What's New in Hip Arthroplasty

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SPECIALTY UPDATE

WHAT'S NEW IN HIP ARTHROPLASTY

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There were numerous papers, abstracts, and presentations on the topic of adult hip reconstructive surgery during the past year. I elected to review the published articles from the *Journal of Bone and Joint Surgery (American Volume), Journal of Arthroplasty,* and *Clinical Orthopaedics and Related Research*. In addition, I reviewed all of the abstracts from major meetings focusing on hip reconstructive surgery, including the annual meeting of the American Academy of Orthopaedic Surgeons, the annual meeting of The American Association of Hip and Knee Surgeons, and the open meeting of the Hip Society. I also reviewed several abstracts from the meeting of the Orthopedic Research Society. The time-interval for the review was June 2001 to April 2002.

The review involved more than 165 papers and 250 abstracts. I have organized the data into eight categories: (1) results of primary total hip arthroplasty, (2) results of revision total hip arthroplasty, (3) outcome measures, (4) metal ion release, (5) implant liability, (6) osteolysis, bone-remodeling, and bearing surface, (7) osteonecrosis of the femoral head, and (8) complications. Last year's review[1] included extensive data regarding the clinical results of a variety of surgical techniques, disease entities, and associated complications. In the current review, I have focused principally on newer data that were presented over the past year.

Results of Primary Total Hip Arthroplasty

Acetabular Cup

Fixation with Cement

Cement is rarely used for acetabular cup fixation. Some authors have recommended it as an option in older patients. Rasquinha et al., in a study of 305 hips treated with second-generation cementing techniques, reported a 1.3% rate of cup failure after twelve years of follow-up. The mean age was seventy years, and >60% of the patients were women. The mean weight of the patients was only 154 lb (69.9 kg). The durability of the femoral stem was excellent, with a 0.7% failure rate. The durability of acetabular cement fixation remains poor in younger patients. Keener et al., in a study of sixty-nine hips, reported a 34% rate of cup failure after a minimum of twenty-five years of follow-up. All patients were less than fifty years old at the time of surgery. Durability was better on the femoral side, with a 5% stem revision rate and a 13% overall mechanical failure rate.

Fixation without Cement

Cementless fixation has evolved into the preferred method for acetabular reconstruction as a result of the excellent clinical results that have been documented in numerous reports over the past decade. This trend is well illustrated by the data that have been collected by Salvati at the Hospital for Special Surgery over the past fifteen years. Salvati reported that, in 1985, 100% of the total hip arthroplasties at that institution were done with cement fixation. The rate of cementless fixation on the acetabular side increased to 50% in 1990, 75% in 1995, and 95% in 2000. Lewallen et al. reported the clinical results for a large cohort of hips that were treated with cementless cups over fourteen years at the Mayo Clinic. Nearly 8000 cups were reviewed, including 5371 that were inserted during primary procedures and 2433 that were inserted during revision procedures. Eleven designs were used in more than fifty hips each. The survival rate at ten years was 88.4% for the shell and 82.2% for the liner after primary arthroplasty. The results were worse after revision surgery, with a survival rate of 85.1% for the shell and 77.3% for the liner. Cups with a wire-mesh surface texture performed better than those with a beaded or hydroxyapatite coating. These data should serve as benchmark for future studies. There was a universal nonlinear fall-off during the second decade for all cup designs after both primary and revision arthroplasties. This finding is of substantial concern. Longer follow-up hopefully will add to the comparison of the clinical durability of different cup designs.

Cementless cups have been successful even if used in

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conjunction with bulk segmental bone-grafting. Spangehl et al.[2] reported reliable efficacy and durability when cementless cups were used in conjunction with bulk bone graft in patients with severe hip dysplasia. Forty-four arthroplasties were done with use of bulk autograft and a cementless cup. The mean duration of follow-up was 12.3 years. Four cups were revised: two for polyethylene wear, and one each for aseptic loosening and cup fracture. Forty-three of the forty-four hips showed incorporation of the bulk graft without evidence of resorption.

The main limitation in the clinical efficacy of cementless cups has been osteolysis requiring revision surgery. Young et al.[3] evaluated the effect of polyethylene liner modularity as a potential factor contributing to wear and osteolysis in patients managed with cementless cups. They followed two groups of forty-one hips, with one group receiving a nonmodular cup and the other group receiving a modular cup. The mean duration of follow-up was 5.5 years for both groups. The patients were matched with regard to demographic parameters. The true wear rate was slightly, but not significantly, lower in the nonmodular group (0.11 mm/yr compared with 0.16 mm/yr; $p = 0.22$). The variation in the wear rate was significantly less in the nonmodular group than in the modular group ($p < 0.05$). This finding may reflect the more uniform wear characteristics of the nonmodular design due to thicker polyethylene, greater liner-shell conformity, and less micromotion. The most important finding was that the prevalence of osteolysis was significantly lower in the nonmodular group (2% compared with 22%; $p = 0.01$). The disadvantage of nonmodular cups, however, is that the articulating liner cannot be exchanged in case of wear. It is hoped that improved wear characteristics associated with highly cross-linked polyethylene liners will result in longer durability of cementless cups.

Femoral Stem

Fixation with Cement

Cement has remained the most popular mode of femoral stem fixation for primary hip arthroplasty in the United States. The durability of cemented stem fixation has been well documented. Berry et al.[4] recently reported the results of the longest follow-up study of cemented total hip arthroplasty in the United States. In that study, 2000 Charnley total hip arthroplasties that were done between 1969 and 1971 were followed for as long as twenty-five years. The procedures were performed with use of early-generation cementing techniques. The survival rate was 86.5% at twenty-five years with revision of either component for aseptic failure as the end point. Men had a twofold greater risk for revision than did women. Age at the time of the index procedure also had an important impact on the survival rate, with younger age associated with a higher risk of failure. In fact, the twenty-five-year survival rate was only 68.7% for patients who were less than forty years old at the time of the procedure, compared with 100% for those who were at least eighty years old. Berry et al. recently reported the thirty-year follow-up results for 333 Charnley arthroplasties. Only thirty-seven patients were still alive; thus, the data reflect the performance over the lifetime of a patient. The thirty-year survival rate was 90% for the stems and 91.7% for the cups, with aseptic loosening as the end point. The thirty-year survival rate was 81% with any revision as the end point. The mean Harris hip score was only 75 points for the surviving patients. These scores were thought to reflect the effects of medical comorbidities but not deterioration of the hip implants themselves.

Klapach et al.[5] reported the clinical results of more than 350 arthroplasties performed with use of second-generation cementing techniques after a minimum duration of follow-up of twenty years. The revision rate was only 1.8% overall and 5% among patients who had lived for at least twenty years. However, this rate (5%) was not significantly different from the 6.3% rate for hips that had been treated by the same surgeon with use of first-generation cementing techniques. Both cementing techniques had good durability, perhaps partially due to the particular design of the femoral stem used (the Charnley polished flat-back stem).

