

CHAPTERS

# 4. Acetabular Revision

1.  
Benign Bone  
Tumors

2.  
Calcaneus  
Fracture

3.  
White Wound  
Drainage

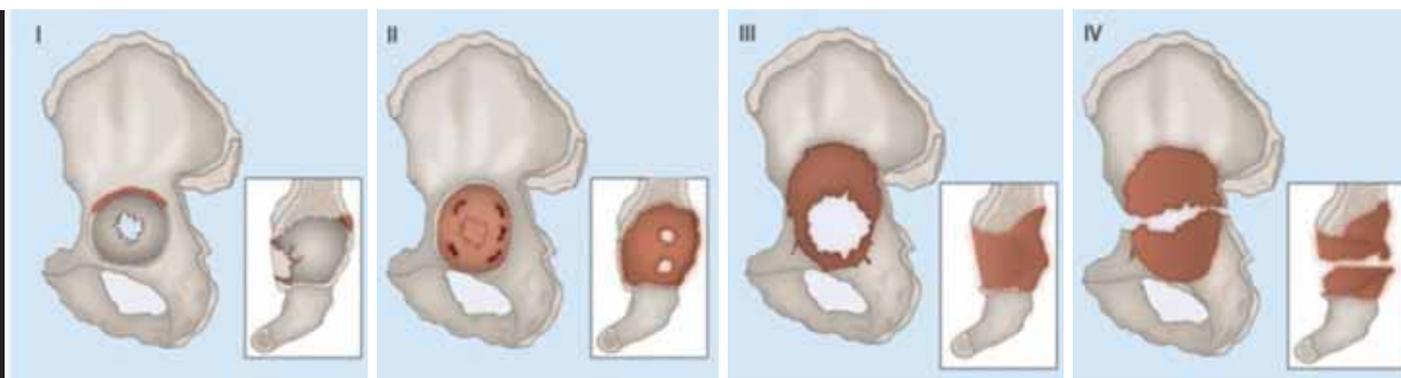
5.  
Tibia Plateau  
Fracture

6.  
High Tibial  
Osteotomy

## Hip Prosthesis Revision Surgery

### Background:

15 - 20% of all prosthetic hip surgeries are revisions [1], with rising numbers of primary hip arthroplasties [2] this figure will increase significantly within the next years [3]. Septic or aseptic loosening of hip prosthesis can lead to massive destruction of bone stock [4], bone loss can be more severe at the acetabulum, where it is often diagnosed late [4]. Moreover, treatment options are limited at the acetabulum, since filling of the bone defect with bone cement (PMMA) plus a cemented cup has demonstrated a high early revision rate up to 40 % [5].



(Taken from: Orthopäde. 2010; 39: 931-94 Mega cups and partial pelvic replacement. von Eisenhart-Rothe R, Gollwitzer H, Toepfer A, Pilge H, Holzapfel BM, Rechl H, Gradinger R.)

### Acetabular Bone Loss:

#### Classifications:

#### AAOS-classification [6]

- ➔ **Type I (segmental)**  
Loss of part of the acetabular rim or medial wall
- ➔ **Type II (cavitary)**  
Volumetric loss in the bony substance of the acetabular cavity
- ➔ **Type III (combined deficiency)**  
Combination of segmental bone loss and cavitary deficiency
- ➔ **Type IV (pelvic discontinuity)**  
Complete separation between the superior and inferior acetabulum
- ➔ **Type V (arthrodesis)**  
Arthrodesis with cancellous bone.

