Management of the Bone-Deficient Hip

MANAGEMENT OF ACETABULAR DEFICIENCY

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The management of acetabular deficiencies presents three major problems: the replacement of the lost bone stock, the restoration of the center of rotation in the original acetabulum, and stable fixation of the acetabular cup. Acetabular defects are best restored with bone grafts in the form of morselized or corticocancellous strut grafts. The easiest way to collect morselized grafts is from femoral heads of primary arthroplasties. The grafts are sterilized in an autoclave and stored in a deep freezer. Our rationale for using morselized, cancellous, homologous grafts and a cementless, hemispheric cup from 1980 to 1984 was both to replace the lost bone stock and to create an inert interface, thus avoiding later aseptic loosening through bone resorption. A follow up of 121 acetabular revisions with an observation time of 8.6 years (6.7 to 11.2) showed good results when cystic defects were grafted. However, when large cavities and/or segmental defects were filled with bone grafts which were exposed to weight bearing, slow but steady cup migration and progressive graft resorption was observed over time. The thicker the layer of morselized bone grafts, the greater the resorption and the rate of migration. In other words, there was a continuous resorption of the grafts under load, with subsequent loosening in a high percentage of cases. The survivorship analysis indicated a revision rate of 40% after a period of 10 years. Although these findings correlate with the results obtained with other methods and reported data in the literature, they can by no means be rated as satisfactory. From this experience, we concluded that morselized bone grafts that are loaded do not guarantee a permanent inert interface, and continuous resorption of the grafts takes place over time. Therefore, morselized, homologous bone grafts should be used for filling of contained cysts only and should not be exposed to weight bearing.

The operative method selected for revision depends on the type of deficiency. Several classifications have been proposed. However, we differentiate between two forms of deficiency and, thus, two procedures. Since the load transmission occurs primarily in the cortical structures of the pelvic host bone, these are also the main supportive structures for the cup. Cortical (ie, supportive) structures are the acetabular rim, the subchondral bone, or the sclerotic bone surrounding the loose cup. Therefore, we distinguish between cavity and rim-supportive (Type 1) defects and segmental and non-rim-supportive (Type 2) defects.

In cavity defects, the cortical acetabular rim is preserved and, thus, supportive. In segmental deficiencies, the acetabular rim and the peripheral zones (1 and 3, according to DeLee and Charnley) are non-supportive. Consequently, their mechanical function as force-transmitting structures must, therefore, be replaced.

In Type 1 acetabular deficiencies (rim-supportive cavity or cystic defect), a close peripheral contact of the cup with a well-vascularized autochthonous pelvic bone can be obtained. With a cementless, hemispherical press-fit cup, a revision can be performed which provides socket stability comparable to the situation in primary arthroplasty.

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Fig 1: A 68-year-old woman with septic loosening of right hip arthroplasty (A). “Girdlestone” after removal of the infected hip endoprosthesis (B). Radiograph after implantation of a non-cemented “Press-Fit Cup” into the contained, rim-supportive (Type 1) acetabulum and implantation of a non-cemented stem (C). Complete radiological integration of the Press-Fit Cup 6.5 years after revision (D).

Segmental, non-rim-supportive, and massive cavity defects can be reconstructed by morselized bone grafts, as well. However, long-lasting firm bone fixation of the socket results if the graft is protected from weight bearing by an acetabular reinforcement ring, according to Müller, Schneider, or Ganz. Dead bone must never be exposed to weight bearing.

Planning an acetabular revision may be difficult, in some cases even impossible, since plain radiographs do not allow distinguishing exactly whether or not the acetabular defect is contained and rim-supportive.

**Operative Technique**

From a straight lateral approach, the newly formed fibrous tissue around the joint is excised and the loose socket is removed. The acetabulum is cleaned of cement remnants and fibrous tissue and then is reamed with spherical reamers to a larger size. The sclerotic zone is reamed until bleeding spots are seen. Cysts are curetted. With a perforated trial cup (“Swiss cheese trial cup”) of the same size as the last reamer, the rim is checked to see whether it is intact, supportive, and ready for implant-bone contact at the periphery of the acetabulum. Cysts and cavities are filled with morselized allografts, and a “Press-Fit Cup” with an oversize of 1.5 mm and flattened pole area is inserted and impacted. Primary stability of the cup is guaranteed, and bony ingrowth into the SULMESH-coating (a fiber mesh of orderly orientated fibers made of chemically pure titanium with a pore size of 100 μm to 500 μm and a porous volume of 65%) occurs as in primary arthroplasties (Fig 1).

In non-contained and non-rim-supportive acetabular deficiencies in which segmental defects, large cavities, and a non-spherical form of the
Fig 2: A 74-year-old woman with loosening of a cemented all-polyethylene cup (A). Postoperative radiograph. The cavity, cystic, and segmental defects are restored by morselized, homologous bone grafts and protected from weight bearing by an acetabular reinforcement ring according to Ganz. The hook is placed around the "tear drop"; hence, optimal location of the center of rotation is obtained (B). Radiograph 4.5 years after revision (C).

S.K. ♀ 74y
26.9.90

Fig 2A.

S.K. ♀ post rev.
1.10.90

Fig 2B.

S.K. ♀
A: 4.5 p.rev.
7.2.95

Fig 2C.

Acetabulum do not allow a firm fixation of a new cup by press-fit, acetabular reinforcement rings according to Müller, Schneider, or Ganz are used. The acetabulum is reconstructed with morselized allografts which are impacted with a spherical (non-perforated) trial cup. These grafts must then be protected from loading with a reinforcement ring which is fixed to the original host bone of the pelvis by 3 to 5 AO cancellous screws. The hook of the Ganz ring (Protek Co) is secured around the tear drop (Fig 2). The hook not only improves the stability of the ring but also brings the center of rotation to its original location. An all-polyethylene cup of corresponding size is then cemented into the support ring.

From 1988 to 1993, 353 acetabular revisions have been performed at our institution, 144 with the author’s “Press-Fit Cup.” Two hundred nine acetabular deficiencies with segmental non-rim-supportive defects have been provided with a Ganz support ring with hook. Until now, only one re-revision had to be performed.
CONCLUSION

There were two lessons to be learned from this experience:

- create a situation similar to that of a primary arthroplasty, (ie, use a press-fit cup for cavity-contained, rim-supportive defects) with close contact between the porous surface and the autochthonous host bone in the periphery (Figs 1A-D); or
- restore the bony defects by morselized allografts and missing cortical supportive structures by means of an acetabular reinforcement ring (Figs 2A-C).

Whichever the case, morselized, homologous grafts are used as “fillers” only and not as “load transmitters.”

REFERENCES