Acetabular Defect Classification and Surgical Reconstruction in Revision Arthroplasty

A 6-Year Follow-up Evaluation

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Abstract: From 1982 to 1988, 147 cemented acetabular components were revised with cementless hemispherical press-fit components, with an average follow-up period of 5.7 years (range, 3–9 years). Acetabular defects were typed from 1 to 3 and reconstructed with a bulk or support allograft. Type 1 defects had bone lysis around cement anchor sites and required particulate graft. Type 2A and B defects displayed progressive bone loss superiorly and required particulate graft, femoral head bulk graft, or cup superiorization. Type 2C defects required medial wall repair with wafer femoral head graft. Type 3A and B defects demonstrated progressive amounts of superior rim deficiencies and were treated with structural distal femur or proximal tibia allograft. Six of the 147 components (4.0%), all type 3B, were considered radiographically and clinically unstable, warranting revision. Three of the six were revised. Moderate lateral allograft resorption was noted on radiographs, but host–graft union was confirmed at rerevision. Size, orientation, and method of fixation of the allografts play an important role in the integrity of structural allografts, while adequate remaining host–bone must be present to ensure bone ingrowth. **Key words:** total hip arthroplasty, revision, acetabulum, allograft.

Aseptic loosening of cemented acetabular components has necessitated revision and rerevision of components. In particular, acetabular revision surgery has become increasingly challenging due to the extent of acetabular bone loss. Patients are frequently asymptomatic for many years as the process known as "cement disease" slowly progresses. By the time patients become symptomatic (ie, pain and/or abnormal gait), the component has migrated and substantial acetabular bone loss has occurred. In these situations, it may be necessary to structurally augment the acetabulum to provide component stability at revision.

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Clinical experience has defined specific recurrent patterns of acetabular deformity.[9,28,29] A method of classifying acetabular defects can be based on the extent of inherent host acetabular support remaining (ie, superior dome, medial wall, anterior column, and posterior columns). By determining the presence or absence of the acetabular supporting structures before and during surgery, the surgeon can determine if additional support is required and develop a rational plan for treatment.

A number of different acetabular component designs are now available for cemented or noncemented use. Among the cementless styles used are hemispherical press-fit porous-coated cups,[13,23,29] hemispherical porous-coated cups with screw augmentation,[11] threaded cups,[3,20] and bipolar components.[14,25,34] In addition, cement,[21,40] custom implants, autogenous grafts, and allografts[5,8,16,27,35]

Table 1. Cemented Acetabular Diagnoses Requiring Revision

Revision Diagnosis	No. of Patients
Aseptic loosening	138
Infection	5
Recurrent dislocation	3
Limb length discrepancy	1

have been used to restore the deficient acetabulum. The variety of implants indicates that controversy still remains as to which reconstructive techniques are best for specific acetabular defects encountered during revision surgery.

Based upon the bone loss seen in 147 failed acetabuli, a systematic approach has been developed to classify these defects. These cases were revised with cementless acetabular components with or without bone–grafts and were reviewed clinically and radiographically after a minimum of 3 years. This study outlines this classification system and proposes treatment options for each type of defect.

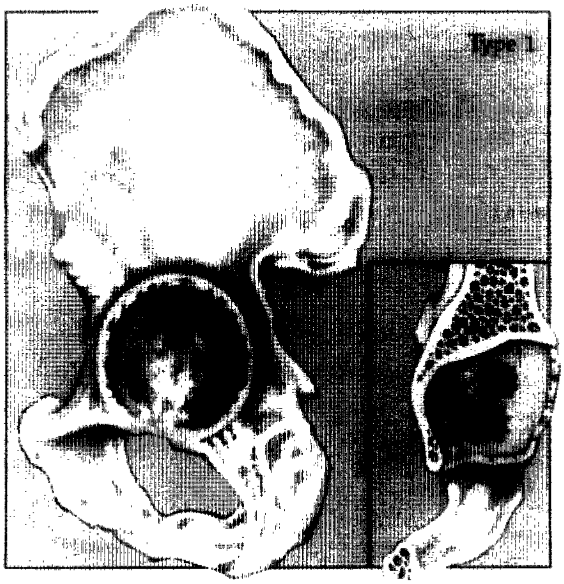

Fig. 1. Type 1 acetabular defects display minimal destruction of the acetabular rim and often have bone lysis localized to cement anchor holes.

Materials and Methods

During 1982–1988, 147 patients underwent acetabular component revision at Central Dupage Hospital by the senior author (W. G. P.) with an average follow-up period of 5.7 years (range, 3–9 years). There were 82 men and 65 women with an average age of 57.4 years (range, 24–89 years). The average number of previous operations was 2.6. The most common reason for revision was late aseptic loosening of the acetabular component (Table 1).

Before surgery, each patient was evaluated with an anteroposterior radiograph and classified as type 1, 2, or 3.

Defect Classification

The acetabular defect classification system is based upon the presence or absence of an intact acetabular rim and its ability to provide initial rigid support for an implanted acetabular component (Table 2). Defects are classified by type, indicating whether the remaining acetabular structures are completely sup-

Table 2. Acetabular Defect Types and Corresponding Preoperative/Intraoperative Characteristics

Defect	Rim	Walls/Domes	Columns	Bone Bed
Type 1	Intact	Intact	Intact and supportive	>50%; cancellous
Type 2	Distorted	Distorted	Intact and supportive	<50%; cancellous
Type 3	Missing	Severely compromised	Nonsupportive	Membranous/sclerotic

Table 3. Grafting Patterns and Methods of Fixation by Acetabular Defect and Subtypes

Defect	Grafting Patterns	Methods of Fixation
Type 1	Particulate graft	N/A
Type 2A	Particulate graft or femoral head allograft	Femoral head fixed inside acetabulum with 6.5-mm cancellous screws
Type 2B	Number 7 femoral head allograft	Screws or plate outside the acetabulum
Type 2C	Particulate graft or wafer-cut femoral head allograft	N/A
Type 3A	Number 7 distal femur or proximal tibia allograft	Screws or plate outside the acetabulum
Type 3B	Proximal femur "arc" graft	Plate

portive (type 1), partially supportive (type 2), or nonsupportive (type 3) of the implanted component. The extent of remaining structural support determines the amount and type of allograft required (bulk vs supportive grafts). The types were divided into subtypes that corresponded to the specific method used to the bony defect (Table 3).

