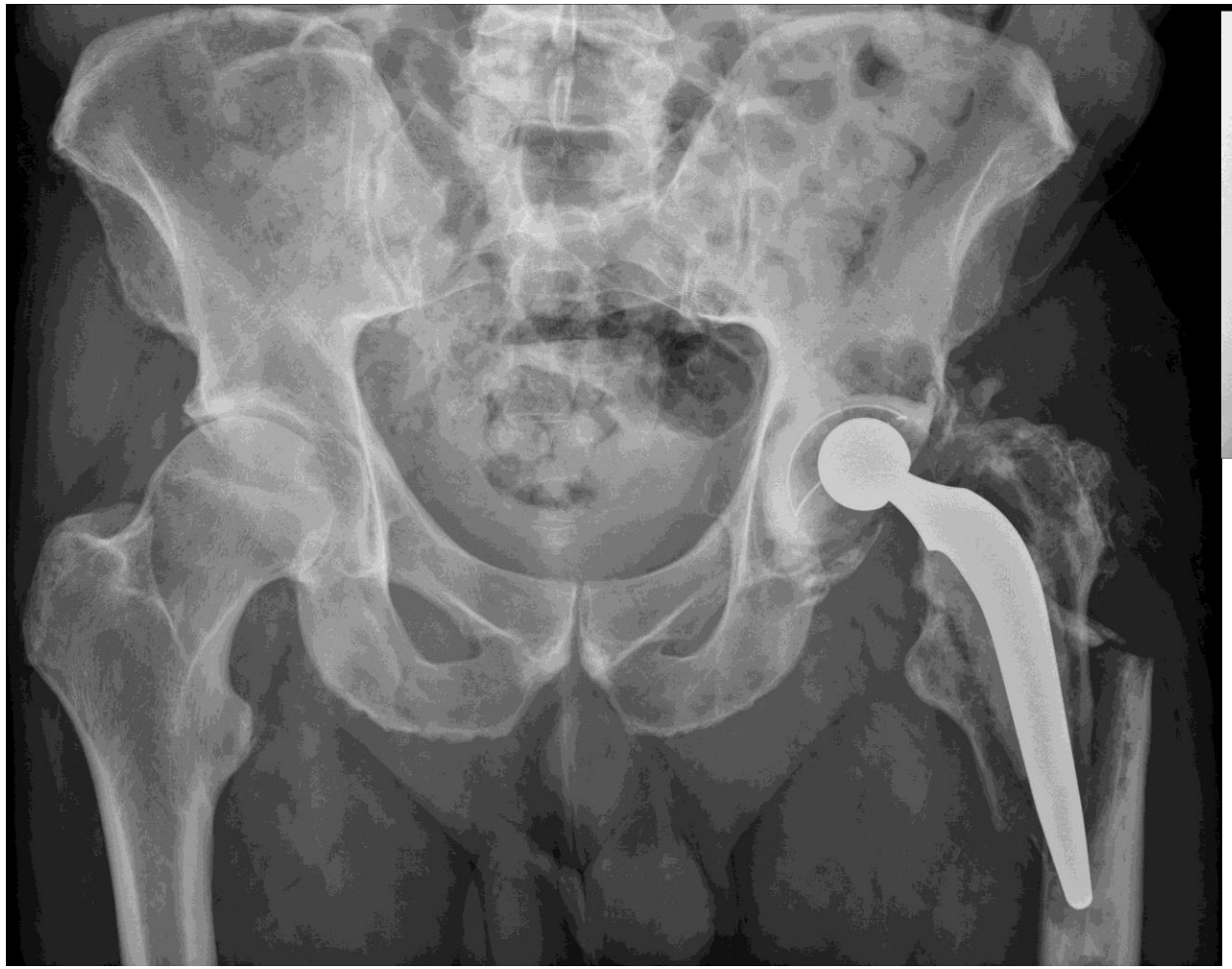
DENNIS KOSUGE
ORTHOPAEDIC SURGEON

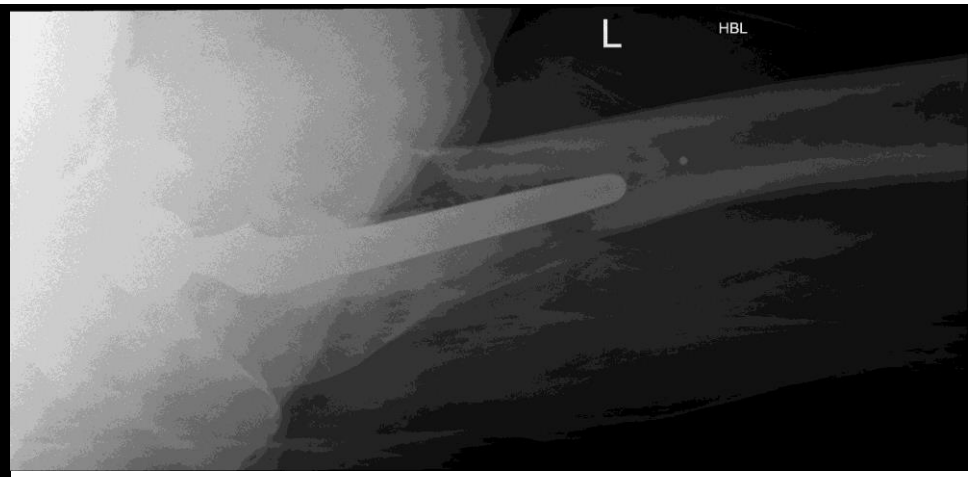
Infection

History & Examination

Inflammatory Markers – associated trauma, interpretation challenging

Aspiration – in suspicious cases (in reality, not routinely performed due to unrealistic nature of aspiration and waiting for results in fracture setting)





DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

What is your surgical plan for this peri-prosthetic fracture?

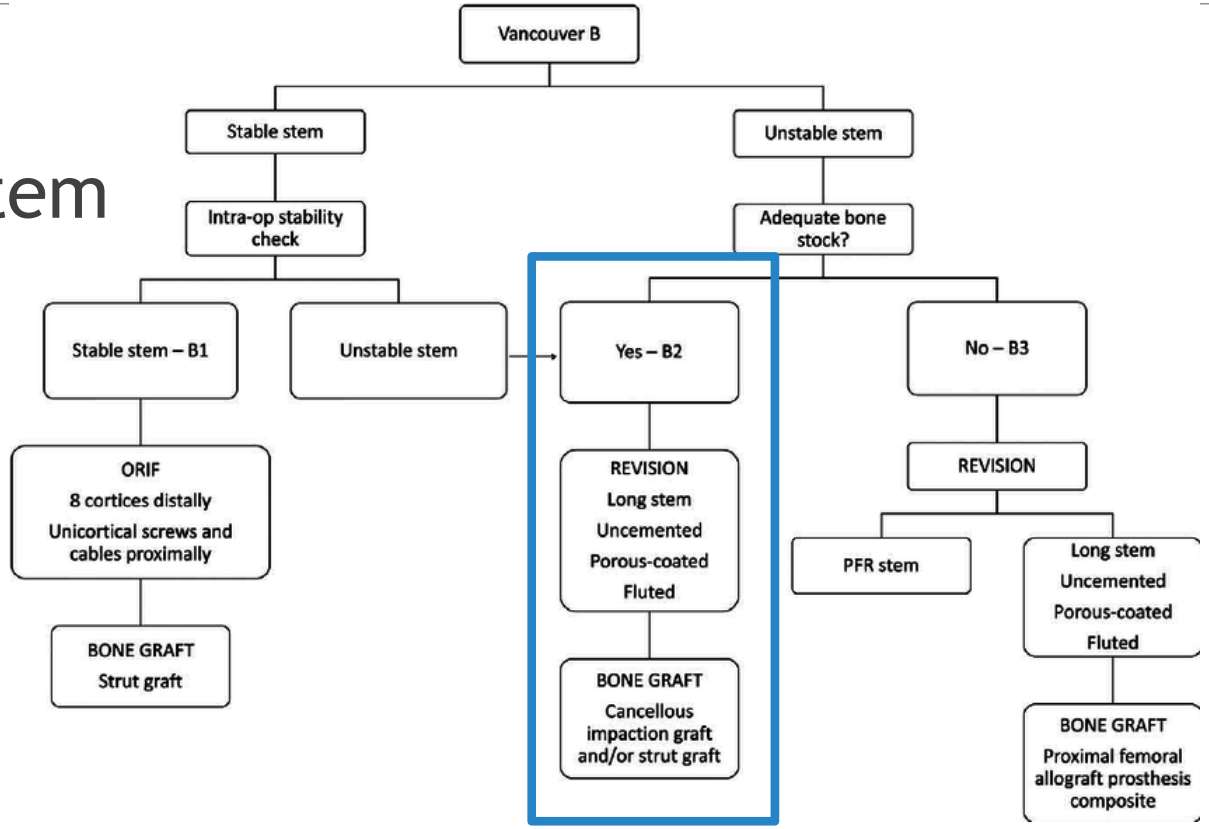
DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Classification

B2

Not polished tapered stem

THR osteolysis



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Revision

One-year FU:

Recovered well

Back to playing golf

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 3

Patient Profile

75M PMH nil medical co-morbidities

Slipped in garden

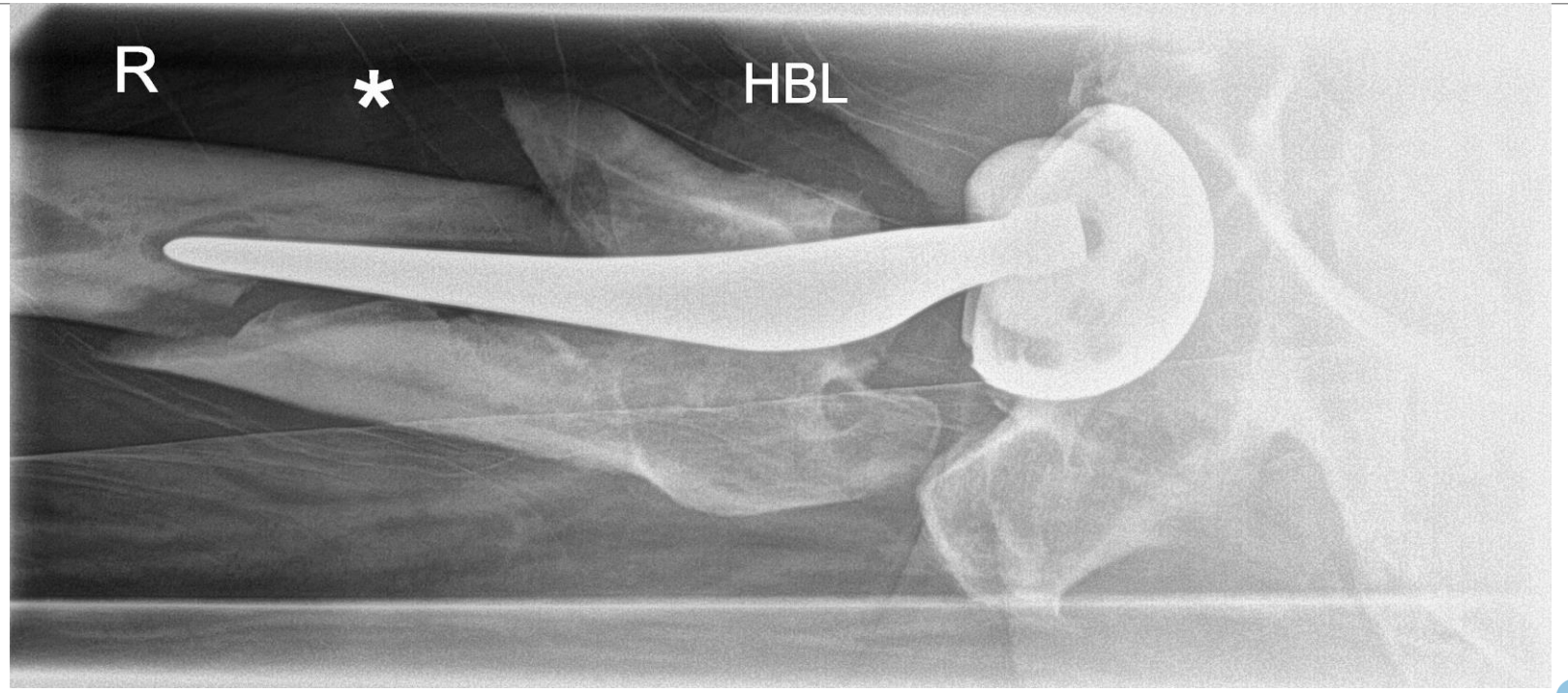
THR 2016; Ipsilateral TKR 2009

Mobilises independently with no aids

Independent ADLs

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 3



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 3

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

What ‘type’ of fracture is this in terms of classification?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Classification

