Endoprosthetic replacement possibilities in Traumatology. Periprosthetic fractures and complications

I. Udvarhelyi
Reconstructive surgery, posttraumatic disorders:

1. Hip
2. Knee
3. Ankle
4. Shoulder
5. Elbow
6. Wrist

Arthroplasty ?    Arthrodesis ?
Secondary degenerative disease following injury

1. Chondropathy
2. Arthritis
3. Necrosis
4. Instability
5. Malalignment

Post op complications
Primary anatomical reconstruction

Arthroplasty: resection
interposition
implantation

Lower Extremity
Upper Extremity

Arthrodesis: distal
Function, weight bearing
General indication

1. Age
2. General state, diseases
3. Rehabilitation
4. Other pathology of the joint
5. Bone stock quality
6. Expectation, function
Indication

Intraarticular injury

- Tibia impression following condylar fractures
- Femur condylar fx
- Tibia, femur condylar attachment
- Patellofemoral fx
- Instability secondary arthritis
- Menisectomy followed by chondropathy, arthritis

Fractures of the femoral neck
Fractures of the acetabulum
Revision Total Hip
Indication

1. Cup, stem malposition
2. Impingement
3. Poliethylen wear
4. Osteolysis
5. Dislocation, instability
6. Progressive protrusion
7. Aseptic – septic loosening
8. Periprosthetic femoral fracture
9. Periprosthetic acetabular fracture
1. Radiology
2. Contracture (flexion, adduction)
3. Leg length, offset
4. Previous incisions, approach
5. Implant choice
6. Classification
7. Bone grafting autologous, homologous, TM Augmentation
Aim of revision

1. Preserve existing bone
2. Reconstruct anatomy
3. Reconstruct hosting bone
4. Provide component stability
5. Appropriate alignment for cup and stem

1. Stability
2. Restore painfree function
Indication:

2002 November-2008 December

• Uncemented press fit stem
  + graft ZMR (Zimmer)
• Uncemented interlocked stem
  + graft
• Uncemented Müller stem
• Cemented stem
  (+ impaction grafting)
• **Anatomic stem NO !!!**

- Uncemented cup
  press fit-reconstruction
- Cemented cup
  + cage, reinforcement ring, grafting
Paprosky classification

Type I: intact ring, contained lesion, uncemented cup, cemented cup with morsellised graft

Type IIa: intact – destruction of ring, ilium, bottom
Type IIb: ilium, cup 1/3 defect, structural graft
Type IIc: ilium+acetabular bottom, grafting

Type IIIa: more, than 3 cm ilium defect, ring destruction, <50%
Type IIIb: ring defect>40%, posterior column reconstruction
Paprosky Femoral Deficiency Classification

Della Valle CJ, Paprosky WG.
Classification and an algorithmic approach to the reconstruction of femoral deficiency in revision total hip arthroplasty.

*JBJS* 2003; 85-A Suppl. 4: 1-6.

1. **Type I**: Minimal loss of metaphyseal cancellous bone. Intact diaphysis. Consider cemented vs. cementless fixation.
2. **Type II**: Extensive loss of metaphyseal cancellous bone. Intact diaphysis. Loss of cancellous bone makes cemented fixation more suspect, consider uncemented fixation (e.g. fully porous coated stem).
3. **Type III-A**: The metaphysis is not supportive. There remains greater than 4 cm of bone in the diaphysis to allow for a scratch fit. Consider uncemented fixation with a fully porous-coated stem vs. a modular tapered stem.
4. **Type III-B**: The metaphysis is not supportive. There remains less than 4 cm of bone in the diaphysis to allow for a scratch fit. Due to short segment of cylindrical bone to support a fully-porous coated stem, the failure rate is high with such a device (50% in one study by the senior author). Consider a modular tapered stem.
5. **Type IV**: Wide open canal without any appreciable isthmus to support an uncemented stem. Consider impaction grafting if the proximal tube is intact +/- an intact calcar. Other alternatives would include an APC or a modular tumor megaprosthesis.
### Classification, indication for surgery

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Johansson</td>
<td>• Loose stem</td>
</tr>
<tr>
<td>3. Dens</td>
<td>• Implant type</td>
</tr>
<tr>
<td>4. Bethea</td>
<td>• High complication rate</td>
</tr>
<tr>
<td>5. Mont &amp; Maar</td>
<td></td>
</tr>
<tr>
<td>6. Tower &amp; Beals</td>
<td></td>
</tr>
</tbody>
</table>

