Periprosthetic Femoral Fractures

SMG

Northern Region
Sunderland Trauma Teaching
Nov 2011

Aims

- Aetiology
- Scale of the problem
- Risk factors
- Approach to management
  - classification
  - treatment
- Outcomes

Aetiology

- Intraoperative
- Postoperative

Intraoperative pp#

- Increasing incidence
  - Primary THR
    - Overall 1%
    - Cemented 0.3 -1.2%
    - Uncemented 3 - 5.4%
  - Revision
    - Cemented 3 - 6.3%
    - Uncemented 7 - 20%

Davidson, JBJS-Am 2008

Intraoperative pp#

- Risk factors
  - Patient
  - Surgeon
  - Implant or technique

Intraoperative pp#

- Risk factors
  - Patient
    - Osteoporosis (age, female sex, steroids...)
    - Metabolic bone disease
    - Abnormal bone (Pagets, osteopetrosis...)
    - Deformity
    - Previous surgery
    - Osteolysis
  - Surgeon
  - Implant or technique

Intraoperative pp#

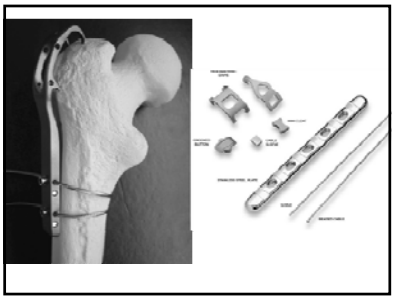
- Risk factors
  - Patient
  - Surgeon
    - Experience
    - Surgical approach
      - Anterolateral > posterior
    - MIS techniques
    - Adequate exposure & ST release, careful dislocation & implant removal reduce risk
  - Implant or technique

Intraoperative pp#

- Risk factors
  - Patient
  - Surgeon
  - Implant or technique
    - Uncemented stems
    - Longer stems (femoral bow)
    - Impaction grafting (4-32%)
    - Prophylactic cables, strut grafts can reduce risk

Intraoperative pp#

- Be aware of risk
- Pre-op planning
- Prophylactic measures
- High index of suspicion, 'change of resistance'
- Explore / on-table imaging
- Revision or fixation
- Implant must be stable at finish

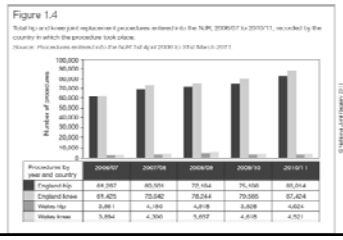


Postoperative pp#

Scale of problem

- Reported rates ~1% (0.1-2%) after primary THR
- Lindahl, J Arthroplasty 2005
  - Increasing incidence
  - Annual incidence 0.07% for first 18yr after THR
  - Accumulated incidence 0.4% after primary THR
    2.1% after revision THR
  - 80% type B fractures

Increasing numbers of THR



Increasing uncemented THR

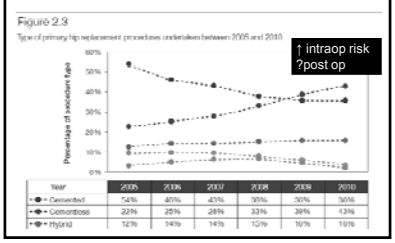
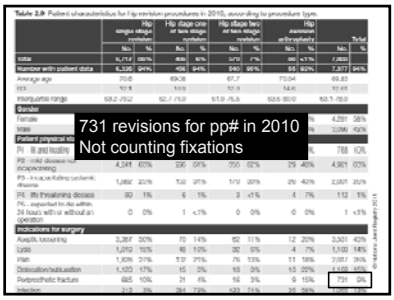


Table 3.4 Summary of NJR data, April 2003 to December 2010.