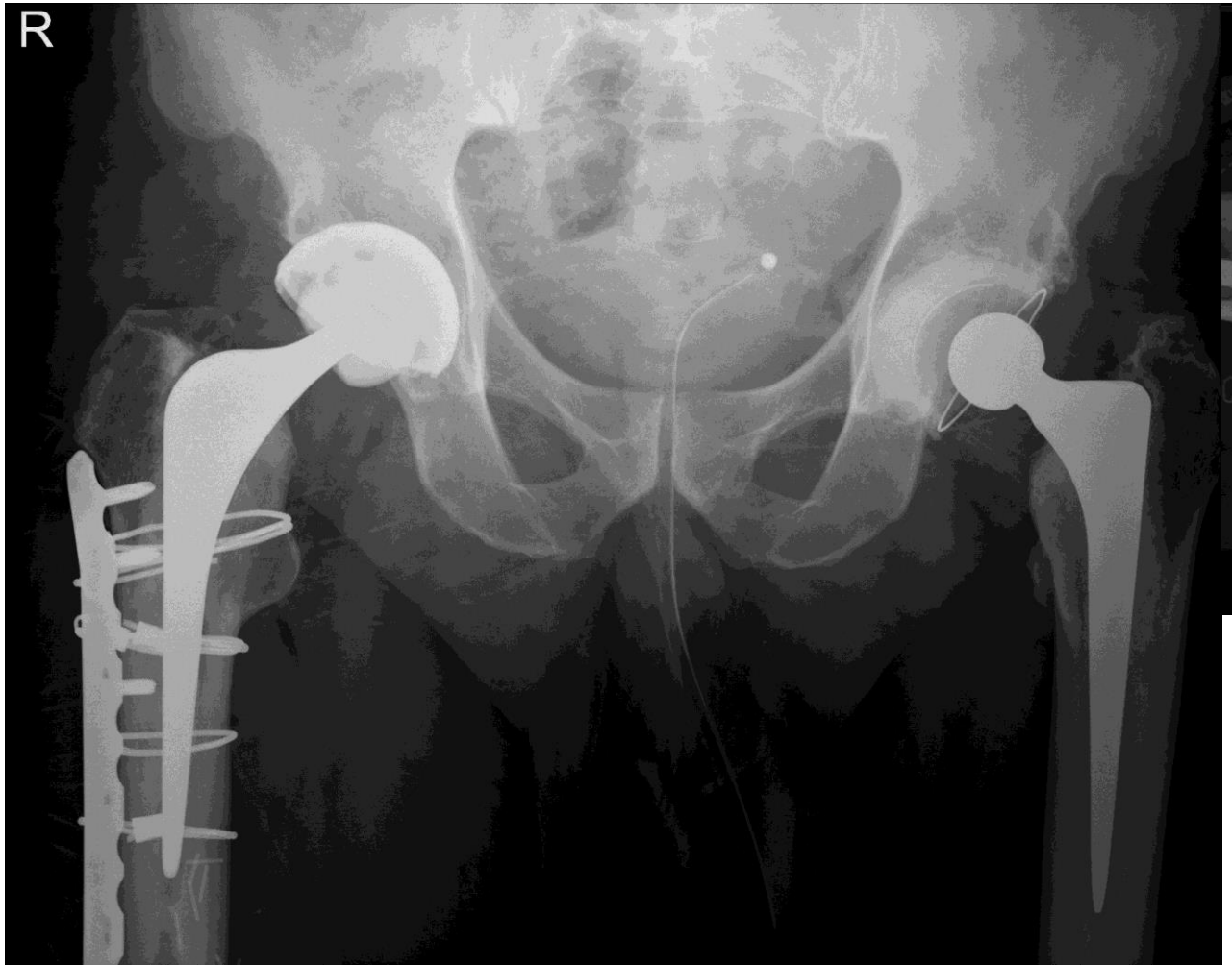
D ***D****ividing the bone between two implants or interprosthetic or intercalary*	Decision-making depends on "block-out analysis"*. Subtype A (both prostheses stable): reduction and fixation Subtype B (one stable and one loose): revision surgery Subtype C (both loose):both joint revision surgery, total replacement
E ***E****ach of two bones supporting one arthroplasty or polyperiprosthetic*	Decision-making depends on "block-out analysis"* (e.g. separate assessment of femoral fracture with stem of THA and acetabular fracture with cup)
F ***F****acing and articulating with a hemiarthroplasty*	Depends on displacement, conservative treatment preferred.

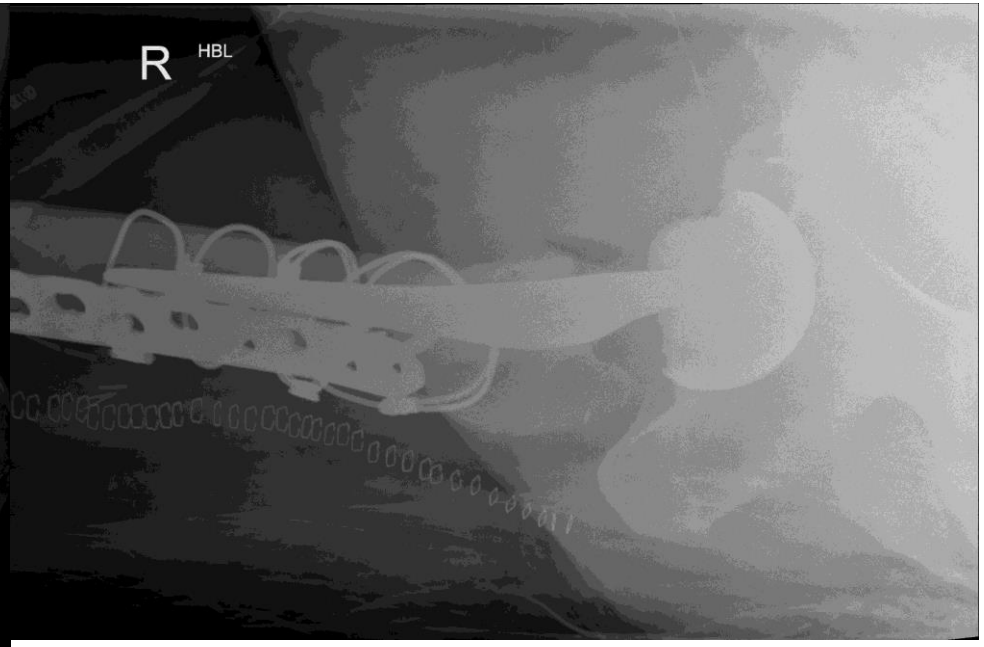
Duncan CP and Haddad F. The Unified Classificaiton System (UCS): Improving our understanding of Periprosthetic Fractures. Bone Joint J. 2014; 96-B(6):713-6

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Question

How would you manage this peri-prosthetic fracture surgically?