Type 1 Acetabular Defects

Type 1 acetabular defects display minimal deformity. Cancellous bone is often retained while lytic defects are present. Bone lysis is localized to areas around cement anchor holes (Fig. 1).

On the preoperative radiograph the component displays no migration, suggesting that the dome is intact. The teardrop is present and indicates that the medial wall is uninvolved and ischial bone lysis is absent, inferring that the posterior wall is present.

Type 2 Acetabular Defects

Type 2 acetabular defects are a distortion of the acetabular hemisphere with destruction of the dome and/or medial wall but retention of the anterior and posterior columns. This defect is secondary to localized superior and/or medial bone lysis. Cancellous bone is often sparse and replaced with sclerotic bone. Type 2A defects (Fig. 2A) are a generalized oval enlargement of the acetabulum. Superior bone lysis is present but the superior rim remains intact. Type 2B defects (Fig. 3A) are similar to type 2A, but the dome is more distorted and the superior rim is absent. Type 2C defects (Fig. 4) involve more localized destruction of the medial wall.

Type 2A (Fig. 2B) and 2B (Fig. 3B) defects demonstrate less than 2 cm of component migration. In type 2A the cup migrates directly superior (because of cavitation of the dome), while in type 2B the component migrates superolaterally (because the superior

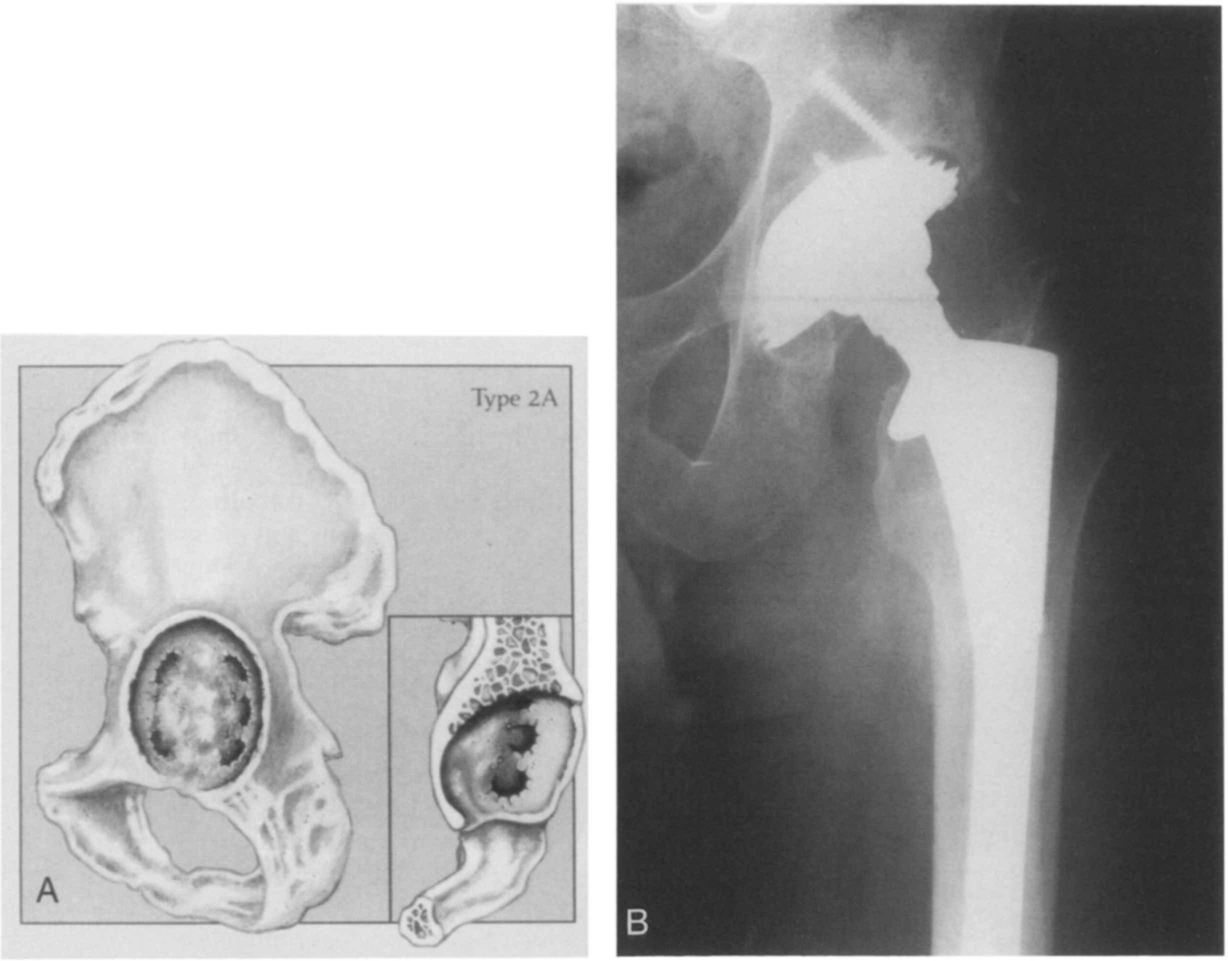

Fig. 2. (A) Type 2A defects show generalized enlargement of the acetabulum with minimal osteolysis of the dome and slight superior and medial migration of the cup. (B) The component migrates superiorly with preservation of the teardrop and ischium. Note that the superior rim prevents lateral migration of the component.