Controversies remain with regard to the impact of stem surface texture on cement fixation. Ayers et al., in an in vitro experiment, evaluated the effect of surface roughness on the stem-cement interface. Two different designs were inserted with use of modern cementing techniques. One stem had a surface roughness of 0.75 Ra, while the other had a surface roughness of 5.3 Ra. Specimens with the rougher stem had significantly greater gaps at the stem-cement interface ($p = 0.02$). This was particularly true in the proximal femoral zones. These voids can, in theory, lead to stress concentration, resulting in a fracture of the cement mantle and loss of fixation. Duffy et al., in an in vitro study, specifically evaluated the impact of surface texture and cementing quality on micromotion of the stem. Stems with identical geometry but two different surface textures were inserted with use of two different cementing techniques. All specimens were tested in stair-climbing mode through as many as six million cycles. The micromotion of the polished stems and that of the grit-blasted stems were nearly identical if the cementing technique was of high quality (grade A). There was significantly greater motion of the polished stem in association with a grade-C2 cement mantle ($p = 0.001$). These data suggest that polished surfaces fare poorly when the cementing technique is poor. Moreover, the authors reported that debonding was not radiographically evident until the motion had exceeded 2000 μm.

There has been substantial controversy with regard to whether increased bonding between the stem and the cement results in premature and accelerated failure of the stem. This potential deleterious effect was evident in a series of hips treated with a polymethylmethacrylate-precoated design. Ezzet reported a 12.5% rate of revision in a study of seventy-two hips that were followed for less than four years. This finding is most disturbing in that all of the stems that failed initially had grade-A or grade-B cementing quality. This high rate of failure may be a reflection of the particular stem design (Zimmer

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Versys Plus) rather than a function of stem precoating.

Another controversy centers upon whether an increased femoral stem offset results in an increased rate of fixation failure. Two recent clinical series demonstrated conflicting results. Moore et al., in a prospective study of 154 hips with a standard offset and sixty-two hips with an extended offset, reported no increase in stem loosening or revision ($p = 0.22$) after a short duration of follow-up of 2.5 years. In contrast, Hodge et al., in a series of eighty-three hips treated with hybrid fixation, reported a 25% rate of stem revision. All of the stems were cobalt-chromium and had a grit-blasted proximal surface texture. Twenty-one stems were revised. Seven of the twenty-one revisions were done within the first fourteen months after primary surgery. Nineteen of the twenty-one revisions were performed in the group of sixty-six hips that had an extended offset. Consistent findings included debonding of the stem-cement interface in zone 1 and fracture of the cement mantle in the posterior part of the proximal aspect of the femur.

Fixation without Cement

The predictable long-term durability of cementless stem fixation has been documented in many reports. The Porous Coated Anatomic (PCA) prosthesis was among the earliest designs intended for cementless fixation. Centers are now reporting the fifteen-year clinical results for this implant. Leung et al., in a series of 168 arthroplasties performed with use of the original PCA stem, reported a 90% rate of stem survival at sixteen years. The rate of stem revision was 4.5%, whereas the rate of cup revision was 29%. The prevalence of thigh pain was high (24%) early in the follow-up period, but it decreased to 5.6% at the time of the final follow-up. The prevalence of osteolysis was 25% in the femur and 21% in the pelvis. Kawamura et al.[6], in a study of more than 300 arthroplasties that had been performed with the PCA design, reported that the fourteen-year rate of survival was 92.7% for the cups and 94.9% for the stems. The rate of cup survival was lower in women than in men ($p = 0.03$). The size of the prosthetic femoral head that had been used (either 32 mm or 26 mm) did not affect the overall rate of revision of either component. The Harris hip score was good or excellent for 75% of the patients. Thigh pain was present in more than half of the patients and was severe or activity-limiting in 16% of the patients.

Capello, in a study of 229 arthroplasties that had been performed with use of a proximally porous-coated stem with a hydroxyapatite coating, reported that the rate of mechanical stem failure was 0.4% at ten to fourteen years. Proximal femoral osteolysis was observed in 38% of the hips. The mean age of the patients at the time of the procedure was fifty-six years. D'Antonio and Capello further reported on a small series of thirty-six hips that had been treated with a hydroxyapatite-coated stem in patients who were less than forty-five years old. After ten to fourteen years of follow-up, only one stem had been revised for loosening. In another, larger cohort of fifty-four hips in patients who were less than fifty years old, no hydroxyapatite-coated stem was revised or judged to be loose after eight to thirteen years of follow-up.

The reports described above involved proximally coated stem designs. Paprosky, in a study of 186 hips that had been treated with an extensively coated stem, reported a 0.8% rate of stem-loosening at twelve to seventeen years. The mean age of the patients was fifty-seven years. The Harris hip score was rated good or excellent for 94% of the patients. Engh et al., in a study of 129 hips that had been treated with an extensively coated stem, reported a 3.4% rate of stem loosening and a 5.4% rate of cup loosening after a minimum duration of follow-up of fifteen years. Osteolysis was noted in 24% of the hips. Osteolysis was not associated with stem failure; however, two-thirds of the cup failures were associated with an osteolytic lesion of >1.5 cm in diameter. These data further substantiate the efficacy and durability of porous-coated implants. Failures due to wear debris and osteolysis continue to increase with longer in situ service.

Cementless fixation has been demonstrated to be durable even in elderly patients. Healy reported a 3% failure rate at five years in a group of 135 hips in patients who were more than sixty-five years old. Moreover, he observed no failures in a group of seventy-eight hips in patients who were more than eighty years old. In contrast, a 4.2% failure rate was observed in a group of more than 200 hips that had been treated with cement fixation.

The durability of total hip arthroplasty in young and active patients has remained poor. Duffy et al.[7] followed eighty-two hips that had been treated with early-generation cementless stem designs between 1984 and 1987 in patients who were younger than forty years old. After a minimum duration of follow-up of ten years, 29.3% of the hips had been revised. The ten-year survival rate was 81.3% for the cups and 84.9% for the stems. These high failure rates can serve as baseline for comparison of newer designs and supplemental fixation methods.

Results of Revision Hip Arthroplasty

There has been relatively little new information with regard to this topic over the past year.