- Fracture localisation
- Stem stability
- Femoral bone quality

- primary implant type
- uncemented press fit
- uncemented fully coated
- cemented Exeter typ.
- cemented Müller typ.
- general health, age
- expectation, rehabilitation
- function, contracture
<table>
<thead>
<tr>
<th>TYPE</th>
<th>LOCATION</th>
<th>SUBTYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Trochanteric Region</td>
<td>A-G: Greater Trochanter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-L: Lesser Trochanter</td>
</tr>
<tr>
<td>B</td>
<td>Around or just distal to the</td>
<td>B1: Prosthesis Stable</td>
</tr>
<tr>
<td></td>
<td>stem</td>
<td>B2: Prosthesis Unstable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B3: Bone stock Inadequate</td>
</tr>
<tr>
<td>C</td>
<td>Well below the stem</td>
<td></td>
</tr>
</tbody>
</table>
• A:  Conservative treatment

• B 1:  Cerclage, DC plate

• B 2-3: Revision implants, early mobilisation

• C:  (prosthesis stable) DC plate
Techniques for component removal

Cup loose

- Stem in place
- Stem extracted

- Preserving bone stock for reconstruction
  - Extraction with bone clamp/Farabeuf

Malpositioned cup fixed

- Stem in place
- Stem extracted

- Explant Acetabular Cup Removal System

Avoid using aggressive measures, chisels, osteotomes!
### Which Stem For Revision?

| Revision uncemented | 1. Wagner type  
|                    | 2. Interlocked  
| Revision uncemented | a. Müller type  
|                    | b. Anatomical?  
| Revision cemented  | 1. Müller?  
|                    | 2. Exeter type 
|                    | 3. Long Stem   |
Approach: Minimalised Watson-Jones
Centralised cement drilling
-marking + pre-drill, dilating drill
Preoperative planning
Mechanical axis - offset
Image intensifier
Extraction knife kit (Explant)
1. Short-long blade
2. Meticulous insertion between cup and cement
3. Circumferential drive of instrument
4. Extraction of cement with chisel
5. Preservation of bone stock
Removal of cup from posterior
With bone clamp/Farabeuf

Defect analyse
Ilial
Ischial
Central
Bone grafting
Release of posterior capsule and scars and rotators of trochanteric fossa

Careful management of defected bone

Prevention of fracture

Following releases return to acetabular preparation

Extensile release of scar tissue mandatory
Step by step technique
Press fit acetabular structural & morsellised grafting
Press fit acetabular structural & morsellised grafting
Press fit acetabular structural & morsellised grafting
Bone grafting
Impaction

Cemented cup;
Moderate destruction
Cortical Destruction; Iliacal Ischial Bottom

Containment; Screw position „pressfit“

Cortical
Bone quality
Drilling, substitution
Implant surface
(rough titanium)

Extensive destruction
Structural+morsellised screw position,
Meldrum-Johansen Containment
Grafting
Structural+morsellised
Cup reconstruction
Mechanical axis
Weight bear
Bone quality
Age
Uncemented
Primary position

Jumbo cup or high hip center
Is bigger better?
Kenneth A. Gustke MD,*

* Florida Orthopaedic Institute,
Temple Terrace, Florida, USA
CDH
Primary position
Secondary contracture
Offset
Pre-fracture Revision with primary implant?

Bone grafting Mechanical axis
Revision – stem length
Primary stability
Weight bearing
Fracture+ prefracture
Re-revision – implant choice
Dall- Miles, Cable - Ready (Zimmer)
Two stage septic revision
Periprosthetic+implant fracture

Drill in component, T-handle, slap hammer
CDH Position
Rotation
Press fit
Primary position!!!
CP: 61 ys, male
Subtroch. fracture
Plate-removal
AVN-OA
Stress fracture
ZMR stem
Results:

Cup reconstruction:

Cemented cup: 11
Augmentation cage+grafting+cemented cup: 27
Uncemented multi-hole cup+grafting: 4

Stem revision:

Wagner type press fit ZMR stem 235 mm: 37
Wagner type press fit ZMR stem 185 mm: 3
Exeter type long revision cemented stem CPT: 2
• Post op: 3+3 wks non-weight bearing
• Post op function: 1-3. day flexion: 45°

HHS
Independent examiner:
Preop.: 47
Postop.: 10days 3m 6m
MI W-J n:9 69 86 91

Pain, VAS, 1-10:
N: 42 revision
Pre. op.: 8,7
Post. op.: 1. days: 4,7
3. days: 2,4

OP time: 127 min
Days in hosp: 5,96

Dislocation: 1
(fracture disloc.) + 1??
Infection: 2
Take home message

- Exclude infection!
- Analyse and plan damage
- Approach
- Careful management of component removal
- Classification and planned management of bone damage
- Augment technique
- Cement removal
- Choose the right implant!
Periprosthetic fractures of TKR:
(0.3-2.5%)

1. Supracondylar femur
2. Tibia
3. Patella
4. Ipsilateral femoral neck
1/
  • Malposition of femoral component
    • Notching
  • Osteoporosis, RA, chronic steroid adm.
    • Trauma
    • Reduced ROM

2/
  • Loosening of tibia
    • Osteoporosis
    • Trauma
    • Poor ROM
    • Stress fracture