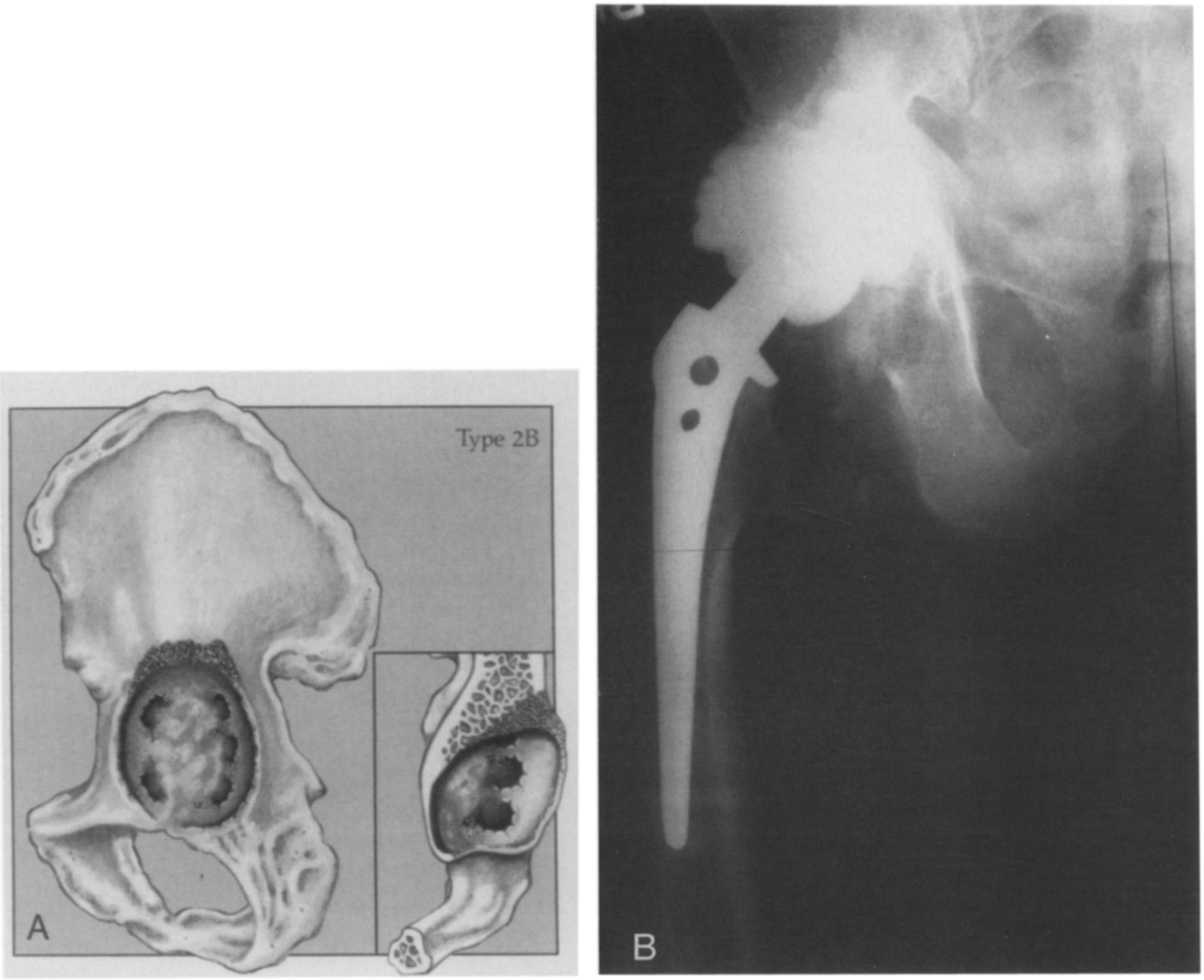

Fig. 3. (A) Type 2B defects are similar to type 2A defects, but more destruction of the dome is present. (B) Radiographically, the component migrates superolaterally, rotating into increased flexion. The teardrop and ischium are present.

rim is absent). Both type 2A and 2B defects show no signs of lysis of the teardrop or the ischium. In type 2C defects the teardrop is obliterated. The component may migrate medially because of an absent medial wall.

Type 3 Acetabular Defects

Type 3 acetabular defects demonstrate severe bone loss resulting in major destruction of the acetabular rim and supporting structures. Type 3A bone loss pattern (Fig. 5A) usually extends from the ten o'clock to the two o'clock position around the acetabular rim. In type 3B defects (Fig. 6) the acetabular rim is absent from the nine o'clock to the five o'clock position. In both type 3A (Fig. 5B) and 3B defects (Fig. 6) the component usually migrates greater than 2 cm superiorly. Type 3A defects demonstrate moderate, but not complete, destruction of the teardrop (medial wall of the teardrop is still present) and moderate lysis of the ischium. Because the medial wall is present, the component usually migrates superolaterally. Type 3B defects show complete obliteration of the teardrop and severe lysis of the ischium, usually resulting in superomedial component migration.

Surgical Technique

Exposure

A more extensive incision in revision arthroplasty, than in primary arthroplasty, is required for better visualization of the acetabulum and remaining bone stock. A modified posterolateral approach centered over the greater trochanter is used, incorporating the primary scar when appropriate.

The tensor fascia lata and gluteus maximus muscle fibers are split, partially releasing the gluteus maximus at its insertion site. The hip external rotators,

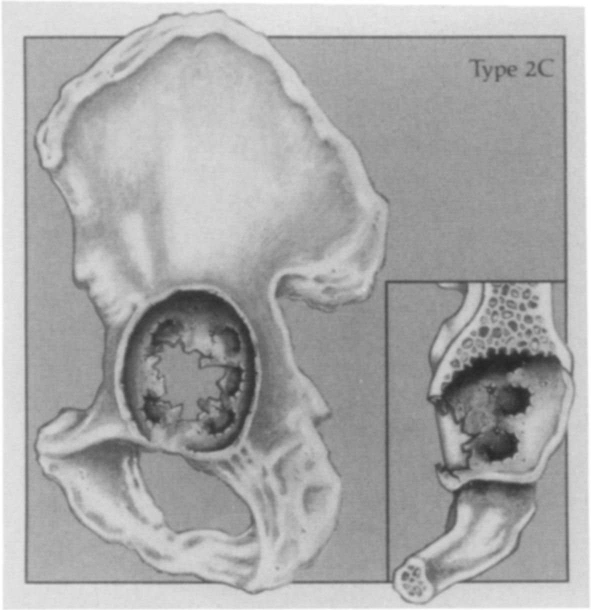

Fig. 4. Type 2C defects involve destruction of the medial wall with generalized rim enlargement.

if present, are freed, exposing the hip capsule. A meticulous capsulectomy affords excellent exposure of the entire bony acetabulum. A trochanter osteotomy is rarely indicated, but with severe proximal migration of the femoral and acetabular components, a sliding trochanteric osteotomy is performed to maintain tension of the vastus lateralis and hip abductors.