Acetabular Revision

Cementless fixation continues to receive increasing support because of its clinical efficacy. Templeton et al.[8] reported excellent results after sixty-one cup revisions that were performed without cement because of the failure of a cemented cup. The mean duration of follow-up was nearly thirteen years. No cup was re-revised because of loosening. Two cups showed radiographic signs of loosening. Polyethylene liner exchange was necessary in eight hips. The same authors compared the results of acetabular revisions performed with cement (eighty-three hips) and without cement (sixty-one hips) after a minimum duration of follow-up of ten years. The results were

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significantly superior for the hips that were treated without cement, both in terms of the revision rate (0% compared with 32%) and in terms of the migration rate (3% compared with 67%) ($p < 0.001$). The polyethylene wear rate was 0.13 mm/year. Men were at higher risk for wear.

Extra-large (jumbo) cups have been used to fill bone deficiencies in the acetabulum for more than a decade. Whaley et al.[9], in a study of eighty-nine revisions performed with use of jumbo cups, reported excellent clinical efficacy and durability after a mean duration of follow-up of 7.2 years. Segmental or combined segmental and cavitary bone deficiencies were noted in 89% of the patients. The overall re-revision rate was 4.5%, and the radiographic loosening rate was 2.4%. The rate of cup survival was 98% at eight years with aseptic loosening as the end point.

Femoral Revision

Impaction grafting remains an option in extreme cases of substantial bone deficiency when other reconstructive methods are not applicable. Incorporation and remodeling of the bone graft have continued to be documented in the literature. Ullmark and Obrant[10] evaluated thirty-one specimens that were retrieved from twenty-one patients who had undergone revision surgery and impaction grafting one to forty-eight months previously. Histological evidence of viable bone and osteoid was evident at four months. Marrow elements appeared by twelve months. At forty-eight months, living cortical bone was in contact with the cement mantle distally but dead bone still remained in the proximal femoral zones. Fetzer et al.[11], in a study of twenty-six femoral revisions performed with use of impaction grafting, reported that no re-revisions were necessary by four to eight years of follow-up. Two-thirds of the stems were polished, while one-third of the stems were grit-blasted or precoated. One stem subsided >5 mm. There were three periprosthetic fractures.

Outcome Measures

Clinical Outcome

In medical economics analysis, the cost per quality of well year (QWY) has been used as a measure of cost-effectiveness. Any medical treatment that costs less than $30,000 per QWY is considered effective. Lavernia, Sadun, and Hernandez, in a prospective study of 154 hip arthroplasties, reported that the cost per QWY was $8500 at one year and $8800 at four years. These data once again confirm the cost-effectiveness of total hip arthroplasty using public health outcome measurement instruments.

Increasing attention has been focused on the impact of preoperative mental health status on the clinical outcome after arthroplasty. Lavernia, Hernandez, and Sierra prospectively evaluated the mental status of 450 patients undergoing both hip and knee arthroplasties. An SF-36 mental health score of <52 was considered to be an indicator for depression. One hundred and sixteen patients (25.8%) were considered to be depressed. These patients had significantly lower postoperative Western Ontario and McMaster Universities Osetoarthritis Index (WOMAC) and Short Form-36 (SF-36) scores in other categories ($p < 0.001$). The differences persisted for more than one year after surgery. It is therefore important for the clinician to realize that the results of surgery can be influenced by the patient's expectations and perception of success or failure. This consideration only underscores the importance of education and communication with the patient prior to surgery.

Cost of Follow-up Care

One of the challenges faced by all clinicians is the cost of following patients after arthroplasty. Longitudinal follow-up, particularly with radiographs, has become paramount, especially with the increasing prevalence of osteolysis, which is generally silent clinically. Moreover, the importance of follow-up was recently magnified by the class-action litigation involving the recall of a certain hip arthroplasty implant. Teeny and York reported the results of a survey of the members of the American Association of Hip and Knee Surgeons. Four hundred and forty-seven surgeons (66% of the membership) responded to the survey. This group of surgeons represented a surgical volume of more than 90,000 arthroplasties per year. The results of the survey revealed that 96% of the respondents recommended routine follow-up with radiographs every one to two years during the first five years after the procedure and that 81% recommended routine follow-up with radiographs at the same interval during the second decade of in situ service. In addition, 10% of the respondents stated that they had been denied payment by insurance companies for radiographs and 12% cited decreased reimbursement as a reason to have limited their recommendations for patients to return for routine follow-up visits. This situation represents a potentially serious public health issue. An increasing number of implants will be remaining in situ for even longer durations, resulting in an increasing number of mechanical failures due to loosening and wear that will require revision surgery. A delay in revision surgery generally results in inferior outcomes because of greater bone loss and other technically challenging problems.

Safety of Hip Arthroplasty

Total hip arthroplasty is one of the safest surgical procedures. Parvizi et al.[12] reported on their experience with more than 30,000 procedures that were performed over a period of twenty-eight years. Ninety deaths occurred within thirty days after surgery, for an overall thirty-day mortality rate of 0.29%. The mortality rate was significantly higher for men and for patients with cardiovascular disease or an age of more than seventy years ($p < 0.0001$). There was no significant difference in the mortality rate between patients managed with or without cement or between those managed with primary or revision surgery. The most important finding was that the mortality rate decreased from decade to decade ($p < 0.0002$).

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The overall thirty-day mortality rate was only 0.15% in the 1990s. Nazarian et al. prospectively followed 380 patients who were scheduled for arthroplasty, 97% of whom had one or more risk factors for cardiovascular disease. Coronary artery disease was documented in 18.4% of the patients, and a previous myocardial infarction had occurred in 8.7%. Nearly all of the operations were done with the patient under spinal anesthesia. Ischemic cardiovascular disease was documented in three patients (0.8%) after surgery: one patient had a myocardial infarction, and two had electrocardiographic changes indicative of ischemia. All three patients had a history of a previous infarction. The authors suggested that extensive preoperative cardiac workup was not required for most patients provided that they did not have a history of a previous myocardial infarction.

Surgical Volume and Outcome

Controversies remain with regard to whether "Centers of Excellence" with higher caseloads provide superior outcomes following joint arthroplasty, particularly in terms of complication rates. Two recent reports provided conflicting data. Thompson et al.[13] prospectively followed more than 1800 consecutive patients who were admitted for elective total hip arthroplasty over a fifteen-month period in Minnesota. Neither surgeon nor hospital volume had any significant impact on the complication rate. Caseload also did not have any influence on walking or pain scores in the follow-up analysis.