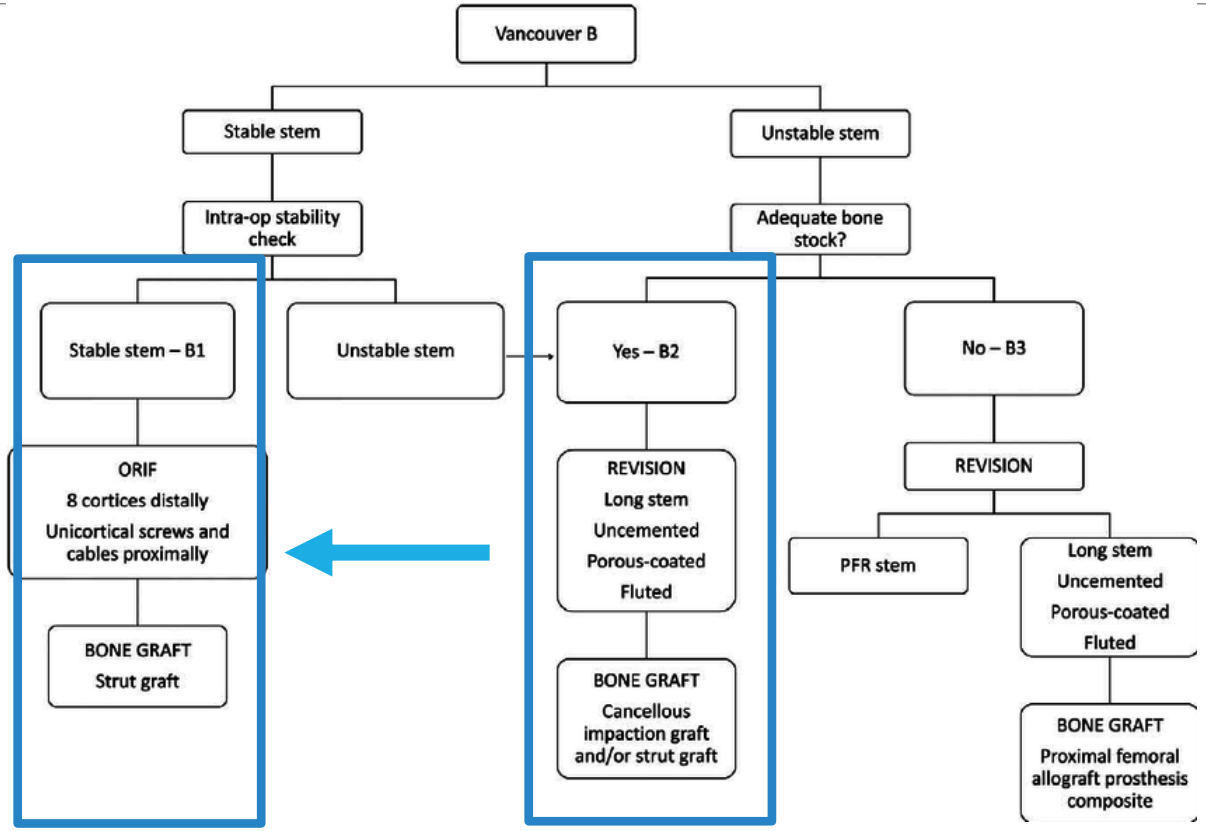


DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Classification

B2

Polished tapered stem



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Classification

Exception

Criteria

Vancouver B2 Peri-Prosthetic Fractures in Cemented Femoral Implants can be Treated With Open Reduction and Internal Fixation Alone Without Revision

The Journal of Arthroplasty 34 (2019) 1430–1434

Peter J. Smitham, PhD, FRCS(Tr & Orth), FRACS [a, b, *], Tania A. Carbone, BSc [a, b], Scott M. Bolam, FRACS [c], Young S. Kim, MD, PhD [d], Stuart A. Callary, BAppSc, PhD [a, b], Kerry Costi, BA [a, b], Donald W. Howie, MBBS, PhD [a, b], Jacob T. Munro, FRACS, PhD [d], Lucian B. Solomon, MD, PhD, FRACS [a, b]

Cemented polished double tapered stems (e.g. Exeter)