Preparation of the acetabulum consists of osteophyte removal, excision of fibrous membrane, and removal of accessible cement. The acetabulum is enlarged with increasing diameter reamers to bleeding bone of the posterior and anterior columns, retaining subchondral bone if possible.

Type 1 Acetabular Defect Reconstruction

A supportive graft is not required for type 1 defects. Similar to primary total hip arthroplasty, the porous-coated implant will achieve its fixation and stability from the anterior and posterior columns and dome of the acetabulum through an intact acetabular rim. A large cup is often required. Particulate grafting may be used to fill cement holes or residual minor irregularities.

Type 2 Acetabular Defect Reconstruction

Type 2 defects, like type 1, provide adequate support for the implanted acetabular component; therefore, a structural allograft is not necessary. Cavitary defects can usually be filled with particulate grafts or bulk grafts.

Surgical reconstruction of type 2A acetabular defects focuses on superior bone loss that can be accomplished by one of three methods. The acetabular component can be placed in a "high" position,[19,33] particulate graft may be used to fill the superior defect, or a femoral head allograft may be rigidly fixed to the superior aspect of the acetabulum with cancellous screws.[17,29] A large sized implant is press-fit.

Type 2B defects are repaired in a similar fashion to type 2A defects except when a fixed allograft is used. Because of the extent of superior bone loss in type 2B defects, screw placement, as in the conventional fixation of a femoral head allograft, is often difficult. In addition to decreased screw purchase, the screws placed within the acetabulum often interfere with reaming. The allograft is contoured so that screws may be placed outside the acetabulum, eliminating this difficulty. A number 7 cut femoral head graft (Fig. 7) can be positioned so that the longitudinal portion of the 7 lies outside the acetabulum while the short transverse portion lies within the acetabulum. The angle of the 7 abuts the superior lip of the acetabulum. Cancellous screws placed through the long portion of the graft into iliac bone outside the acetabulum provide rigid fixation of the graft (Fig. 8).

Reconstruction of a type 2C acetabulum addresses the protrusio defect with either particulate or wafer-cut femoral head graft. Stability of the acetabular component is achieved by rim press-fit.

Type 3 Acetabular Defect Reconstruction

Type 3 defects demonstrate marked bone loss extending into the posterior and anterior rims. In this scenario, the major structural acetabular supports have been compromised and structural allografts must be used to provide rigid fixation. Femoral or proximal tibial allografts are preferable to a femoral head allograft because they provide a wider graft to span the more extensive rim deficit and they are structurally more durable.

Repair of the type 3A acetabular defect requires either a proximal tibia or a distal femur cut into the shape of a number 7 (Figs. 9, 10). These grafts are fixed to the ilium with cancellous screws placed outside the acetabulum or with a reconstruction plate. In this method of reconstruction, the allograft provides structural support but additional fixation is often required with peripheral or dome screws. A protrusio defect, when present, is treated with type 2C reconstruction technique.

Type 3B acetabular defects require a larger graft to span the large host rim defect (Fig. 11). In this situation a proximal femoral allograft transected in a coro-