## Hip Prosthesis Revision Surgery

### Paprosky-classification [7]



➔ **Type I**  
Minimal deformity, intact rim



➔ **Type IIA**  
Superior bone lysis with intact superior rim



➔ **Type IIB**  
Absent superior rim, superolateral migration



➔ **Type IIC**  
Localized destruction of medial wall



➔ **Type IIIA**  
Bone loss from 10am-2pm around rim, superolateral cup migration

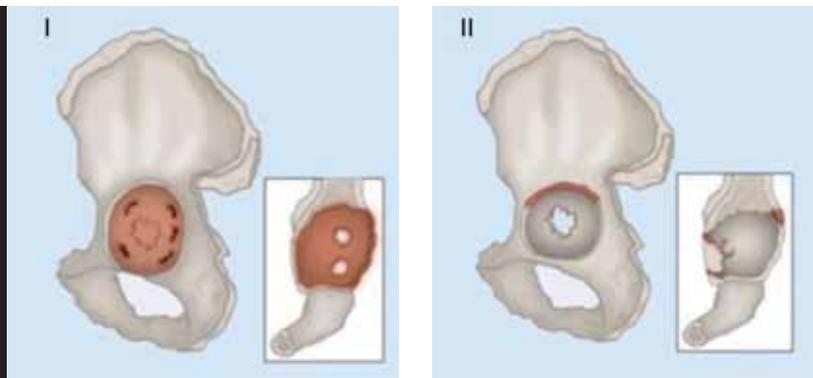


➔ **Type IIIB**  
Bone loss from 9am-5pm around rim, superomedial cup migration

Available at [www.http://synapse.koreamed.org/ViewImage.php?Type=F&aid=410748&id=F2&afn=1147\\_HP\\_25\\_2\\_85&fn=\\_1147HP](http://www.synapse.koreamed.org/ViewImage.php?Type=F&aid=410748&id=F2&afn=1147_HP_25_2_85&fn=_1147HP)

# Hip Prosthesis Revision Surgery

## Morscher-Classification [8]



- ➔ **Type I:** contained or cavitary defects, acetabular rim is intact
- ➔ **Type II:** uncontained or segmental defects, acetabular rim is damaged

(Taken from: Orthopäde. 2010; 39: 931-94 Mega cups and partial pelvic replacement. von Eisenhart-Rothe R, Gollwitzer H, Toepfer A, Pilge H, Holzapfel BM, Rechl H, Gradinger R.)

### Diagnostics:

- ➔ Clinical examination
- ➔ X-rays
- ➔ CT-scan
- ➔ Laboratory results (WBC, CRP)
- ➔ Aspiration of joint fluid if septic loosening is suspected (gram stain, WBC, culture)

### Therapy:

#### Conservative treatment:

The first line approach as an alternative to hip replacement is conservative management which involves a multimodal approach of medication, activity modification and physical therapy [26].

Re-fixation of migrated implants cannot be achieved by conservative treatment.

Revision hip surgery is a major procedure with multiple risks (blood loss, infection, fractures, damage to nerves and vessels) [9].

The benefit for the patient has to outweigh the risks of the procedure, especially in patients with severe comorbidity [10].

#### Operative treatment:

Acetabular revision with reconstruction of bone loss

#### Aims of acetabular revision [8]

- ➔ Reconstruction of acetabular bone loss
- ➔ Reestablishment of the rotation centre at original acetabular position
- ➔ Readjustment of leg length
- ➔ Stable fixation of new cup

## Hip Prosthesis Revision Surgery

### Morscher-Classification [8]

#### Steps of the surgical treatment

**Removal of loosened cup:** The primary incision and approach should be used. Membranes and fibrotic soft tissues are excised and the cup is removed.

Sometimes the cup is better integrated than radiographically suspected. In those cases a curved osteotome or a pneumatic impact wrench [11] can be used. If the cap was fixed additionally with screws, screws and other devices will have to be removed as well.

Next the acetabulum is debrided with different curettes, bone nibblers or high speed burrs. The sclerotic bone should be removed, but the ventral and dorsal acetabular rim has to remain intact.

#### Intraoperative evaluation of the acetabulum:

- ➔ After debridement the remaining bone stock of the acetabulum has to be evaluated.
- ➔ A cup trial is used to decide if press-fit technique gives enough stability.
- ➔ Following the suggestions from Morscher et. al. [8] and based on their classification, treatment options for two different acetabular situations are described below.