In contrast, Katz et al.[14] reported significant differences in the outcome of total hip arthroplasty as a function of case volume, both for hospitals and for surgeons. Those investigators analyzed Medicare data on nearly 60,000 primary and 13,000 revision hip arthroplasties performed over a one-year period. Twelve percent of the primary and 49% of the revision operations were performed at centers in which ten or fewer of these procedures were done annually. In addition, 52% of the primary and 77% of the revision operations were done by surgeons who performed ten or fewer of these procedures annually. Only 6% of the primary hip arthroplasties were done by surgeons who performed more than fifty procedures annually. Mortality rates were significantly lower at centers in which more than 100 primary arthroplasties were done than at centers in which fewer than ten were done ($p < 0.01$). Mortality rates were also lower after revision procedures done by surgeons who performed more than ten such procedures annually as compared with those done by surgeons who performed fewer than three such procedures annually. Moreover, dislocation rates were lower after primary procedures done by surgeons who performed more than fifty such procedures annually compared with those done by surgeons who performed fewer than five such procedures annually. That study had a number of limitations. The Medicare database did not provide information with regard to pain relief, psychosocial function, the durability of the implants, or costs. More extensive research is necessary to refine and clarify the data before they can be used to justify changes in the delivery pattern of total hip arthroplasty.

Metal Ion Release

Alternative bearing surfaces have received increasing attention over the past few years. Metal-on-metal articulation was the center of focus during the past year, partially due to the recall of the Sulzer Inter-Op acetabular cup (Sulzer Orthopedics, Austin, Texas). This very important topic will be discussed below in the section on product liability. One of the research award papers from the Hip Society in 2002 focused on metal ion release in hips with metal-on-metal couplings. MacDonald et al. reported on forty-one patients in a prospective, randomized, blinded study comparing metal-on-metal with metal-on-polyethylene articulations. The mean duration of follow-up was 2.9 years. There were no differences between the two groups with regard to either the clinical or the radiographic outcome measures. However, there were significant differences between the two groups with regard to the metal ion concentrations both in erythrocytes and in urine. Compared with the preoperative erythrocyte metal ion levels, the metal-on-metal group had, on the average, a twenty-four-fold increase in the cobalt level ($p < 0.01$), a twofold increase in the chromium level ($p > 0.05$), and no difference in the titanium level. With regard to urine metal ion levels, the metal-on-metal group had a 103-fold increase in the cobalt level ($p < 0.001$), a twenty-nine-fold increase in the chromium level ($p < 0.001$), and a threefold increase in the titanium level ($p < 0.016$). Previous reports had indicated that patients with metal-on-metal articulations had a gradual decrease in metal ion levels with longer durations of follow-up. In contrast, the study by MacDonald et al. demonstrated that 41% of the patients had persistently elevated ion levels through the time of the latest follow-up. The long-term clinical effects of these increased concentrations of metal ions remain unclear.

Elevated metal ion concentrations are also found in patients with metal-on-polyethylene articulations. Higher metal ion concentrations have especially been documented in patients with loose implants. This has been less of a concern in patients with stable implants. Jacobs et al. presented important data from a prospective study involving fifty-eight patients. The patients were divided into four groups: (1) patients treated with a cemented cobalt-chromium stem, (2) patients treated with a cementless cobalt-chromium stem, (3) patients treated with a cementless titanium-alloy stem with a cobalt-chromium femoral head, and (4) control patients without any implant. All of the patients who had an implant were functioning well without signs of loosening. All of the cups were made of titanium-alloy and were implanted without cement. Serum and urine metal ion levels were measured prior to surgery and at one, three, five, and seven years after surgery. All of the patients who had an implant demonstrated elevated levels at three years in comparison with the controls. Serum cobalt and chromium levels remained elevated even at seven

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years in the patients who had had an arthroplasty. While the magnitude of metal ion release was not dramatically elevated in these patients with well-functioning implants, the concentration threshold necessary for the occurrence of adverse effects remains unknown.

Dr. Joshua Jacobs was honored this year with one of the prestigious Kappa Delta Awards for his work on wear, metal ion release, and the biological implications of each. He outlined eight important findings from work done over more than a decade: (1) titanium levels rise for as long as three years after surgery and then revert to control values, (2) cobalt and chromium levels remain elevated even after seven years, (3) the most likely source of cobalt and chromium over the long term is fretting corrosion at the modular taper junction of the femoral component, (4) passive dissolution of the cobalt-chromium stem surface is not a likely source of the metal ions, (5) protein binding of the trace elements involves two different molecular weights for chromium and only one molecular weight for titanium, (6) wear particles are commonly transported to the liver, spleen, and abdominal lymph nodes, with higher quantities in patients with failed implants than in those with well-functioning implants, (7) the concentrations of wear particles in distant organs are relatively low in most patients without any evidence of toxicity, and (8) the principal source of wear particles is not the articulation itself. The clinician should be cognizant of the propensity for systemic dissemination of the degradation products of joint arthroplasty implants through hematogenous and lymphatic routes. Expeditious revision should be considered once mechanical failure has been recognized in order to minimize the production of high concentrations of debris and metal ions. Moreover, measurements of serum and urine metal ion concentrations may serve as useful clinical tools with which to identify patients who may be at the highest risk for adverse effects associated with wear debris and exposure to trace elements.

Product Liability

One of the most important events related to hip arthroplasty during the past several decades occurred in 2001 with the recall of a large number of Inter-Op acetabular cups (Sulzer Orthopedics). The problem was principally related to the manufacturing and cleaning process. This particular cup design required an additional machining process after the porous coating had been applied to the outer surface. The inner surface was then machined to increase congruency. The oil involved in the machining process was not completely removed by the cleaning process, resulting in oil contamination of the porous surface. More than 26,000 cups were assessed to be at risk. Blumenfeld and Bargar recently reported their experience with this problem. Seventy-five cups were inserted in seventy-one patients. Thirty-seven cups were identified to be in the recall lot. Twelve (32%) of these cups had been revised at the time of the report, with five additional cups demonstrating radiographic signs of probable loosening. The timing to revision was short, generally less than six months after the index operation. All implants were revised by inserting another cementless cup, generally 2 to 6 mm larger in outer diameter, after additional reaming. All patients were doing well clinically at the time of short-term follow-up following the revision surgery.

Tissues retrieved at the time of revision surgery have demonstrated a consistent histological pattern. Campbell, Mirra, and Catelas reported their findings in a study of tissue samples retrieved from more than 100 hips with a failed Sulzer cup. All intraoperative bacteriological cultures were negative. The most common finding was extensive chronic inflammation with a predominance of plasma cells and lymphocytes. Many specimens also had features of acute inflammation with neutrophils. Other characteristic features included granulomas, foreign-body giant cells, necrosis, and fibrin exudation. Immunohistochemical staining demonstrated predominantly T lymphocytes with small numbers of B lymphocytes. Interleukin-1 and interleukin-6 assays were highly positive, but tumor necrosis factor was infrequently identified. These histological and immunological findings were not limited to the cup membrane alone; similar features were found in the pseudocapsular tissues.

Most femoral stems in these patients remained stable, although a few were revised because of loosening. One common radiographic finding was severe osteopenia in the proximal part of the femur, suggestive of an intense inflammatory process around the hip joint. Many lawsuits have been filed. Currently, the court is reviewing the proposal put forth by Sulzer for a settlement that exceeds $1 billion.