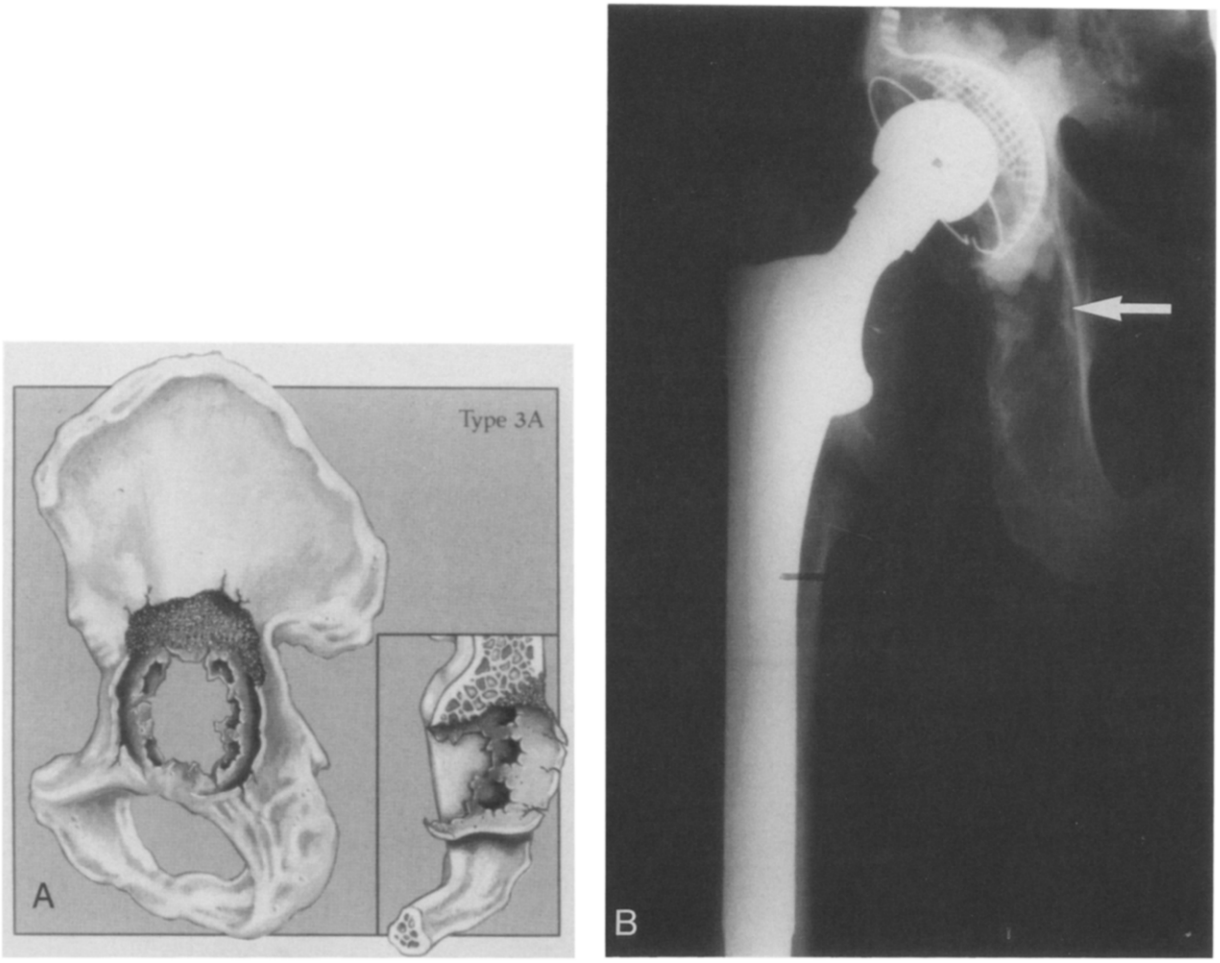

Fig. 5. (A) Type 3A bone loss patterns involve the superior rim of the acetabulum from the ten o'clock to the two o'clock position and often display medial wall deficiency. (B) The component migrates superiorly or superolaterally. Note the presence of the teardrop (arrow).

nal plane is laid over the defect. The natural curve formed by the femoral head, neck, and calcar provide an adequate graft to span the large acetabular rim defect (hence called the "arc" graft). This type of graft is secured to the ilium and ischium with pelvic reconstruction plates. The construct is reamed, and the acetabular component is inserted with rim fixation and screw augmentation.

Postoperative Course

Patients who require a nonstructural allograft are started on one-third weight bearing with crutches for 4 weeks, followed by 1 month of full-weight bearing with crutches, 1 month with a cane, and then unrestricted ambulation as tolerated. Patients who receive a structural graft must be protected from full-weight bearing for 6 months. For the first month, non-weight bearing is recommended. During the second month, one–third weight bearing with crutches or a walker is recommended, with slow progression to full-weight bearing up to 6 months.

Results

Before and during surgery the acetabuli were evaluated to assess the pattern of bone loss. The 147 acetabular revisions consisted of 37 type 1 defects, 79 type 2 defects, and 31 type 3 defects. Of the 79 type 2 defects, 20 patients were categorized as type 2A, 54 as type 2B, and 5 as type 2C. Of 31 type 3 defects, 25 patients were type 3A and 6 were type 3B. In most cases, the intraoperative assessment of bone deficiency and rim support correlated with the preoperative roentgenographic evaluation.

Comparing the preoperative defect assessment to the intraoperative findings, the total number of both preoperative type 2 and type 3 defects was overestimated. Of the preoperative type 2 defects, 89% were

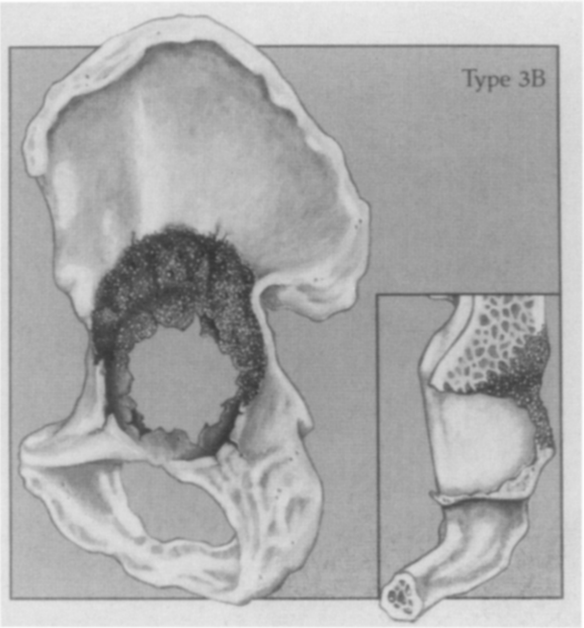

Fig. 6. Type 3B defects are similar to type 3A defects, but the rim defects span from the nine o'clock to the five o'clock position.

found to be true type 2 defects, while the remaining 11% were up-graded to type 3 defects during surgery. In the type 3 preoperative group, 95% were found to be type 3, while the remaining patients were type 2 defects when assessed during surgery.

Simple reconstruction of the superior acetabular defect, with particulate graft or placements of the ac-

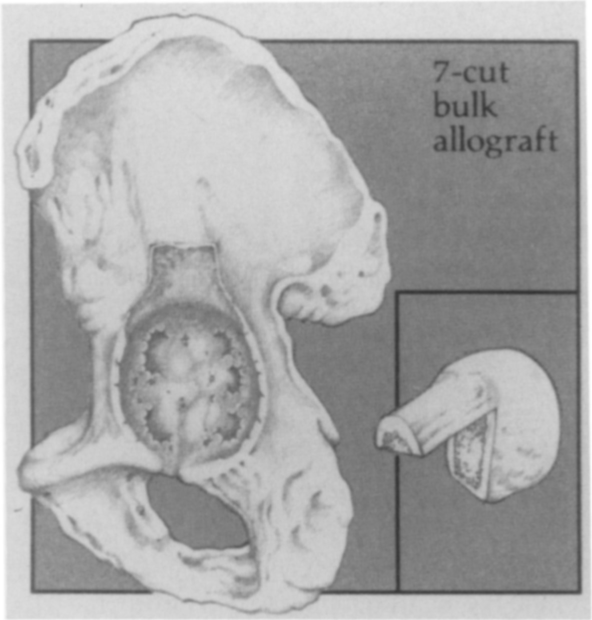

Fig. 7. In type 2B defects, the dome defects were repaired using a number 7 femoral head allograft.