#### Situation I:

- ➔ Morscher Type I acetabular bone loss:
  - Contained or cavitory defects, acetabular rim is intact
  - Intra-operative evaluation with cup trial positive: press- fit can be achieved



### Procedure: Implantation of press-fit cup and reconstruction of bone loss with morsellised allograft

- ➔ Debrided bone cysts and bone voids can be filled with morsellised allograft or bone graft substitute, a press-fit cup is implanted and intrinsic stability achieved [12].

## Hip Prosthesis Revision Surgery

### Morscher-Classification [8]

#### Situation II:

- Morscher Type II acetabular bone loss:
  - Uncontained or segmental defects, acetabular rim is destroyed
  - Intra-operative evaluation with test-cup negative: press-fit cannot be achieved



**Procedure:** Implantation of a reinforcement ring (Müller or Ganz) or an anti-protrusio cage (Burch-Schneider) plus cemented cup and reconstruction of bone loss with morsellised allograft

- If segmental defects of the acetabular rim, large bone voids or a non-spherical form of the acetabulum do not allow the implantation of a press-fit cup, reinforcement acetabular rings, for example established by Müller [13, 14] and Ganz [15] or anti-protrusio cages by Burch-Schneider [16, 17] are indicated.
- The bone loss of the acetabulum is reconstructed with morsellised allograft and impacted with a cup trial. The reinforcement rings or anti-protrusio cages are fixed with cancellous screws.
- The devices give mechanical support to the cup [16]. If the ring or cage is placed correctly, the rotation centre of the hip is reconstructed at its original anatomical position.
- A polyethylene cup is fixed with bone cement (PMMA) onto the reinforcement ring or the anti-protrusio cage. PMMA-leakage behind the device increases the stability of the cage-cup combination.

#### Reconstruction in acetabular bone loss

There is still a lack of evidence to determine the best method for reconstructing acetabular bone loss [18-25]. Different treatment options exist, some are listed below:

- autologous bone graft [18,19]
- impacted morsellised cancellous bone allografts (impact grafting) [4, 20]
- bulk allograft bone [21]
- freeze-dried, irradiated and chemically-treated allograft vitalised with autologous marrow bone substitutes [22]
- demineralized bone matrix [23]
- bone substitutes [24, 25]

When following Morscher's ideas and principles to reconstruct acetabular bone loss [8], it is possible to use CERAMENT™|BONE VOID FILLER in conjunction with or instead of morsellised allograft.