CB interface intact; SC interface disrupted

Anatomical reduction achievable

Classiciation – B2g (good) and B2p (poor) cement mantle

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

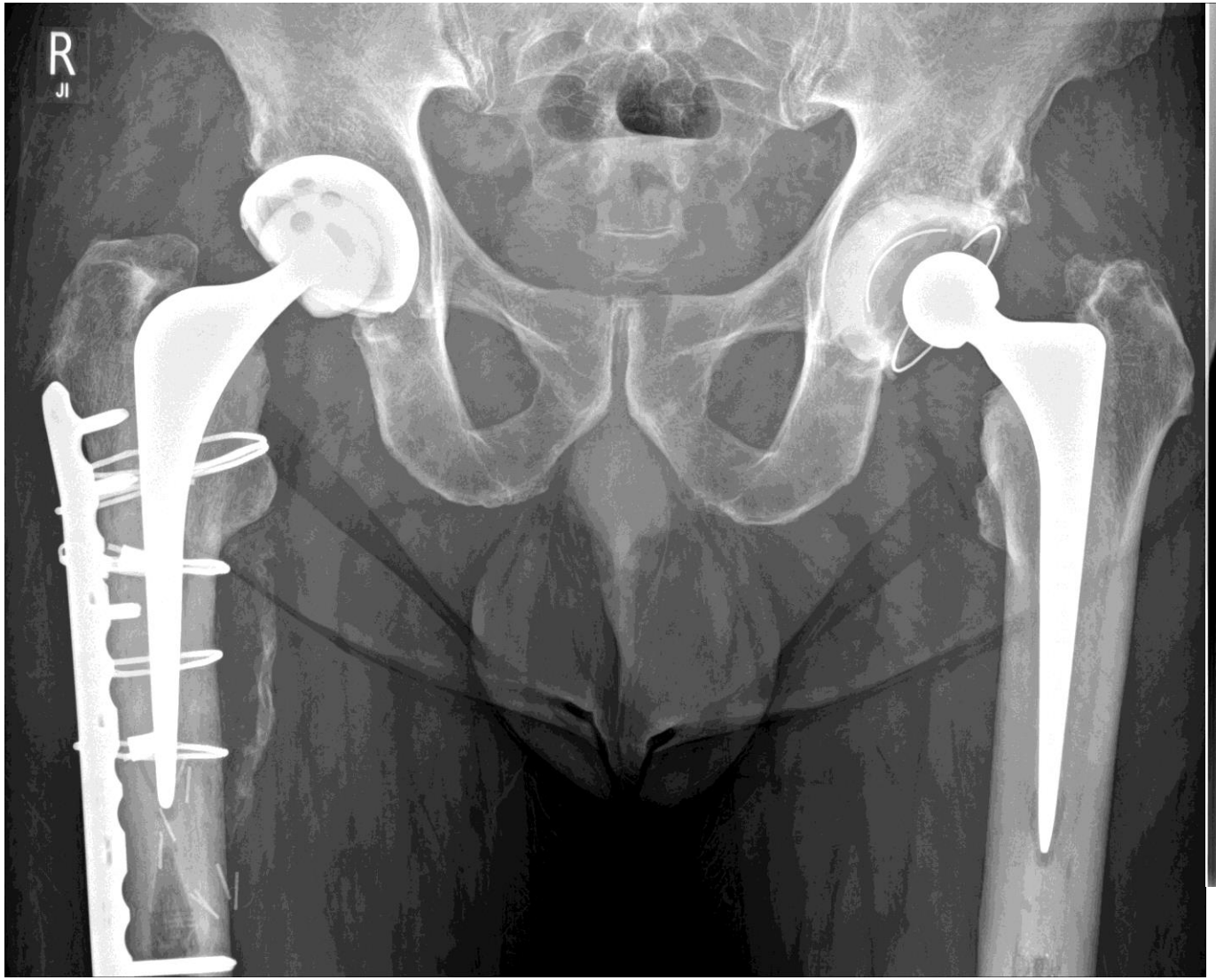
Case 3

At one year FU:

Returned to independent mobility with no aids

Independent ADLs

DENNIS KOSUGE
ORTHOPAEDIC SURGEON



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 3

At 15 months FU:

Thigh pain exacerbated by weight-bearing

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Questions

What investigations would you request, and why?

Inflammatory markers – WBC 9.7; CRP 51; ESR 52
NM scan
Aspiration – *S.epidermidis*

Questions

For Prosthetic Joint Aspirations:

What bottle do you use?

What investigations do you request?

When do you send the sample to the laboratory?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Prosthetic Joint Aspiration

Synovial white cell count

>3000 cells/μl

Percentage neutrophil

>80%

Culture

Major criteria (at least one of the following)	Decision
Two positive cultures of the same organism	Infected
Sinus tract with evidence of communication to the joint or visualization of the prosthesis	