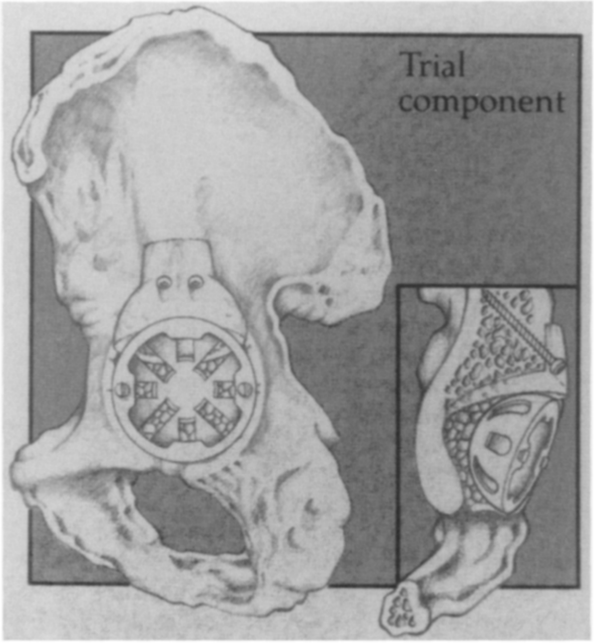

Fig. 8. The number 7 cut femoral head was positioned so that the angle of the 7 buttressed against the ilium. Cancellous screws were placed through the long portion of the graft into the ilium in the direction of axial forces across the hip.

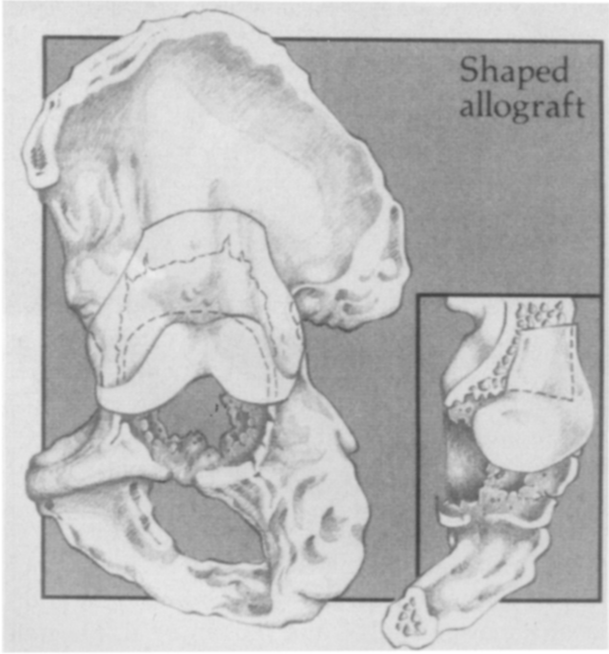

Fig. 9. Type 3A acetabular defects were repaired with a proximal tibia or distal femur allograft cut into a number 7 graft.

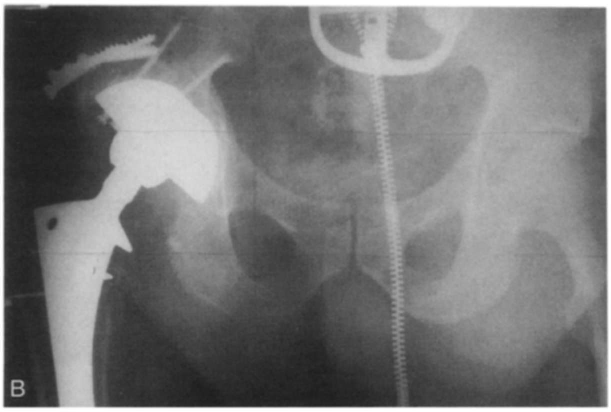

Fig. 10. Case 1: A 40-year-old man fractured his right hip at the age of 24 in an automobile accident and was initially treated with open reduction and internal fixation. Since that time the patient underwent multiple hip surgeries and ultimately received a total hip arthroplasty at the age of 33. The patient complained of significant groin and thigh pain for 2 years, and required the use of an assistance device for ambulation. (A) Preoperative radiograph of the right hip at age 36 demonstrates superior and lateral migration of the acetabular component with generalized dome and moderate medial wall osteolysis. During surgery the acetabular defect was classified as type 3A. The acetabulum was reconstructed with a distal femur allograft secured with 6.5-mm cancellous screws. A 72-mm press-fit porous-coated hemispherical cup was secured with two long 4.5-mm screws. (B) Radiograph taken 5 years after implantation demonstrating a stable component with incorporation of the allograft. The graft shows lateral resorption, but the central weight-bearing portion is intact. The patient had no complaints of thigh or groin pain.

etabular component at a higher level, was required in 37 patients. These patients were categorized as type 1, 2A, and 2C. A total of 56 patients, all either type 2A or type 2B, underwent augmentation grafting using a femoral head rigidly fixed with screws. The remaining 31 type 3 patients required support grafts.

Postoperative radiographs obtained at the last follow-up visit were evaluated for evidence of component loosening and migration (according to the criteria of Ranawat et al.[33] and Massin et al.[22]), graft resorption, and graft union. Structural allografts demonstrated lateral graft resorption and rounding, but centrally the subjective bone density was unchanged. There were no signs of fracture of the grafts or disengagement of the graft from the host–bone. All but six components showed less than 3 mm of migration. Of the components that migrated less than 3 mm, the migration was noted between the 6th and 12th months of the follow-up period and did not progress after 1 year. Six components (4.0%) migrated greater than 3 mm, and the allografts demonstrated moderate lateral resorption.