## Literature

1. Sporer SM, Paprosky WG, O'Rourke MR. Managing bone loss in acetabular revision. *Instr Course Lect.* 2006; 55: 287–297.
2. Aqua- Institut für angewandte Qualitätsförderung und Forschung im Gesundheitswesen GmbH. Bundesauswertung zum Erfassungsjahr 2013 – 17/2 Hüft-Endoprothesen Erstimplantation, [https://www.sqg.de/downloads/Bundesauswertungen/2013/bu\\_Gesamt\\_17N2-HUEFT-TEP\\_2013.pdf](https://www.sqg.de/downloads/Bundesauswertungen/2013/bu_Gesamt_17N2-HUEFT-TEP_2013.pdf)
3. Jämsen E1, Furnes O, Engesaeter LB, Konttinen YT, Odgaard A, Stefánsdóttir A, Lidgren L. Prevention of deep infection in joint replacement surgery. *Acta Orthop.* 2010; 81: 660-666
4. Slooff TJ, Schreurs BW, Gardeniers JW, Buma P. Rekonstruktion des Acetabulums mit impaktierten Knochentransplantaten und Zement. In Duparc J.: *Chirurgische Techniken in Orthopädie und Traumatologie*, 2005, Elsevier, München, 301-307
5. Engelbrecht DJ, Weber FA, Sweet MB, Jakim I. Long-term results of revision total hip arthroplasty. *J Bone Joint Surg Br.* 1990; 72: 41-45
6. D'Antonio JA, Capello WN, Borden LS, Bargar WL, Bierbaum BF, Boettcher WG, Steinberg ME, Stulberg SD, Wedge JH. Classification and management of acetabular abnormalities in total hip arthroplasty. *Clin Orthop Relat Res.* 1989; 243: 126-137
7. Paprosky WG, Perona PG, Lawrence JM. Acetabular defect classification and surgical reconstruction in revision arthroplasty. A 6-year follow-up evaluation. *J Arthroplasty.* 1994; 9: 33-44
8. Morscher EW, Elke R, Berli B. Klassifikation und Behandlung von Acetabulumdefekten. In Duparc J.: *Chirurgische Techniken in Orthopädie und Traumatologie*, 2005, Elsevier, München, 293-299
9. Bischel O, Seeger JB, Krüger M, Bitsch RG. Multiple Acetabular Revisions in THA - Poor Outcome Despite Maximum Effort. *Open Orthop J.* 2012; 6: 488-494.
10. Elke R et al. Revisionsendoprothetik. In: Tschauner [Hrsg]. *Orthopädie und orthopädische Chirurgie.* 2004. Thieme, Stuttgart, New York, S.383 – 384
11. Anspach WE 3rd, Lachiewicz PF. A new technique for removal of the total hip arthroplasty acetabular component. *Clin Orthop Relat Res.* 1991; 268: 152-156.
12. Morscher E, Berli B, Jockers W, Schenk R. Rationale of a flexible press fit cup in total hip replacement. 5-year followup in 280 procedures. *Clin Orthop Relat Res.* 1997; 341: 42-50.
13. Rosson J, Schatzker J. The use of reinforcement rings to reconstruct deficient acetabula. *J Bone Joint Surg Br.* 1992; 74: 716-720.
14. Zehntner MK, Ganz R. Midterm results (5.5-10 years) of acetabular allograft reconstruction with the acetabular reinforcement ring during total hip revision. *J Arthroplasty.* 1994; 9:469-479
15. Uchiyama K, Takahira N, Fukushima K, Yamamoto T, Moriya M, Itoman M. Radiological evaluation of allograft reconstruction in acetabulum with Ganz reinforcement ring in revision total hip replacement. *J Orthop Sci.* 2010; 15: 764-771
16. Gill TJ, Sledge JB, Müller ME. The Burch-Schneider anti-protrusio cage in revision total hip arthroplasty: indications, principles and long-term results. *J Bone Joint Surg Br.* 1998; 80: 946-953.
17. Perka C, Ludwig R. Reconstruction of segmental defects during revision procedures of the acetabulum with the Burch-Schneider anti-protrusio cage. *J Arthroplasty.* 2001; 16: 568-574
18. Figueras Coll G, Salazar Fernandez de Erenchu J, Roca Burniol J. Results of acetabular wiremesh and autograft in protrusio acetabuli. *Hip Int.* 2008; 18: 23-28
19. Welten ML, Schreurs BW, Buma P, Verdonshot N, Slooff TJ. Acetabular reconstruction with impacted morsellised cancellous bone autograft and cemented primary total hip arthroplasty: a 10- to 17-year follow-up study. *J Arthroplasty.* 2000; 15: 819-824
20. Schreurs BW, Slooff TJ, Buma P, Gardeniers JW, Huiskes R. Acetabular reconstruction with impacted morsellised cancellous bone graft and cement. A 10- to 15-year follow-up of 60 revision arthroplasties. *J Bone Joint Surg Br.* 1998; 80: 391-395
21. Kerboull M, Hamadouche M, Kerboull L. The Kerboull acetabular reinforcement device in major acetabular reconstructions. *Clin Orthop Relat Res.* 2000; 378: 155-68.
22. Ochs BG, Schmid U, Rieth J, Ateschrang A, Weise K, Ochs U. Acetabular bone reconstruction in revision arthroplasty: a comparison of freeze-dried, irradiated and chemically-treated allograft vitalised with autologous marrow versus frozen non-irradiated allograft. *J Bone Joint Surg Br.* 2008; 90: 1164-1171
23. Patil N, Hwang K, Goodman SB. Cancellous impaction bone grafting of acetabular defects in complex primary and revision total hip arthroplasty. *Orthopedics.* 2012; 35: e306-312
24. Schwartz C, Vautrin M. Phosphocalcium ceramics are efficient in the management of severe acetabular loss in revision hip arthroplasties. A 22 cases long-term follow-up study. *Eur J Orthop Surg Traumatol.* 2014 May
25. Whitehouse MR, Dacombe PJ, Webb JC, Blom AW. Impaction grafting of the acetabulum with ceramic bone graft substitute: high survivorship in 43 patients with a mean follow-up period of 4 years. *Acta Orthop.* 2013; 84: 371-376
26. [http://en.wikipedia.org/wiki/Hip\\_replacement](http://en.wikipedia.org/wiki/Hip_replacement)