Year of operation	Primary hip	Revision hip
Number of all NJR records		
2003 (April-Dec)	26,432	2,826
2004	48,032	5,238
2005	57,490	6,342
2006	59,715	6,689
2007	66,616	7,436
2008	69,839	7,933
2009	69,936	7,848
2010	68,907	7,852
All years	466,967	51,764

0.4% of 466,967 = 1868



Postoperative pp#, risk factors

- Patient
- Weakened bone
- Implant/technique

Postoperative pp#, risk factors

- Patient
  - Female
  - Old age
  - Inflammatory arthritis
  - Medications
  - More active, younger
- Weakened bone
- Implant/technique

Postoperative pp#, risk factors

- Patient
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Postoperative pp#, risk factors

- Patient
- Weakened bone
  - Osteoporosis
  - Loosening/osteolysis
  - Stress risers
- Implant/technique

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  - Stress risers
- Implant/technique

Implant loosening

- Bethea- 75% of 31 pp# associated with loose implant CORR 1982
- Beals- 27% of 93 pp# loose CORR 1996

Postoperative pp#, risk factors

- Patient
- Weakened bone
  - Osteoporosis
  - Loosening/osteolysis
  - Stress risers
    - Cortical perforation
    - Screw holes
    - Press-fit stem tip
- Implant/technique

Cortical perforation

- Larson- strength only 44% of intact femur
  J Orthop Res 1991
- Talab- 4 # of 14 perforations in 500 THR CORR 1979

?bone grafting and protected WBing

Postoperative pp#, risk factors

- Patient
- Weakened bone
  - Osteoporosis
  - Loosening/osteolysis
  - Stress risers
    - Cortical perforation
    - Screw holes
    - Press-fit stem tip
- Implant/technique

Postoperative pp#, risk factors

- Patient
- Weakened bone
- Implant/technique
  - ?higher risk cemented
  - Large press-fit stems
  - Impaction grafting

Postoperative pp#, risk factors

- Patient
- Weakened bone
- Implant/technique
  - ?higher risk cemented
  - Large press-fit stems
  - Impaction grafting

Mayo clinic 1997

- 0.6% of 17,579 cemented primary
- 0.4% of 2,078 uncemented primary
- 2.8% of 3,265 cemented revisions
- 1.5% of 1,132 uncemented revisions

?relects age & bone quality in those chosen for cemented

Assessment & management

Assessment

- What do you need to know?

Assessment

- What do you need to know?
- History

Assessment

- What do you need to know?
- History
  - What happened?
  - Details of previous surgery, date, implants etc
  - ?pain & mobility prior to #
  - Anything to suggest infection
  - Co-morbidities

Assessment

- What do you need to know?
- History
- Exam

Assessment

- What do you need to know?
- History
- Exam
  - Soft tissues
  - Scars
  - ?infection
  - Neurovascular status
  - General health

Assessment

- What do you need to know?
- History
- Exam
- Investigations

Assessment

- What do you need to know?
- History
- Exam
- Investigations
  - Bloods, inc ESR,CRP
  - ?aspiration / biopsy
  - General work-up
  - Xrays
  - ?CT
    - esp for acetabulum
    - ?osteolysis / poly wear
    - Component position

Assessment

- What do you need to know?
- X rays:

Assessment

- What do you need to know?
- X rays:
- Fracture location
- Fracture pattern
- Stem stability- is it fixed or loose?
- Quality of remaining bone stock

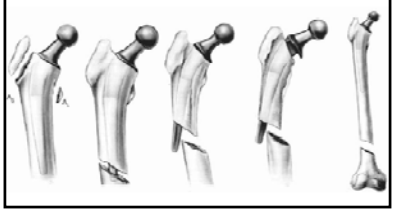
Classification

Vancouver- Duncan & Masri, ICL 1995

- Validated, reliable
  - Brady,J Arthroplasty 2000
  - Rayan, JBJS-Br, 2008
- Allows: assessment of fracture management planning

