4. Acetabular Revision
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].

**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

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Morscher-Classification [8]

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


**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 additional 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 cavitary 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].
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.
Acetabular revision
Implantation of an anti-protrusio 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 planed approach [2]
- Skin preparation and draping as usual
- Team time-out

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-protrusio cage (Bruch-Schneider [6])
- The reinforcement ring or anti-protrusio 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-protrusio 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-protrusio 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.
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- 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 antiprotrusio 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

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

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

- 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

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Literature