## Acetabular revision

Implantation of an anti-protrusion cage (Bruch-Schneider) plus cemented cup and reconstruction of acetabular bone loss with an uncontained or segmental defect (acetabular rim is not intact)

### Surgical positioning and preoperative procedures:

- ➔ Mark the site of surgery while informed consent of patient is obtained
- ➔ The use of a radiolucent table is recommended
- ➔ Prepare mobile C-arm
- ➔ Antibiotic prophylaxis 30 min before incision [1]
- ➔ Usually the primary incision is used for the revision.
- ➔ Place the patient in a lateral or supine position according to the planned approach [2]
- ➔ Skin preparation and draping as usual
- ➔ Team time-out



Figure 1. Müller reinforcement ring



Figure 2. Ganz reinforcement ring



Figure 3. Anti-protrusion cage

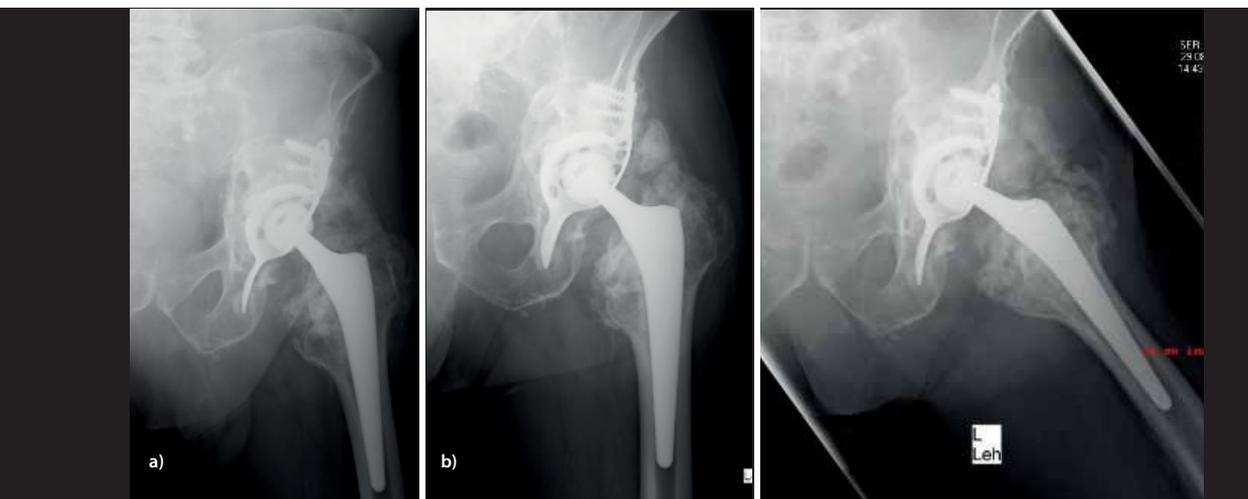
### Surgery:

- ➔ The primary incision and approach should be used for the revision [2]
- ➔ Fibrotic or necrotic soft tissue and the (neo-) capsule are excised [2]
- ➔ The loosened cup is removed. If the cup is more stable than suspected, curved osteotomes may be used [3]
- ➔ The acetabulum is debrided with different curettes, bone nibblers or high speed burrs
- ➔ Remove all screws, implants, PE-wear, bone cement (PMMA) and debris [2]
- ➔ Take samples for bacterial cultures and histological examination [4]
- ➔ After debridement the remaining bone stock of the acetabulum has to be evaluated. A cup trial is used to decide, if press-fit can be achieved [2]
- ➔ If press-fit fixation is not possible, the next step is to implant an acetabular reinforcement ring (Müller [5] or Ganz) or an anti-protrusion cage (Bruch-Schneider [6])
- ➔ The reinforcement ring or anti-protrusion cage is fixed with cancellous screws [2]
- ➔ Debrided bone cysts and bone voids behind the device are filled with CERAMENT™|BVF
  - ➔ Mix CERAMENT™ as per the Instructions For Use. Wait for three minutes when the material will be more viscous
  - ➔ Inject CERAMENT™ into the voids and gaps behind the device under fluoroscopic control
  - ➔ Place an abdominal cloth on the reinforcement ring or anti-protrusion cage with gentle pressure
  - ➔ Wait for 15 minutes until CERAMENT™ has hardened
  - ➔ A polyethylene cup is fixed with bone cement (PMMA) onto the reinforcement ring or the anti-protrusion cage
  - ➔ Continue the hip joint revision as usual
  - ➔ Take care for accurate hemostasis
  - ➔ Follow normal surgical practice and if applicable use a drain with contact to the neck of the femoral component
    - Use two drains (one deep and one superficial) or more
  - ➔ Perform a multi-layered closure (fascia, subcutaneous and skin)

## Acetabular revision

## Follow Up:

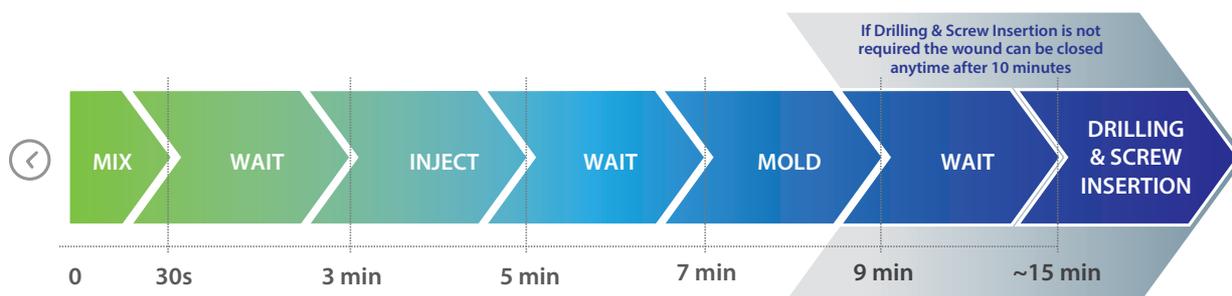
- ➔ Clinical and radiographic controls



**Radiographic controls** :a) one and b & c) two years after surgery, with good bone regeneration and patient clinically stable post surgery. Images reproduced by kind permission of Dr J Svacina, Bodden-Kliniken Ribnitz-Damgarten, Germany



- ➔ Ensure good contact with cancellous bone
  - Perform a meticulous debridement of the acetabulum and bone voids
- ➔ Wait three minutes after mixing before you start to inject CERAMENT™|BONE VOID FILLER ('Spaghetti-test')
- ➔ Minimize contact with blood:
  - Extensive bleeding might result in intermixing of blood with the CERAMENT™ paste
  - Place an abdominal cloth on the reinforcement ring or anti-protrusion cage with gentle pressure
- ➔ Follow normal surgical practice and if applicable use a drain with contact to the neck of the femoral component
  - The drain may draw white coloured fluid some hours after surgery, which does not endanger or jeopardise the success of surgery
- ➔ Close soft tissue and skin two layers: Place all deep sutures first and then tighten them all together



#### Literature

1. Bratzler DW, Houck PM. Clin Infect Dis. 2004; 38: 1706-1715
2. Morscher EW, Elke R, Berli B.. In Duparc J.: Chirurgische Techniken in Orthopädie und Traumatologie, 2005, Elsevier, München, 293-299
3. Anspach WE 3rd, Lachiewicz PF. Clin Orthop Relat Res. 1991; 268: 152-156.
4. Atkins BL, Athanasou N, Deeks Jj et al. J Clin Microbiol 1998; 36: 2932–2939
5. Rosson J, Schatzker J. J Bone Joint Surg Br. 1992; 74: 716-720.
6. Gill TJ, Sledge JB, Müller ME. J Bone Joint Surg Br. 1998; 80: 946-953.