Another product recall in 2001 involved the zirconia ceramic femoral head component manufactured by Saint-Gobain in France. The reason for the recall was the risk of component fracture. The exact number of fractures remains unclear at this time. One would suspect that the number of fractures will increase with a longer duration of in situ service.

These events clearly underscore the importance of follow-up for patients managed with hip arthroplasty. In addition to the costs of the lawsuits, tremendous costs have been incurred in association with the contacting of patients, patient education, follow-up, and revision operations. These revisions are no different from any other revisions with similar risks for complications, which undoubtedly will add to the legal and financial burdens both on surgeons and on the industry.

Osteolysis, Bone-Remodeling, and Bearing Surfaces

Osteolysis

Osteolysis as a result of wear debris at the articulating surfaces remains one of the most important failure mechanisms in patients managed with total hip arthroplasty.

Ayers, Allen, and Schoonmaker reported the effect of tumor necrosis factor on bone resorption around cement in an animal model. Tumor necrosis factor invariably caused decreased osteoid concentration and induced bone resorption. The important finding was that bone resorption occurred

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even in association with the lowest level of tumor necrosis factor, with no significant difference among the different concentrations. This model can provide a framework for the evaluation of the potential influence of different pharmacological and physical modalities with regard to both the prevention and the reversal of bone resorption.

Two intriguing papers focused on the use of medications both to prevent and to reverse osteolysis. Millett et al.[15] studied the effect of alendronate on the treatment of osteolysis in a rat model. Intra-articular injections of polyethylene particles were used to induce the development of osteolysis. Animals were randomized into a prevention group and a treatment group. Animals in the prevention group received alendronate while the particles were being injected. Animals in the treatment group did not receive alendronate until osteolysis had fully developed. Histomorphometric analysis was used to quantitate bone volume. In the prevention group, the baseline trabecular bone volume was 21.5% in animals that received saline injections only (controls). This value decreased to 13.1% in animals that received particle injections. This decrease did not occur, and in fact greater trabecular bone developed (as indicated by a trabecular bone volume of 32.6%), in animals that received alendronate ($p < 0.001$). In the treatment group, the trabecular bone volume was 27.2%, 17.7%, and 30.2% for the saline-solution-treated controls, the particle-treated animals, and the alendronate-treated animals, respectively ($p = 0.002$). These data support the concept that alendronate can prevent osteolysis and can even increase bone volume in the presence of established osteolysis.

Another report focused on the potential use of pentoxifylline (Trental) for the treatment of osteolysis. This agent has been used for the treatment of peripheral vascular disease for more than two decades. It is apparently a potent inhibitor of the production of tumor necrosis factor both in vivo and in vitro. Pollice et al.[16] analyzed the response of eight healthy volunteers who were managed with oral administration of Trental for seven days. Peripheral monocytes were isolated in the volunteers before and after treatment. Tumor necrosis factor levels were measured after the monocyte cultures were exposed to titanium particles. There was a significant reduction in the concentration of tumor necrosis factor after Trental treatment ($p < 0.001$). This reduction was especially significant in association with higher doses of titanium particles. Data from both of these studies[15,16] provide hope that an oral agent may be clinically effective for the prevention and reversal of osteolysis.

Bone-Remodeling

One of the concerns associated with cementless femoral stems has been adverse bone-remodeling due to stress-shielding, particularly in patients managed with long and extensively-coated stiffer stem designs. Sychterz et al.[17] reported on twenty retrieved femora that had received an extensively-coated straight cobalt-chromium stem. The bone density of the contralateral femur was used as the control. The investigators found a high correlation between bone loss and the stiffness parameters of the stem ($r > 0.88$). On the average, women had a 21.9% loss in bone density whereas men had a 13.6% loss. Although that study demonstrated the influence of mechanical stiffness factors on bone-remodeling, other factors (e.g., hormonal status, drugs, other metabolic diseases, and activity level) could account for the variance in bone loss data not accounted for exclusively by mechanical parameters.

Bearing Surface

Ceramic

Ceramic remains an attractive bearing surface. Promising clinical results have been reported in large trials involving newer implant designs. Hamadouche et al.[18] reported the clinical results of 118 consecutive total hip arthroplasties performed with a ceramic-on-ceramic articulation after more than eighteen years of follow-up. Both cemented and cementless fixation were used. The durability of acetabular fixation was marginal, with a survival rate of only 61% for cemented cups and 86% for cementless cups. The survival rate for cemented stems (87%) was similar to that for cementless stems (85%). The important finding was that no osteolysis was observed in hips with stable fixation. Wear of the alumina ceramic coupling was estimated to be <0.025 mm/yr. In the study by Urban et al.[19], sixty-four hips that had been treated with a ceramic-on-polyethylene coupling and cement fixation were followed for a mean of 18.2 years. The twenty-year survival rate was 79%. The rate of polyethylene wear was measured to be 0.034 mm/year. This wear rate was dramatically lower than the rate of 0.16 mm/year that was reported for metal-on-polyethylene couplings in a series of ninety-two cementless hip arthroplasties that were followed for a mean of ten years.

One of the major proposed benefits of ceramic-on-ceramic articulations is decreased generation of wear debris. Mochida et al.[20] compared tissue samples that were retrieved from the sites of failed hip arthroplasties involving both ceramic-on-ceramic couplings (eleven patients) and ceramic-on-polyethylene couplings (seven patients). All of the acetabular shells and femoral stems were made of titanium alloy. The duration of in situ service prior to revision surgery was similar in both groups (thirty-one months in the ceramic-on-ceramic group and forty-two months in the ceramic-on-polyethylene group). Histological and immunochemical analyses demonstrated the cellular elements to be principally macrophages with few lymphocytes. The total particle quantity was threefold higher in the ceramic-on-polyethylene group ($p = 0.008$). The average particle quantity per year was also threefold higher in the ceramic-on-polyethylene group. No difference was detected between the groups with regard to the size or shape of the particles. Energy-dispersive spectroscopy analysis demonstrated that the particles in the ceramic-on-ceramic group were, on the average, 66% ceramic and 30% titanium alloy. These data, however, do not conclusively support the concept that there is a decreased biological response to the lower quan-

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tities of wear debris that are associated with ceramic couplings.

Polyethylene

Highly cross-linked polyethylene has been used in greater clinical applications as its wear characteristics have continued to be documented to be superior to those of conventional polyethylene. Several studies have recently demonstrated that this superiority was especially notable in the presence of the most adverse type of wear (that is, wear caused by third-body debris). In one representative study involving both 28-mm and 46-mm femoral head sizes, Bragdon et al. subjected highly cross-linked polyethylene liners to cement particles in simulator testing through as many as five million cycles. There was undetectable wear in association with the 46-mm heads, whereas a wear volume of 0.74 mg/million cycles was associated with the 28-mm heads. In contrast, in tests involving conventional polyethylene, the 46-mm and 28-mm heads were associated with a wear volume of 29 mg/million cycles and 19.4 mg/million cycles, respectively. These data demonstrated that highly cross-linked polyethylene is more resistant than conventional polyethylene, at least following short-term simulator testing.