Classification

Vancouver- Duncan & Masri, ICL 1995



Classification

Vancouver- Duncan & Masri, ICL 1995

Type A 4%

Trochanteric region

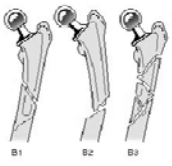
Classification

Vancouver- Duncan & Masri, ICL 1995

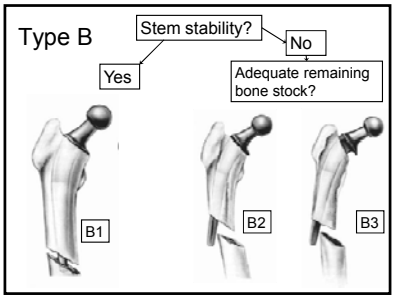
Type B 87%

Around stem or slightly distal to tip

B1-stable 19%
B2-loose 45%
B3-inadequate bone stock 37%



Type B



Classification

Vancouver- Duncan & Masri, ICL 1995

Type C 9%

Well below stem

Treatment

Goals

- Fracture union
- Maintain or obtain functional prosthesis
- Restoration of WBing function

Options

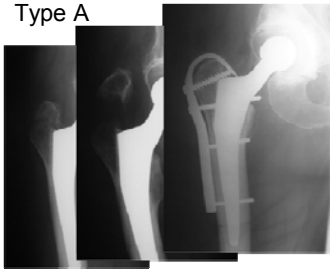
- Prevention
- Protected WBing
- Non operative management
- Revision
- Fixation

Classify & plan treatment

Type A

- If fracture stable- ?non-op unstable- fix
- If implant loose- revise

Type A

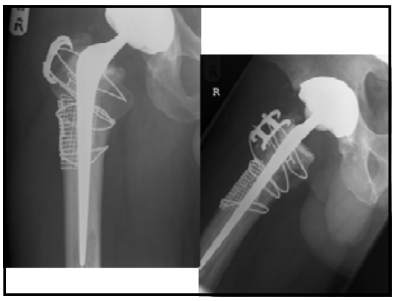


Type A- beware lytic

38M, THR for AVN

Fit and active

6 weeks 4years 6.5 years 7 years



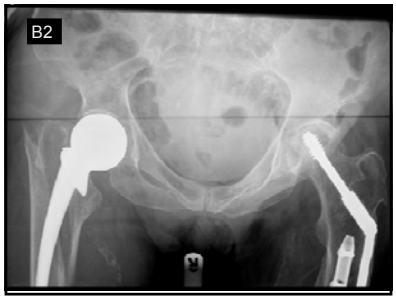
Type B

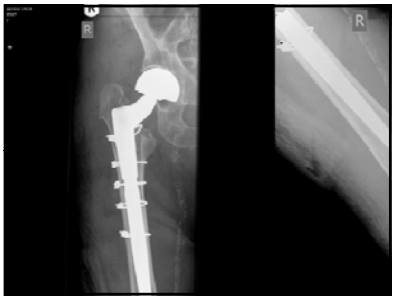
- History, exam, XR to sub classify
- B1 fixation
- B2, B3 revision
- ? easier revision in B2 after ORIF
  - -Kamineni 15 B2 # fixed, all united at mean 3.5 months, 3 revised BHS 2000

Type B1 & Type C- fixation

Type B 2 or 3- revision

- Assess bone stock
  - After implant / cement removal
- Acetabulum
- Implants
- Augmentation





Type B 2 or 3- revision

- Assess bone stock
- Acetabulum:
  - Loose, worn, malpositioned?
- Implants
- Augmentation

Type B 2 or 3- revision

- Assess bone stock
- Acetabulum:
  - Loose, worn, malpositioned?
- Implants
- Augmentation

Type B 2 or 3- revision

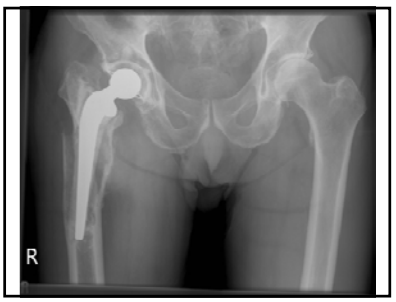
- Assess bone stock
- Acetabulum
- Implants
- Augmentation

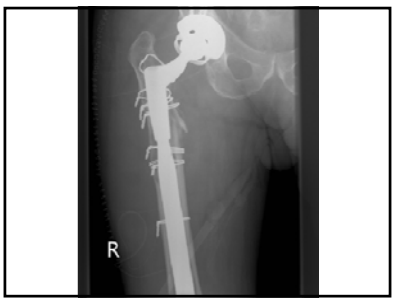
- Must have axial & rotational stability
- By-pass distal extent of # by at least 2 cortical diameters
- Fixation as proximal as possible but as distal as necessary

Type B 2 or 3- revision

- Assess bone stock
- Acetabulum
- Implants
- Augmentation

- Is the isthmus intact?
- Is there a need for distal screw fixation?
- Is the whole femur deficient?