Pain relief was subjectively quantitated before and after surgery using a modified D'Aubigne and Postel[7] hip-rating scale. The grading system incorporated the subjective level of pain and the ability to ambulate without assistance. The highest number assigned to

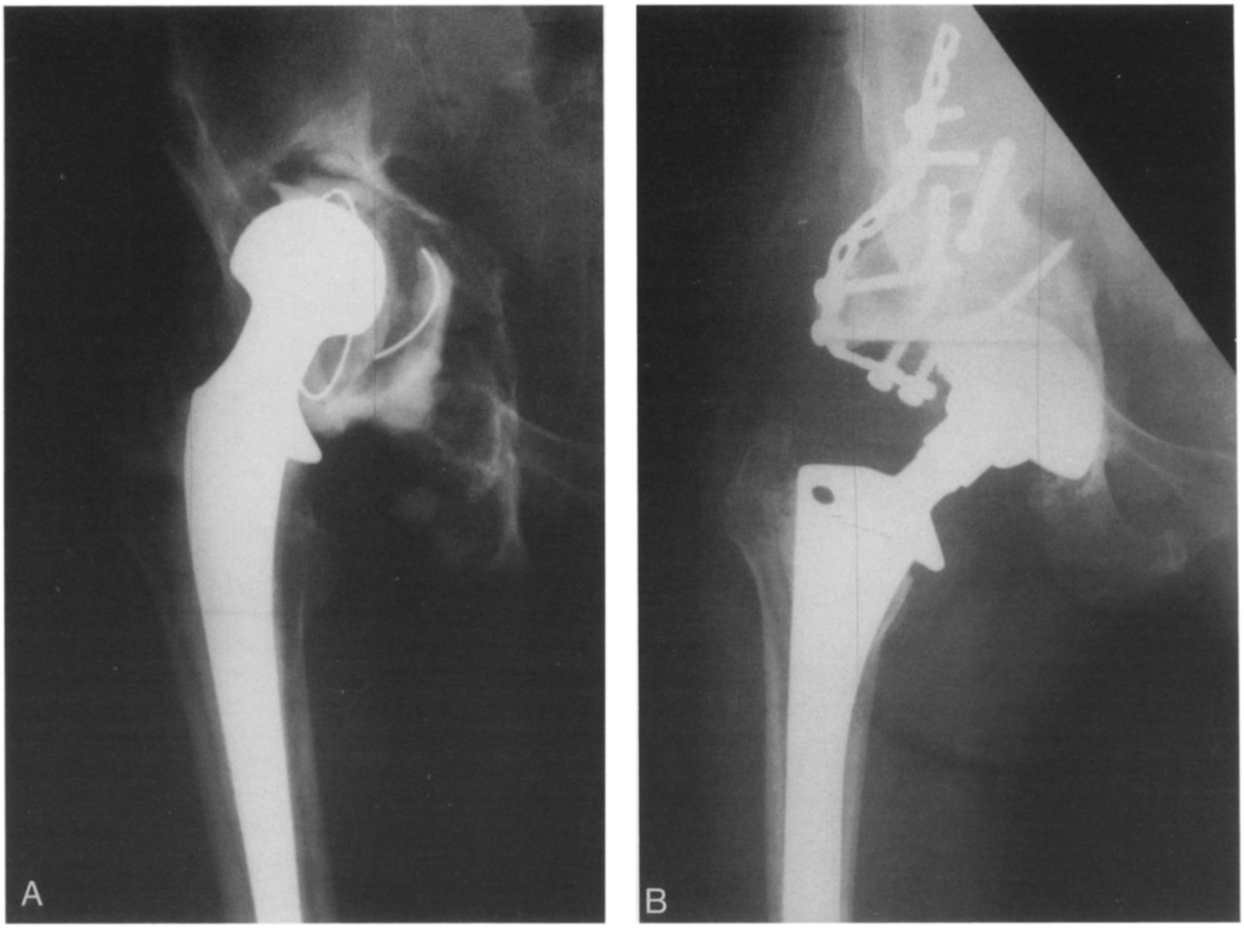

Fig. 11. Case 2: A 39-year-old woman developed avascular necrosis of her right hip after a fracture at the age of 22. When she was 26 she underwent a total hip arthroplasty with a cemented polyethylene acetabular component. The patient developed groin pain and required crutches for ambulation for 2 years before being seen. (A) Radiograph of the patient's right hip demonstrating severe osteolysis superiorly and medially. During surgery her acetabulum was classified as a type 3B defect and reconstructed with a proximal femur "arc" allograft that was secured with multiple cancellous screws and a pelvic reconstruction plate. (B) Radiograph that demonstrates complete incorporation of the allograft without resorption of the graft after 3 years. The patient was pain-free at this time.

no pain and ambulation without assistance was 6 each, for a maximum value of 12. The average preoperative score was 4.2, while the early postoperative score was 9.6. The subjective postoperative scores of all 147 patients were improved.

The six components that demonstrated more than 3 mm of migration were classified as type 3B defects. These patients were pain-free following their revision. Four of the six patients ambulated without assistance, while two patients resumed ambulating with a walker. The first sign of impending failure seen in the four assistance-free patients was a painful limp and later assisted ambulation with a cane. Three of these four patients complained of pain. The two walker-assisted patients were assessed radiographically, indicating migration but they did not complain of pain.

Of the six patients who were felt to be clinically and radiographically loose, three underwent revision surgery again, two did not want further surgery, and one had not made a decision at the time of this study. At rerevision, the grafts demonstrated complete incorporation at the allograft–host interface. In all three cases, no further allograft was required. Intraoperative cultures were negative.

Complications

In this series, there were two acute superficial gram-positive streptococcal infections, two sciatic nerve palsies, and seven hip dislocations. Three pulmonary emboli and two myocardial infarctions were recorded in the immediate postoperative period. Of the 15 (10%) sliding trochanteric osteotomies, none showed signs of complications. The overall complication rate was 11%.

The two infections encountered occurred within the first 3 weeks after surgery, and presented clinically with erythema, warmth, and mild drainage. Both patients were surgically explored, and the infections were felt to be superficial to the tensor fascia. Appropriate intravenous antibiotics were given and the infections resolved uneventfully without component removal. Of the two sciatic nerve palsies, one patient regained partial motor function, while the second patient demonstrated no improvement at the last follow-up visit. The hip dislocations were acutely relocated closed and treated for 8 weeks in a hip spica brace. Four of the patients were multisurgery patients with poor hip abductor function. One patient who demonstrated appropriate component position and good hip abductors dislocated three times, but stabilized with continued brace treatment. This patient's dislocations were felt to be secondary to poor patient compliance. Another hip required revision of the acetabular component because of initial retroversion of the component.