McKellop et al. found lower quantities of debris when highly cross-linked polyethylene was compared with conventional polyethylene in a mechanical testing experiment. More importantly, they also documented a difference in the morphology of the particles that were produced. Particles in the shape of fibrils were twofold less common in the highly cross-linked group. This different morphology may result in a different biological response when the host is exposed to the debris.

Muratoglu et al. evaluated thirty-five polyethylene cup liners that were retrieved at the time of revision surgery. There were sixteen highly cross-linked and nineteen conventional polyethylene liners. The mean duration of in situ service was seven months and five months, respectively. Optical microscopy demonstrated scratching and polishing of both types of liners, although these changes were more extensive in the conventional group. Machine marks were more diminished in the conventional group. The intriguing aspect of the report focused on the experiment regarding shape memory. It is well recognized that melting plastically deformed polyethylene (highly cross-linked or conventional) triggers the shape-memory effect, enabling recovery of the initial geometry of the material. When the investigators conducted the melting recovery testing, disappearance of surface scratches and restoration of the original machine marks were consistently observed in the highly cross-linked group. This finding was in contrast to the incomplete recovery that was observed in the conventional group. The authors believed that their data supported the hypothesis that changes in the surface of the highly cross-linked liners were due to recoverable plastic deformation of the articulating surface rather than to loss of material due to true wear. The clinical effects are unknown at the present time.

Pollock et al.[21] reported on a novel method for the manual measurement of polyethylene wear. This simple method involves the use of transparent templates from the various manufacturers. These templates, which take into account the thickness of the metal shell with each given diameter, can simply be laid over the radiographs and an estimate of polyethylene wear can then be made. Those investigators compared the template measurements with the direct measurements of seventeen cups that had been retrieved after a mean of twelve years in situ. Two other manual methods (the Dorr technique and the Livermore technique) were also used for comparison. The mean error was 0.04 mm for the template method, 0.07 mm for the Livermore method, and 1.54 mm for the Dorr method. The more important finding was that the template method had the narrowest range of estimates in comparison with the other two methods. The template method may offer clinicians an accurate tool with which to evaluate polyethylene wear readily in the clinic in order to provide an opinion as to whether excessive wear is present and whether revision surgery should be recommended.

Osteonecrosis

Osteonecrosis of the femoral head remains an important clinical entity that affects more than one million patients in the United States. Several authors have recently reported on the clinical outcome of a variety of treatment options. Vascularized fibular grafting has been used as a treatment option for nearly two decades. Pellegrini et al. reported their experience in a prospective study involving thirty hips. Patients were assessed with digital angiography for patency of the anastomosis and with magnetic resonance imaging for progression of the necrotic segments. The mean duration of follow-up was 3.5 years. All fifteen stage-III and IV hips collapsed, with 60% of the patients progressing to prosthetic replacement. Twenty-seven percent of the stage-II hips collapsed, with 7% progressing to hip arthroplasty. The mean interval between grafting and hip arthroplasty was only 1.5 years. The area of the necrotic segment was found to be significantly correlated with collapse ($p = 0.02$). Toth et al. reported the efficacy of vascularized fibular grafting in patients in whom core decompression had failed. Forty hips were followed for a mean of four years. These patients were compared with a group of patients without a previous failure of core decompression in whom vascularized fibular grafting was performed as the initial treatment. Poor prognostic factors included steroid use and an advanced stage of osteonecrosis. There was no difference in the rate of conversion to hip arthroplasty between the failed core decompression group and the vascularized fibular graft group (48% compared with 37%; $p = 0.3$).

Berend et al. reported the clinical results of total hip arthroplasty following failed vascularized fibular grafting for osteonecrosis. Eighty-nine hips were followed for a mean of 9.2 years. The mean time-interval between grafting and hip arthroplasty was 2.7 years, which was slightly longer than that in the above series by Pellegrini et al. Revision was necessary in 17%

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of the hips. The rate of survival of the arthroplasty implants was 94% at five years and 85% at ten years. The major finding was that cement fixation fared poorly on the femoral side, with a success rate of only 43%. Cementless stems did well, with an overall success rate of 93% at nine years. The authors found no difference between proximally coated and extensively coated stems. These results underscore the difficulty that remains in the management of this high-risk patient population.

Rajadhyaksha et al. reported promising short-term results in a study of sixty hips that had prosthetic femoral resurfacing arthroplasty for the treatment of osteonecrosis. After a mean duration of follow-up of 3.6 years, 95% of the hips were considered to have a successful result on the basis of clinical outcome measures. Two hips were converted to total hip arthroplasty at twelve and fifty months. Longer-term follow-up is necessary to fully determine if this "bone-preserving" surgery is superior to routine total hip arthroplasty for the treatment of osteonecrosis. Moreover, it is equally important to follow the results of the conversion procedures performed after the failure of a surface arthroplasty. The results of conversion total hip arthroplasty following failed vascularized fibular grafting, as reported by Berend et al., have been no better than the results of primary total hip arthroplasty performed with cementless fixation for the treatment of osteonecrosis.

One of the more exciting surgical techniques for the treatment of osteonecrosis involves the use of autologous bone-marrow grafting. Hernigou reported the results of this technique in a study of 189 hips that were followed for five to ten years. Bone aspirate was taken from the anterior iliac crest. The aspirated cells were concentrated and were injected after core decompression. Only nine of the 145 hips with stage-I or II changes progressed to total hip arthroplasty, resulting in a success rate of 94%. In contrast, twenty-five of the forty-four hips with stage-III and IV changes progressed to hip arthroplasty. Patients with a greater number of progenitor cells in the marrow aspirate had superior outcomes. Mont et al.[22] reported the results of strut autografting with and without osteogenic protein-1 in a canine model of femoral head osteonecrosis. The model involved a subchondral defect measuring 2 cm in diameter. Radiographic and biomechanical testing demonstrated moderate-to-excellent healing of the defect in animals that had been treated with grafting with or without osteogenic protein-1. Control animals that were not treated with grafting did not demonstrate any healing. It is apparent that, in both humans and animals, smaller defects can be successfully treated with decompression and grafting with use of some form of autogenous bone induction or conduction material. The challenge remains to maximize the clinical efficacy of these biological methods of treatment with proper patient selection. Another surgical technique involves supporting the articular cartilage with cement. Mayor et al. reported the short-term results for fifteen patients with stage-III or IV osteonecrosis who were treated with cement inflation of the femoral head. All patients had significant pain relief. The degree of symptom relief declined with time. Reoperation was needed in two hips after one and four years of follow-up.