## Implantation of a press-fit cup and reconstruction of bone loss in a contained acetabular defect (acetabular rim is intact)

### Surgical positioning and preoperative procedures:

- ➔ Mark the site of surgery while informed consent of patient is obtained
- ➔ The use of a radiolucent table is recommended
- ➔ Prepare mobile C-arm
- ➔ Antibiotic prophylaxis 30 min before incision [1]
- ➔ The primary incision is normally used for the revision
- ➔ Place the patient in a lateral or supine position according to the planned approach [2]
- ➔ Skin preparation and draping as usual
- ➔ Team time-out



Figure 1.

Figure 2.

Figure 3.

Figure 4.

Images reproduced by kind permission of Dr R Iundusi, Policlinico Tor Vergata, Rome Italy

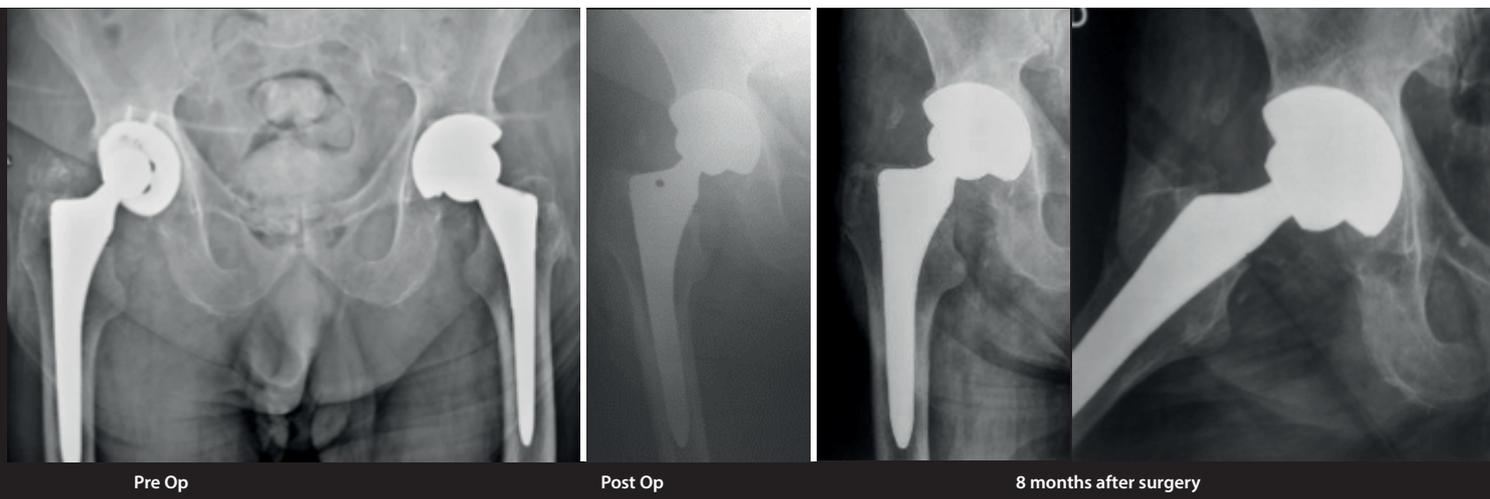
### Surgery:

- ➔ The primary incision and approach should be used for the revision [2]
- ➔ Fibrotic or necrotic soft tissue and the (neo-) capsule are excised [2]
- ➔ The loosened cup is removed. (Fig. 1) If the cup is more stable than suspected, curved osteotomes can be used [3]
- ➔ The acetabulum is debrided with different curettes, bone nibblers or high speed burrs
- ➔ Remove all screws, implants, PE-wear, bone cement (PMMA) and debris [2] (Fig.2)
- ➔ Take samples for bacterial cultures and histological examination [4]
- ➔ Sclerotic bone is removed, the ventral and dorsal acetabular rim should remain intact. (Fig. 3)
- ➔ After debridement the remaining bone stock of the acetabulum is evaluated.
- ➔ A cup trial is used to decide, if press-fit fixation can be achieved [2]
- ➔ If press-fit fixation is possible fill debrided bone cysts and bone voids with CERAMENT™|BONE VOID FILLER (Fig. 4)
- ➔ Mix CERAMENT™ as per the Instructions For Use
- ➔ Wait for three minutes when the material will be more viscous
- ➔ Inject CERAMENT™ in the voids of the acetabulum
- ➔ Place an abdominal cloth around the hardening CERAMENT™
- ➔ In this indication you don't have to wait for the CERAMENT™ to set
- ➔ Implant a press-fit cup
- ➔ Continue the hip joint revision as usual
- ➔ Take care for accurate hemostasis
- ➔ Use two drains (one deep and one superficial) or more
- ➔ Perform a multi-layered closure (fascia, subcutaneous and skin)

## Acetabular revision

## Follow Up:

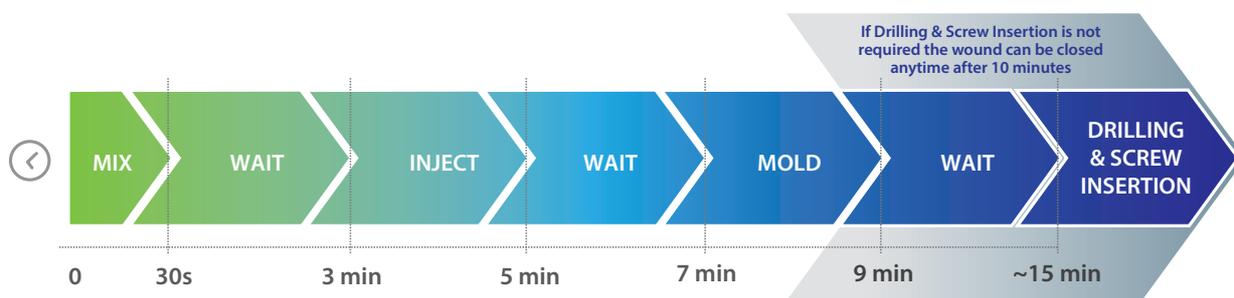
- ➔ Clinical and radiographic controls



Images reproduced by kind permission of Dr R Iundusi, Policlinico Tor Vergata, Rome Italy



- ➔ Ensure good contact with cancellous bone
  - Perform a meticulous debridement of the acetabulum and bone voids
- ➔ Wait three minutes after mixing before you start to inject CERAMENT™|BONE VOID FILLER ('Spaghetti-test')
- ➔ Minimize contact with blood:
  - Extensive bleeding might result in intermixing of blood with the CERAMENT™ paste
  - Place an abdominal cloth around the hardening CERAMENT™
- ➔ Minimize manipulation or touching of CERAMENT™ during setting
- ➔ Follow normal surgical practice and if applicable use a drain contact to the neck of the femoral component
  - The drain may draw white coloured fluid some hours after surgery, which does not endanger or jeopardize the success of surgery
- ➔ Close soft tissue and skin in layers
- ➔ Place all deep sutures first and then tight them all together



#### Literature

1. Bratzler DW, Houck PM. Clin Infect Dis. 2004; 38: 1706-1715.
2. Morscher EW, Elke R, Berli B.. In Duparc J.: Chirurgische Techniken in Orthopädie und Traumatologie, 2005, Elsevier, München, 293-299.
3. Anspach WE 3rd, Lachiewicz PF. Clin Orthop Relat Res. 1991; 268: 152-156.
4. Atkins BL, Athanasou N, Deeks Jj et al. J Clin Microbiol 1998; 36: 2932–2939.