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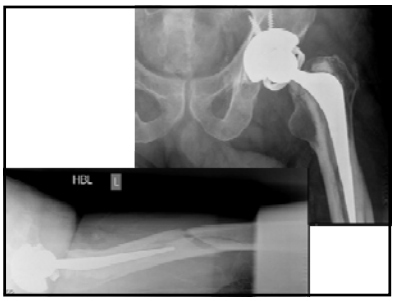


Type B 2 or 3- revision

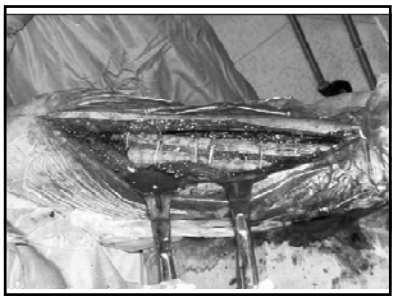
- Assess bone stock
- Acetabulum
- Implants
- Augmentation

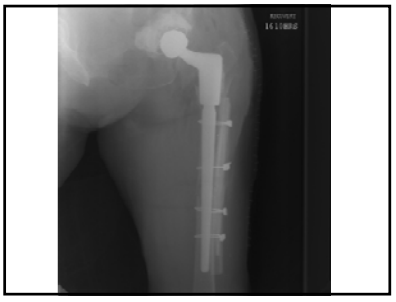
- Is the isthmus intact?
- Is there a need for distal screw fixation?
- Is the whole femur deficient?

Type B 2 or 3- revision

- Assess bone stock
- Acetabulum
- Implants
- Augmentation

- Fracture pattern
  - Long spiral
    - Lower bending moment
    - Heal faster
  - Transverse / short oblique
    - Higher bending moment
    - Heal slower
- Additional support
  - Strut grafts
- Restoration of bone stock
  - Impaction bone grafting





Type B 2 or 3- revision

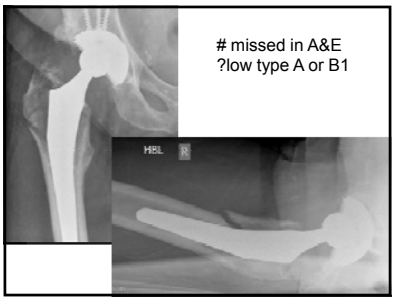
- These are complex cases
- Plan carefully
- Be prepared!

Type B1 & Type C

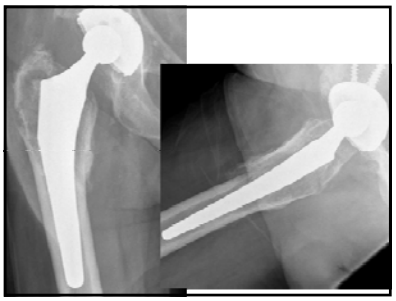
Treatment options

- Non operative
  - Undisplaced, stable #, good bone

Johansson JBJS-A 1981
Cooke JBJS-B 1988



missed in A&E
?low type A or B1



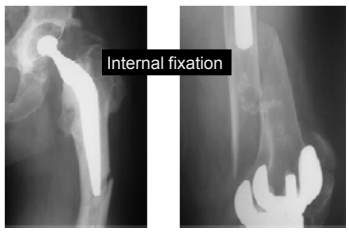
Treatment options

- Non operative
  - Very elderly, unfit
  - If # reduction can be achieved & maintained