3/
  • Patellofemoral incongruency
    • Osteoporosis
    • Trauma
OA Knee, ROM<<, supracondylar femoral fract:    14
OA Knee, ROM<<, tibia fracture:              1
TKR, ROM<60°:                               11
Osteoporosis:                               7
Notching:                                   6 (31.5%)
Patellar fracture:                          1
( over-resection of patella, overstuffing, non resurfacing significantly )
Aetiology

- Femoral component notching 3mm /30%
  - Bony remodelling inadequate (Hypovascularity)
  - Elastic modulus difference
  - Endosteal ischemia
  - Osteolysis
- Minimal trauma, rotational forces
  - Narcotic motion
  - RA, steroid
Classification

1. Mayo
2. Stuart Hansen
3. Felix
4. Goldberg
5. Lewis & Rorabeck
6. Rorabeck & Taylor
Supracondylar femoral fracture + TKR

Dislocation:  - minimal, reduction, conservativ treatment
             - closed rereduction, op
             - significant dislocation:
               closed reduction, op
               op: implant stable, loose

Bone quality:  1. OP  - distal FN
              - revision TKR

  2. Good bone stock:
     - plate fixation, poliaxial, non-contact
     - distal FN
     - cerclage, plate
     - revision TKR

Localisation:  - distal, - diaphyseal
Mayo tibia

- I./ tibial plateau
- II./ around component stem
  - III./ diaphyseal
  - IV./ tibial tub.

- A/ implant stable
- B/ implant loose
- C/ intraoperative
Mayo Femur:
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCS, fixed angle plate, poliaxial non-contact plate</td>
<td>6</td>
</tr>
<tr>
<td>Distal FN</td>
<td>16</td>
</tr>
<tr>
<td>Revision arthroplasty</td>
<td>11</td>
</tr>
<tr>
<td>Conservative</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Implant</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>7</td>
</tr>
<tr>
<td>LPS</td>
<td>2</td>
</tr>
<tr>
<td>LCCK</td>
<td>2</td>
</tr>
</tbody>
</table>

Mean age: 69.2
Preoperative planning

1. Radiology
2. Contracture (flexion, varus)
3. Previous incisions, approach
4. Implant choice
5. Classification
6. Bone grafting, autologous, homologous
7. Augmentation, TM

Alignment - AP long
Rotation – Patella tracking, transepicondylar axis & stability in flexion
Sizing: AP (anterior, lateral)
Augmentation
Function & mechanical axis
Malalignment, rotation
$F_{k_1} > > F_{k_2}$

OA+OP
TKR, ROM $>> + OP$
• Revision implant
• Segmental indication
- Lateral parapatellar
- Medial parapatellar
- Midvastus
- Subvastus
- Trivector
- VMO type I.II.III. & previous
- Modified midvastus
- QS
- QS
• Supracondylar fracture
• Choice of treatment
• Distal femoral IM nail
  • Malalignment
  • Increased valgus
• Flexion contracture
Indication for MMI revision:

- Revision of MIS UKA
- Revision of standard UKA
- Revision of valgus TKA
Patellar dislocation, traction
Contracture: lateral retinaculum
Patellar vascularisation
• 56yr female
• Accident 14ys before, ROM 5-30°
• House wife, medium demand
• Expectation: pain relief, better ROM
OP technique
OP technique
• Revision implants
• Primary case
• Constraint
• 51yr male
• Accident 20ys before
  • ROM 20-40°
  • Farming activity
  • Medium demand
• Expectation: pain relief
  better ROM

Trauma
Pseudoarthrosis
OP technique
• Revision implants
• Primary case
• Constraint

Trauma
Pseudoarthrosis
FU: 2000 Jan - 2006 Jan / 21 patients

81% female / 69,2 ys / 8-71 ms
Appropriate alignment
ROM: @ 3 ms 90°, post op 2D: 45°
Ø Blood loss (cell saver) (625cc)
Tournique Ø 105 (min = 80)
Ø OR: 115 min (min: 80)
Pain score VAS pre op. Ø 8.5, 4.2 p. op.

Knee Society Knee Score:

88.4 TKR / 76.42 OS / 6-36 ms
Function: 81.0 TKR / 71.24 OS / 6-36 ms
Complication
(11 cases)

- Post op hemarthrosis 2
- Transient peroneal n. deficiency 1
- Infection / re-revisio 2 stage 1

➢ Total 36%
• Implant loose - Revision
• Implant malpositioned - Revision
• Implant stable - OS, refer to aetiology
  - Revision
• Type of fracture - plating
  - IM technique – trochlea
• Refer to post op management
• Refer to physical state of patient
Take home message

- **Intraoperative** fractures should be fixed and then protected by a stem and mostly avoidance of weight bearing until healed.
- **Postoperative** fractures can occur with significant trauma, or minor injury when osteolysis is present. Operative management is almost always required. The method of treatment depends upon factors such as the stability of implant fixation, location of the fracture, quality of the bone, and presence or absence of an appropriate femoral component.

Thank You!