Discussion

Various types of acetabular defects seen in revision acetabular surgery have been described, but few studies have proposed a complete classification system.[6,9,26] It has been observed that the bony destruction seen in failed acetabular components progresses in an orderly fashion and that various patterns seen are steps in a cascade of periacetabular bone destruction. The goal of this study was to describe a reproducible classification system for failed acetabular components, to propose a systematic approach to restore these acetabular defects, and to present follow-up data.

Longer follow-up evaluation of primary total hip arthroplasties has led to an increase in the number of total hips revised and an increase in the number of hips undergoing rerevision. Follow-up studies of cemented acetabular revisions reveal an alarming incidence of radiographic lucencies and aseptic loosening.[1,15,18,30] Because of the drawbacks of cemented revision acetabuli, more emphasis has been placed on cementless acetabular cups and allograft reconstruction of bony defects.[10,14] Of the cementless cups used, the press-fit porous-coated hemispherical cup has consistently shown better results than the threaded[13,37] or bipolar cups.[4,13,36]

The main problem encountered in revision acetabular surgery is loss of bone stock that often compromises acetabular implant support. This problem has led to more complex revision surgeries that require the use of allograft augmentation. Multiple short-term follow-up studies have shown good graft incorporation into host–bone,[13,23,26,36,38] while others have discouraged the use of allografts because of potential late graft resorption and component loosening with longer follow-up time.[16,24]

In this series the allografts, when used as bulk grafts in type 1 and type 2 defects and as structural grafts in type 3A defects, did not show significant resorption or loosening. A generalized pattern of lateral resorption was seen, similar to that described by Oakeshott et al.,[26] but the central weight-bearing portion of the graft remained dense and intact. The mild migration (<3 mm) of most components occurred between 6 and 12 months, but did not progress after 1 year. This initial migration was felt to represent the period when the graft was the weakest, during which time revascularization and creeping substitution occurs.[2,38] The components' position ultimately stabilized after 1 year, once bone ingrowth was felt to have occurred.

In the six patients whose revisions failed, the structural grafts demonstrated incorporation into host–bone but the cups continued to migrate. All of the failures were type 3B defects with between 25% and 49% of remaining host–bone in contact with the component. At revision surgery, the grafts had not failed but rather host–bone ingrowth into the components was absent.

Success of cementless porous-coated components is ultimately dependent on the quality of microinterlock through bone ingrowth. Factors that influence this ingrowth are lack of micromotion, absence of infection, and adequate host–bone for ingrowth.[32] In this series the components that failed were implanted into acetabuli with massive host–bone destruction. The fact that the intraoperative cultures were negative and the components were initially stable with the allograft construct indicate that, with massive destruction, the remaining host–bone may not be adequate to promote substantial bone ingrowth. In the remaining patients, the components did not significantly migrate and it was felt that ingrowth had occurred.

Another important factor is the surgeon's ability to determine before and during surgery whether or not the acetabulum that remains will support an uncemented component. The acetabular rim and supporting columns are important intrinsic stabilizing structures.[31,39] Head et al.[12] feels that the two most important structures providing stability of an acetabular component are the dome subchondral bone and posterior column that act as important and critical load transferring devices.

Preoperative radiographic assessment may give the surgeon an indication of the remaining acetabulum's ability to support an implant. The direction and extent of component migration indicate the status of supporting structures. Straight superior migration indicates that the dome is deficient. If the component migrates superolaterally, the dome and superior rim are absent, while the anterior column or medial wall are present resisting medial migration. Likewise, a deficient medial wall or column destruction will result in medial component migration. The extent of migration suggests the severity of rim destruction and helps distinguish type 3 from type 2 defects. By assessing the presence or absence of a teardrop and ischium, the surgeon can determine whether the medial wall or anterior column and posterior wall or column are present or partially destroyed, respectively.

In most revision cases, the rim will support a component and a predictably good to excellent result will be obtained. These cases require particulate or bulk graft to fill small defects in the acetabulum. However, when the rim is deficient and will not support an acetabular component, a structural support allograft should be used. Structural grafts restore the acetabular rim and provide rigid component stability until tissue ingrowth has occurred.

Jasty and Harris[16] condemned the use of femoral head allografts for structural grafting of superior acetabular defects because of late resorption and component migration. Their experience demonstrate that certain allografts may not be suitable to withstand increased loading required of a structural graft. Therefore, we believe that certain criteria should be followed when using structural allografts in acetabular reconstruction. Choosing the appropriate allograft to optimally match the defect, orienting the graft to withstand the most load, and fixation of the graft separate from the component play an important role in the success of structural allografts.

Initially, when choosing an allograft the size of the defect that needs to be revised must be considered. Large defects require large grafts to span the defect. From our experience, fresh-frozen cadaveric proximal tibia and distal femurs provide adequate material to restore the acetabular rim in advanced acetabular destruction.

Secondly, the allograft should be oriented to withstand compressive forces encountered when the hip is axially loaded. Ideally, the trabeculae of the grafts and the graft fixation screws should parallel the resultant forces across the hip into the dome of the acetabulum. The trabecular pattern of a proximal tibia or distal femur can be orientated to provide optimal resistance to migration of the acetabular component.

And lastly, the bone–graft should be securely fixed to the host, independent of the acetabular component. Stability of the graft can be obtained from 6.5-mm cancellous screws or with pelvic reconstruction plates, but placement of fixation devices should not impede the placement of the acetabular component. Shaping grafts in a number 7 configuration enable the surgeon to place screws outside the acetabulum away from reaming and cup placement.

By adhering to these criteria for the use of structural allografts, we found that all allografts incorporated into host–bone and a major portion of the grafts remained. Reoperation on failed revisions was easily performed using a larger diameter porous-coated component without additional bone–graft. In type 3B acetabular defects the allograft was not the problem but rather the lack of bone ingrowth potential that led to component failure. In severe cases a total acetabular implant with a cemented component may be indicated.

It is our contention that acetabular revision can be successfully performed by using cementless hemispherical press-fit components and by augmenting initial stability with allograft when needed. By strictly adhering to this classification system and performing the appropriate reconstruction method, acceptable and predictable results of acetabular revision surgery can be expected.

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