Treatment options

- Adolphson- 21 treated in traction, all united. 6 reoperation for malunion
  Arch Orth Tr Surg 1987
- Beals- 93 # in 86 patients
  28% treated non-op
  45% malunion or marked shortening
  11% non-union
  CORR 1996
- Mont & Maar- review 487 patients satisfactory outcome with traction in 57% along stem, 43% at tip, 77% distal to tip
  J Arthroplasty 1994

Type B1 & Type C



not How to fix pp#

not How to fix pp#

- Lag screws alone
- Circlage alone

not How to fix pp#

- Mennen plates

not
How to fix pp#

not
How to fix pp#

- Noorda- 36 pp# treated with Mennen plate
  10 non-union with 20-30° varus
  8 plates broke

JBJS-A 2002

Type C

- # distal to stem tip
- Standard principles of fracture fixation
- May need to overlap distal part of stem to avoid stress riser

Type B1

- More difficult
- Assessment of stem stability
- Accurate reduction
- Control of proximal fragment
- Implants
- Augmentation

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- Assessment of stem stability
- Accurate reduction
- Control of proximal fragment
- Implants
- Augmentation

- High rate of fixation failure in some reports, up to 30-50%
- Probably B2 mis-classified as B1

Type B1

- More difficult
- Assessment of stem stability
- Accurate reduction
- Control of proximal fragment
- Implants
- Augmentation

- Careful preop X ray analysis
  - Intact interface
  - Lucent lines, I-C; B-C; I-C
  - Cement mantle # alone is OK
- Fluoroscopy
- Intraoperative assessment

Type B1

- More difficult
- Assessment of stem stability
- Accurate reduction
- Control of proximal fragment
- Implants
- Augmentation

- Careful preop X ray analysis
- Fluoroscopy
  - Screen, look for movement
- Intraoperative assessment

Type B1

- More difficult
- Assessment of stem stability
- Accurate reduction
- Control of proximal fragment
- Implants
- Augmentation

- Careful preop X ray analysis
- Fluoroscopy
- Intraoperative assessment
  - If stem tip accessible through #
  - Arthrotomy, dislocate & test

Type B1

- More difficult
- Assessment of stem stability
- Accurate reduction
- Control of proximal fragment
- Implants
- Augmentation

- 45 stems classified pre-op as B1
- 20% (9) of stems found to be unstable, reclassified as B2 intra-op

Corten, JBJS-Br 2009

Type B1

- More difficult
- Assessment of stem stability
- Accurate reduction
- Control of proximal fragment
- Implants
- Augmentation

- Increased failure:
  - Medial comminution
  - Varus malreduction

Type B1

- More difficult
- Assessment of stem stability
- Accurate reduction
- Control of proximal fragment
- Implants
- Augmentation

- Stem / cement filling canal
- Proximal fracture extension
- Large bending moment

Type B1

- More difficult
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Fixation of pp fractures
Testing of plate constructs

- Plates with cables alone
- Plate + prox cables, distal bicortical screws
- Plate + prox unicortical screws, distal bicortical
- Plate + prox uni + cables, distal bicortical
- Cortical allografts + cables

Tested in axial compression, bending,torsion

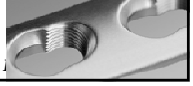
Fixation of pp fractures
Testing of plate constructs

- Plates with unicortical screws & cables proximal + bicortical screws distal best
- Multifilament cables better than monofilament

Schmotzer, J Arthroplasty 1996

Locking Compression Plates

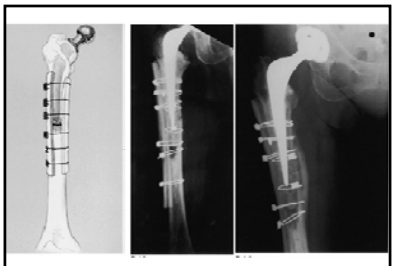
- Well suited to osteoporotic bone
- Angle stable construct
- Blood supply preserved
- Enables MIPO
- Coaxial combination holes



Cortical strut allografts

- Use cables not wire to attach
- 3 cables in each segment
- 2 struts, lateral and anterior
- Avoid medial stripping
- Use struts 1/3 diameter of host bone
- Freeze dried less stable in torsion than fresh frozen