Another intriguing paper focused on the possible relationship between HIV infection and osteonecrosis of the femoral head. Ries et al.[23] reported a 57% prevalence of osteonecrosis in HIV-positive patients who did not have any other known risk factors for osteonecrosis. In contrast, the prevalence of osteonecrosis was 13% in the group of patients without HIV who had no identifiable risk factors. The mechanism by which HIV infection may cause osteonecrosis is not clear. Some of the possibilities include hypertriglyceridemia, antiphospholipid antibodies predisposing to thrombosis, and protein-S deficiency. This problem may become more important clinically as more patients with HIV infections are now living longer because of improved medical treatment.

Complications

Thromboembolism

Thromboembolism remains the most common complication following hip arthroplasty. Controversies continue as to which prophylaxis is the most efficacious. Data from two key studies became available this year. Pitto et al.[24] evaluated the incidence of thromboembolism after total hip arthroplasty with cement. One hundred and thirty patients were randomized into two groups. In one group the stem was inserted with use of a routine technique, and in the other group the stem was inserted with use of a bone-vacuum technique and with a cannula placed in the canal to decrease the pressurization effect. Significantly more echocardiographic embolic events occurred in the group without the bone vacuum ($p < 0.05$). Moreover, the prevalence of deep-vein thrombosis was significantly lower in the bone-vacuum group (3% compared with 18%; $p < 0.05$). Both groups received routine prophylaxis with use of low-molecular-weight heparin after surgery.

The other study involved the use of a novel antithrombotic agent, pentasaccharide, which is a specific inhibitor of factor Xa in the coagulation cascade. Phase-III clinical trial data on patients undergoing joint arthroplasty and patients with a hip fracture were presented at two separate national meetings. A large number of patients (more than 7000) were enrolled in this double-blind, randomized study in which pentasaccharide was compared with enoxaparin. The overall risk reduction in the pentasaccharide group was >50% in comparison with the enoxaparin group. Conflicting data, however, were reported with specific respect to patients managed with hip arthroplasty. There was a significant reduction (>50%) in one trial ($p < 0.001$); the difference in the other trial was not significant ($p > 0.05$), although there was still a 28% risk reduction in comparison with enoxaparin. There was also a significantly lower prevalence of proximal deep-vein thrombosis in the pentasaccharide group ($p < 0.01$). The bleeding risks were similar in the groups. This drug may offer yet another option to the clinician for prophylaxis against thromboembolism.

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Warfarin has remained the most popular method of prophylaxis in the United States. It has become increasingly difficult to adjust the dose in the outpatient setting from both a logistics and a cost point of view. Vives et al.[25] reported on the efficacy of a fixed low-dose warfarin regimen for prophylaxis. Two hundred and forty-five patients were placed on an adjusted-dose regimen while in the hospital after a primary joint arthroplasty. They were then randomized to either an adjusted-dose regimen (designed to maintain the international normalized ratio between 1.4 and 1.8) or a fixed low-dose regimen (2 mg each day without monitoring). Thromboembolism was documented with either Doppler ultrasound scanning or clinical surveillance. The overall thromboembolism rate was 7.1% in the adjusted-dose group and 4.6% in the fixed-low-dose group ($p = 0.02$). The prevalence was significantly lower in the fixed-low-dose group after both hip arthroplasty ($p = 0.01$) and knee arthroplasty ($p = 0.03$). The international normalized ratio was significantly lower in the fixed-low-dose group (mean, 1.26 compared with 1.45) ($p < 0.01$). However, 8% of the patients in the fixed-low-dose group also had an excessively elevated international normalized ratio of >3.1. These patients probably had some type of hypersensitivity response to warfarin. The fixed-dose regimen was at least as effective as the adjusted-dose regimen. However, it was still necessary for some of the patients to be monitored.

Two studies involved testing for thrombophilic markers. Mont et al. tested twenty-nine patients with known pulmonary embolism following arthroplasty of the lower extremities. These patients were matched with twenty-nine controls who did not have thromboembolism following arthroplasty. The investigators performed extensive tests involving twenty-one serologic factors and five genes associated with thrombophilia and hypofibrinolysis. All patients with a previous pulmonary embolism had at least one abnormality of plasminogen activator-inhibitor activity. In addition, the proportions of patients with elevated prothrombin times and thrombophilic homocystine levels were higher in the study group than in the control group. Westrich et al. tested fourteen patients with known pulmonary embolism for markers of coagulation abnormalities. Similar to the previous study, more patients with pulmonary embolism had abnormal markers ($p = 0.06$). They also found heterozygosity of particular genetic mutations in prothrombin and antithrombin only occurring in patients with pulmonary embolism. These studies set the foundation for further investigations that will continue to be performed to determine whether preoperative testing of certain patients suspected of being at high risk is clinically and economically effective and feasible.

Dislocation

Berry and Harmsen reported that the cumulative risk for dislocation in a study of more than 6600 hips was 1% at one month and 1.8% at one year, with the risk rising at a constant rate of 1% per each five years until it reached 7% at twenty-five years. The risk was significantly greater in patients who were more than seventy years old at the time of the final follow-up (12.5% compared with 6.5%; $p = 0.018$). Women had a higher risk than men (8.9% compared with 4.5%; $p = 0.0001$). Additionally, patients with osteonecrosis had a more than twofold greater risk than patients with osteoarthritis (14.1% compared with 6.4%). These data show that dislocation rates continue to increase with longer follow-up, perhaps reflecting in part the effects of neuromuscular deterioration and wear at the articulating surface.

Bernasek, Gustke, and Brockman analyzed sixty-three consecutive revisions that were done for dislocation. The principal etiology for the dislocation was impingement in 37% of the hips, soft-tissue tension in 30%, and component malposition in 28%. Recurrence of dislocation occurred in 5% of the hips in which both components had been revised but in 45% of those in which only one component had been revised. Partial revision, however, was effective for addressing soft-tissue tension problems and was associated with only a 4% rate of recurrence. Risk factors for recurrent dislocation following revision surgery were obesity, alcohol, and smoking.