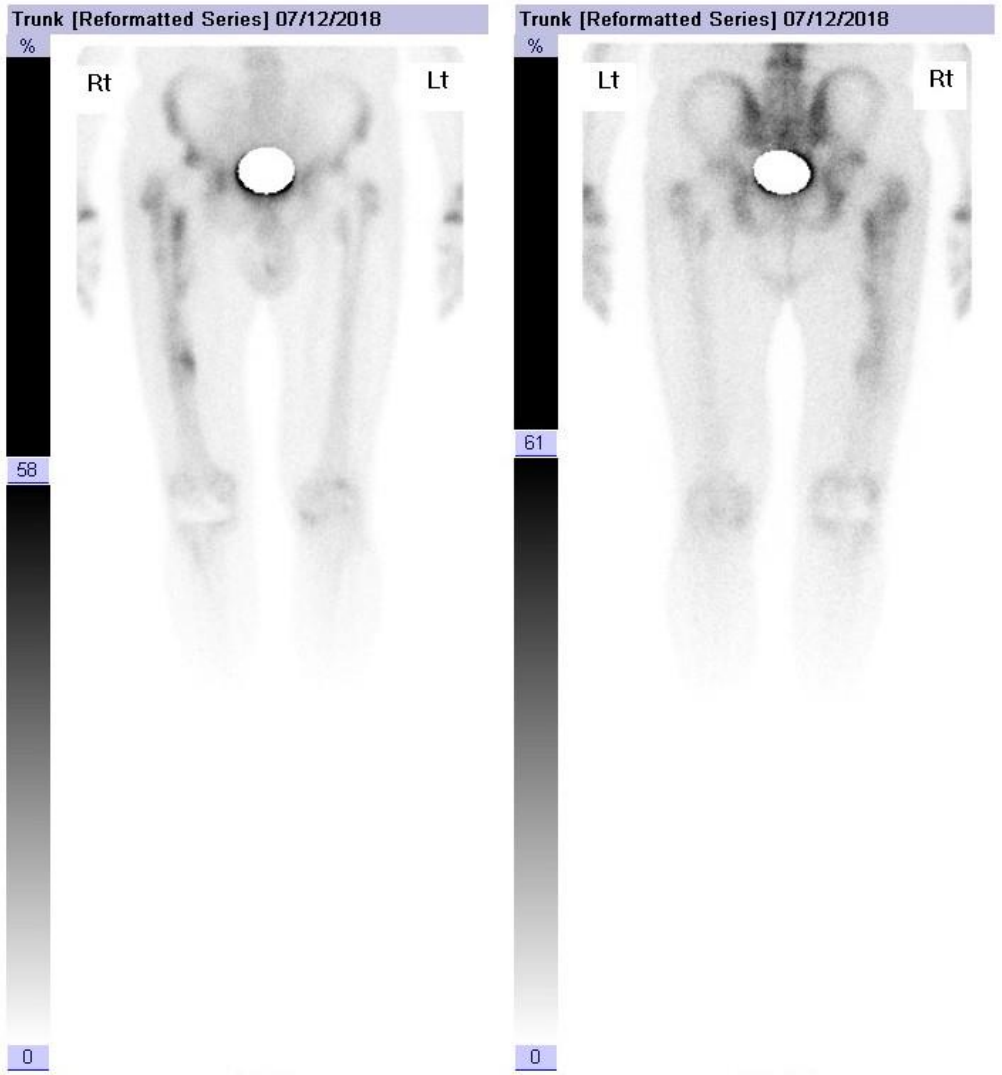
Preoperative Diagnosis	Minor Criteria	Score	Decision
Serum	Elevated CRP *or* D-Dimer	2	≥6 Infected
Serum	Elevated ESR	1	
Synovial	Elevated synovial *WBC count or LE*	3	2-5 Possibly Infected [a]
Synovial	Positive alpha-defensin	3	
Synovial	Elevated synovial PMN (%)	2	0-1 Not Infected
Synovial	Elevated synovial CRP	1	

Intraoperative Diagnosis	Inconclusive pre-op score *or* dry tap [a]	Score	Decision
	Preoperative score	-	≥6 Infected
	Positive histology	3	4-5 Inconclusive [b]
	Positive purulence	3	
	Single positive culture	2	≤3 Not Infected

Parvizi J, Tan TL, Goswami K, Higuera C, Della Valle C, Chen AF, Shohat N. The 2018 definition of perioprosthetic hip and knee infection: an evidence based and validated criteria. J Athroplasty. 2018;33(5):1309-14

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Study Date: 07/12/2018



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Questions

How does a bone scan work?

What radio-nuclide label is commonly used?

How long does it take?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Questions

What are the principles of management of a PJI?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Prosthetic Joint Infection

Principles of management

Isolate bacteria and determine antibiotic sensitivities

‘Gold’ standard remains two-stage revision but single-stage acceptable in correct circumstances

Spacer

Aim – eradication of infection and pain-free joint

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

IV antibiotics:

IV Teicoplanin and Rifampicin 6/52

PO Doxycycline and Rifampicin 6/52

WBC 7.0 CRP 4

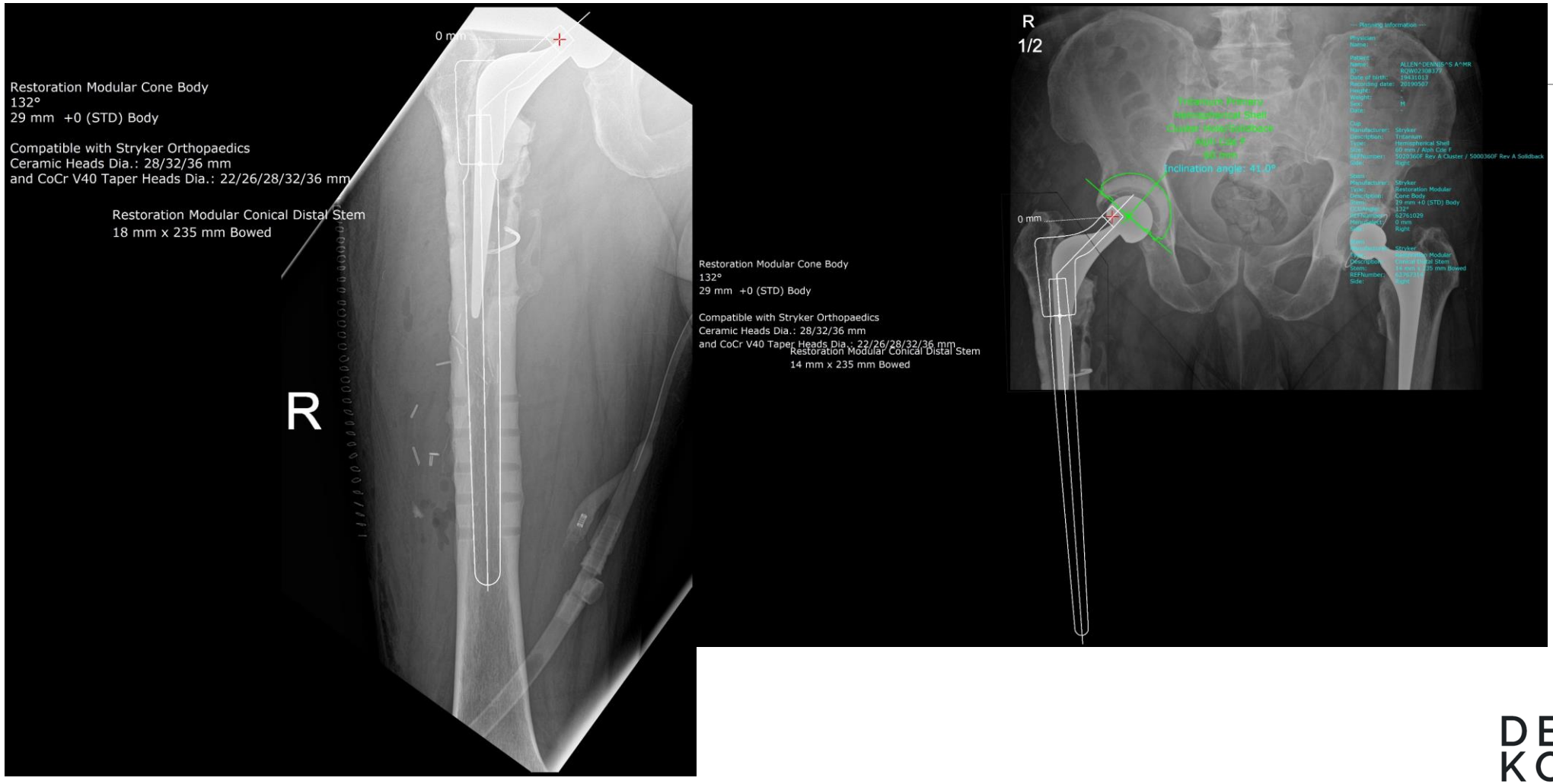
Aspiration no bacterial growth

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Questions

How would you reconstruct this?

DENNIS KOSUGE
ORTHOPAEDIC SURGEON



DENNIS KOSUGE
ORTHOPAEDIC SURGEON

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Case 3

At six months FU:

No clinical signs of infection

Returned to independent mobility with no aids

Independent ADLs

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Questions

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Reading List

Duncan CP and Haddad F. The Unified Classification System (UCS): Improving our understanding of Periprosthetic Fractures. Bone Joint J. 2014; 96-B(6):713-6

Gruen TA, McNeice GM, Amstutz HC. 'Modes of Failure' of cemented stem-type femoral components: a radiographic analysis of loosening. Clin Orthop Relat Res. 1979;141:17-27.

Parvizi J, Tan TL, Goswami K, Higuera C, Della Valle C, Chen AF, Shohat N. The 2018 definition of perioprosthetic hip and knee infection: an evidence based and validated criteria. J Athroplasty. 2018;33(5):1309-14

Calleja M, Alam A, Wilson D, Bradley K. Basic science: nuclear medicine in skeletal imaging. Current Orthopaedics. 2005;19:34-9.

Smitham PJ, Carbone TA, Bolam SM, Kim YS, Callary SA, Costi K, Howie DW, Munro JT, Solomon LB. Vancouver B2 peri-prosthetic fractures in cemented femoral implants can be treated with open reduction and internal fixation alone without revision. J Arthroplasty. 2019;34(7):1430-4.

DENNIS KOSUGE
ORTHOPAEDIC SURGEON

Objectives

ISCP Curriculum

Diagnostic and guided injections

Radiological investigations to assess the hip

Management of periprosthetic fractures around prostheses and implants

Failed arthroplasty and soft tissue surgery

Principles of revision surgery for failed arthroplasty

Case Based Discussions

Cover the above curriculum

DENNIS KOSUGE
ORTHOPAEDIC SURGEON