Haddad, JBJS Am 2002

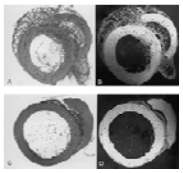


Cortical strut allografts

- Chandler- anatomic union 16 of 19# at 4 mths
  2 non-union, 1 delayed
  Sem Arthroplasty 1993
- Hadad- 19 strut grafts alone, 21 graft + plate
  39 united, returned to preinjury level
  JBJS-A 2002

On-lay cortical allograft struts

- Cook- improved healing with OP1 CORR 2000



On-lay cortical allograft struts

- Expensive- $2500 femoral allograft, limited availability
- Difficult to shape
- ?disease transmission
- Weaken over 4-6mths

Biomechanical testing

- On-lay cortical allograft struts
- Dennis- Ogden plate biomechanically stronger than 2 strut grafts, 1,295N v 950N JOT 2001

Plate fixation

- Ogden- 100% union 10 #. No complications Orth Trans 1978
- Corten- 97% (29 of 30) united at 6.4mths JBJS-Br 2009
- Sen- 83% union, of 12# Acta Orth Belg 2007
- Ricci- 100% union of 41 # JBJS-A 2006

Current Concepts for B1#

- Cable –plate systems designed for pp#
- Single lateral fixation device
- Biplanar fixation

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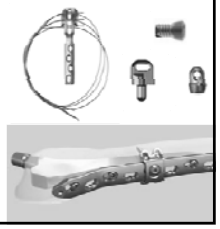
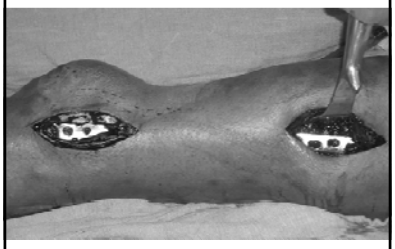


Current Concepts for B1#

- Cable –plate systems designed for pp#
- Single lateral fixation device
- Biplanar fixation
- Less invasive (possible)
- Indicated when:
  - No medial comminution
  - Accurate reduction
- Fix long
  - At least 4 bicortical equivalent either side of #
- Combined screws & cables



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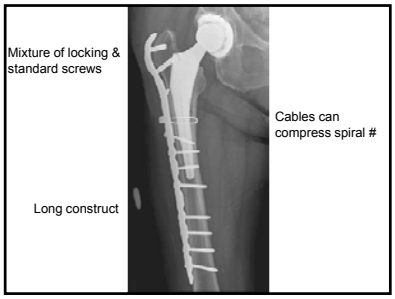
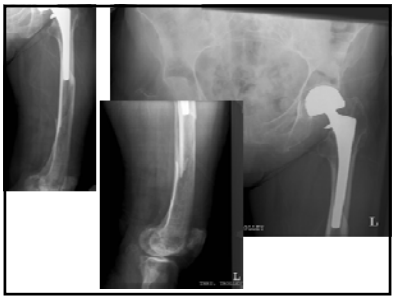
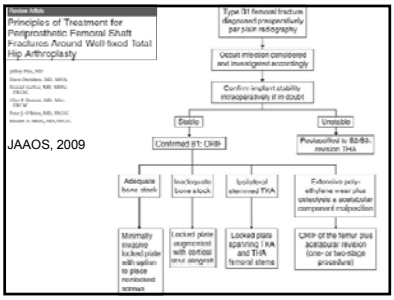


Current Concepts for B1#

- Cable –plate systems designed for pp#
- Single lateral fixation device
- Biplanar fixation
- Wider exposure required
- Indicated for :
  - more unstable # patterns
  - Poor bone quality
- 2 plates or plate + cortical strut graft





JAAOS, 2009

Summary

- Uncommon but serious problem after joint replacement
- Incidence increasing
- Treatment depends on
  - location & pattern of #
  - stability of implant
  - adequacy of bone stock
- Fixation or revision
- Phone a friend!

Summary

BE PREPARED!

Any questions?