Constrained liners have become increasingly popular for addressing the problem of dislocation. Bremner et al. presented additional follow-up data on a cohort of revisions that had been performed with use of constrained liners that that they had reported on previously. One hundred and one cups were followed for eight to thirteen years. Five hips had additional dislocations, eight were revised for loosening, and four were revised for osteolysis. The overall mechanical failure rate was 17% at a mean of ten years. It was promising that no acceleration in the rate of failure was found with longer follow-up. Hozack et al. and Lavernia et al., in two separate studies, analyzed the failures of constrained liners. Three mechanisms of failure were identified in both studies: (1) failure at the bone-cup interface with loss of fixation, perhaps due to increased torque associated with constrained liners; (2) failure of the liner locking mechanism; and (3) dislodgment of the femoral head from the liner without disruption of the locking mechanism, most commonly due to impingement of the neck against the elevated liner rim. The overall failure rate was as high as 12% in one series. It is therefore important for the surgeon to observe all of the required principles of hip arthroplasty, such as clearance, offset, and tissue tension even when a constrained liner is selected in order to minimize failure.

A larger head diameter decreases the dislocation rate because of an increased range of motion, increased clearance, and increased offset. Muratoglu et al.[26] reported that highly cross-linked polyethylene liners with a thickness of 3 mm demonstrated negligible wear after more than ten million cycles of simulated gait testing with 22-mm, 28-mm, 32-mm, and 48-mm femoral heads. In contrast, conventional polyethylene liners (used as controls) demonstrated a correlation of wear and penetration with head size. The long-term performance of

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highly cross-linked polyethylene remains to be defined; however, the use of larger femoral heads to address recurrent dislocation or to prevent dislocation may become a clinical option.

One of the principal causes of dislocation is component malpositioning, particularly malpositioning of the acetabular cup. Jolles, Genoud, and Hoffmeyer reported on the accuracy of computer-assisted cup placement. One hundred and fifty cups were inserted by ten different experienced arthroplasty surgeons into plastic pelves in the laboratory. Three different insertion techniques were investigated: freehand insertion, insertion with use of a conventional cup positioner, and insertion with the computer-assisted device. The mean variations from the ideal cup abduction and anteversion angles were less with the computer-assisted device than with the other two techniques. Computer-assisted insertion resulted in mean variations of only 1.5° for anteversion and 2.5° for abduction, compared with 10° and 3.5°, respectively, for the freehand technique and with 8° and 4°, respectively, for the conventional cup positioner technique. The precision of cup placement is only one of the many factors that can influence the prevalence of dislocation. Techniques and instruments such as this one can aid the surgeon during surgery; however, they may also give the surgeon a false sense of security, perhaps resulting in underachievement of the other prerequisites of the surgical principles of hip arthroplasty.

Infection

Infection remains the most feared complication following hip arthroplasty. In contrast with data from two separate papers published last year on the increased prevalence of infection in HIV-positive patients, Dungy et al. reported different findings in a series of sixty joint arthroplasties in HIV-positive patients. The mean duration of follow-up was eight years. There was only one infection, which occurred following an elbow arthroplasty. There were two important findings: (1) 75% of the procedures were done in patients with hemophilia who were able to maintain adequate CD-4 cell counts successfully, and (2) four articulation surface exchanges were necessary because of wear. This second point underscores the importance of ensuring the durability of fixation and the minimization of wear even in patients who previously were thought to have a relatively short life expectancy.

Kilgus and Howe reported important data on resistant organisms in a study of seventy joint infections, half of which occurred after hip arthroplasty and half of which occurred after knee arthroplasty. All patients were treated with use of a standardized protocol. The success rate for the treatment of infections caused by sensitive organisms was 81% for the hips and 88% for the knees. In contrast, there was a very poor prognosis for infections caused by organisms that were sensitive to vancomycin only. The success rates in this group were only 48% for the hips and 18% for the knees. Dbillon, Ries, and Jacobs compared the success rates associated with the treatment of infections caused by methicillin-resistant *Staphylococcus aureus* (seven cases) or methicillin-sensitive *Staphylococcus aureus* (twenty-nine cases) after joint arthroplasty. Survival of the implants after reimplantation was only 14% in the methicillin-resistant group, compared with 69% in the methicillin-sensitive group. Calhoun et al. reported important findings regarding the treatment of methicillin-resistant *Staphylococcus aureus* osteomyelitis in an experimental animal model. The animals were treated with oral linezolid or with parenteral vancomycin for four weeks and then were taken off antibiotics for two weeks before being killed. Infection was undetectable in 100% of the animals that had been treated with linezolid, 93% of those that had been treated with vancomycin, and 28.6% of the controls that had not received any antibiotics. This antibiotic may improve our management of infections due to resistant organisms.

Rah et al., in a study of eighty-three patients who were treated over a ten-year period, reported on the clinical efficacy of performing multiple-stage operations for the treatment of periprosthetic infections. They analyzed the success rate after two, three, and four-stage operations, with the additional stages being more débridement prior to final reimplantation. The infection-free rate was 70% after two-stage procedures and 83% after both three-stage and four-stage procedures. This approach may be especially applicable in the presence of resistant organisms.

Colonic Pseudo-obstruction

Colonic pseudo-obstruction and ileus are relatively rare postoperative complications that are associated with substantial morbidity and, on occasion, mortality. Two recent reports highlighted the problem and its risk factors. Petrisor et al.[27] analyzed thirty-one cases of this complication among nearly 2700 patients who had had an arthroplasty. The pseudo-obstruction developed an average of 3.5 days after surgery. The risk factors included male gender, bilateral knee arthroplasty, and revision hip arthroplasty. No patient died. Two patients each required endoscopic and surgical decompression. The mean duration of hospitalization was thirteen days for patients with pseudo-obstruction compared with 7.5 days for patients without pseudo-obstruction. The mean duration of hospitalization was thirty-seven days for patients who required surgical intervention. Bederman et al.[28] reported a 0.32% prevalence of this condition among more than 21,000 patients managed with arthroplasty. Female gender, bilateral knee arthroplasty, and younger age were identified as risk factors. Orthopaedic surgeons should be aware of this rare condition and respond quickly in order to minimize the associated morbidity.

Upcoming Meetings of Interest

The Hip Society and the American Association of Hip and Knee Surgeons remain the principal organizations involved in research, clinical outcome measures, physician and patient education, and political lobbying efforts with regard to the disciplines associated with hip reconstructive surgery. Both

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organizations sponsor an excellent scientific program each year at their annual meetings. The Hip Society meeting is always held in conjunction with Specialty Day at the Annual Meeting of the American Academy of Orthopaedic Surgeons. The next meeting will be in February 2003 in New Orleans. The American Association of Hip and Knee Surgeons routinely holds its annual meeting in Dallas during the first weekend in November. Members from both organizations participate extensively in the educational efforts at other meetings throughout the year.

In Memoriam

It is with sincere regret and sadness that I bring the news of death of four members of the Hip Society over the past year. Dr. Marshall Urist, Dr. Heinz Wagner, Dr. Andrew McBeath, and Dr. Dennis Lennox have all been important contributors to the mission and vision of all those who have made a commitment to hip reconstructive surgery.

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