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# What's new in adult reconstructive knee surgery.

Carl A Deirmengian

*Rothman Institute, Thomas Jefferson University; Lankenau Institute for Medical Research*

Jess H Lonner

*Lankenau Institute for Medical Research, [jess.lonner@rothmaninstitute.com](mailto:jess.lonner@rothmaninstitute.com)*

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## SPECIALTY UPDATE

What's New in Adult Reconstructive  
Knee Surgery

Carl A. Deirmengian, MD, and Jess H. Lonner, MD

The purpose of this review is to summarize studies on various topics in adult knee reconstruction that were published during the year 2010. The keywords “knee” and “arthroplasty” and “prospective” and “randomized” were used to perform a search of the National Library of Medicine’s PubMed database; the search was limited to studies that were published in *The Journal of Bone and Joint Surgery* (American Volume) or *The Journal of Arthroplasty* in 2010. The resulting seventeen studies are included in this review of adult reconstruction of the knee and are included in the complete bibliography at the end of the manuscript. In addition, other studies from 2010 were chosen for their specific relevance to the topics being discussed.

**Epidemiology and Economic Factors**

Continuing research into the epidemiology and economics of adult hip and knee arthroplasty has improved our understanding of costs, processes of care, and outcomes. Data related to these topics are ever important in a time when standards and mandates of care are being generated by various administrative bodies. As health care protocols and recommended processes of care are generated, there is a clear need to validate decisions that affect entire populations of patients.

Bozic et al.<sup>1</sup> used the Perspective database to identify 182,146 patients managed with primary hip and knee arthroplasty in order to assess the independent effects of surgeon volume, hospital volume, and process standardization on short-term outcomes. The authors used adherence to antibiotic prophylaxis, the appropriate use of perioperative beta-blockers, and venous thromboembolism prophylaxis as a proxy for care that was provided with process standardization. As expected,

both surgeon volume and hospital volume were associated with significant improvements in short-term outcomes, including reduced complication rates, reduced rates of reoperations and readmissions, reduced mortality, and reduced length of hospital stay. In addition, the authors found that process standardization was independently responsible for reduced length of hospital stay and improved short-term outcomes. Given the increasing volume of adult hip and knee arthroplasty procedures, many practices and hospitals are instituting standardized protocols of care to improve the efficiency of care while reducing the likelihood of suboptimal care. Although few would argue that adherence to antibiotic and thromboembolism prophylaxis and beta blocker management alone would explain the author’s findings, consistency in meeting these standards of care is likely a marker for programs that provide efficient and optimal care for hip and knee arthroplasty patients.

Bini et al.<sup>2</sup> focused on the readmission rate after primary hip and knee arthroplasty in relation to patient discharge disposition. They wanted to understand the relative complication rate in patients who were discharged to a skilled nursing facility as compared with patients who were discharged to home. The Kaiser Permanente Total Joint Replacement Registry was utilized to identify 9150 patients managed with primary hip and knee arthroplasty who had an American Society of Anesthesiologists (ASA) score of  $\leq 2$  and were discharged without an inpatient complication. The authors isolated these patients in an effort to minimize the patient selection that could bias toward having sicker patients at a skilled nursing facility. Interestingly, patients who were discharged to a skilled nursing facility had an almost twofold increase in readmissions after primary hip and knee arthroplasty, even after controlling for ASA score, age, sex, and in-hospital complications. The authors admitted that, despite their efforts, the observed effect may

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## WHAT'S NEW IN ADULT RECONSTRUCTIVE KNEE SURGERY

result from patient selection, with “sicker” patients being more likely to be discharged to a skilled nursing facility. Given the clinical importance of the findings, it is prudent to follow patients closely even when they are discharged to a skilled nursing facility.

When considering the trend toward decreasing reimbursement in health care, combined with the increasing need for joint arthroplasty, there is obvious reason to be concerned that patient access to hip and knee arthroplasty procedures will be at risk. Fehring et al.<sup>3</sup> defined the supply side of arthroplasty access by describing the predicted workforce of joint replacement surgeons over the next six years. The American Academy of Orthopaedic Surgeons (AAOS) database and the 2004 and 2006 AAOS Orthopaedic Practice in the United States Surveys (OPUS) were used to generate data regarding the inflow and outflow of arthroplasty surgeons from the workforce. The National Inpatient Sample (NIS) was used to generate data to predict the number of hip and knee arthroplasties likely to be demanded over the same time period. By the year 2016, 1896 arthroplasty surgeons will retire if sixty-five years is used as the retirement age whereas 4239 arthroplasty surgeons will retire if fifty-nine years is used as the retirement age. In comparison, only 400 arthroplasty surgeons will join the workforce by 2016. This disparity in surgeons is predicted to yield a shortfall of 174,409 procedures if sixty-five years is used as the retirement age as compared with a shortfall of 1,177,761 if fifty-nine years is used as the retirement age. The authors expressed concern over the supply side crisis that threatens patient access to hip and knee arthroplasty over the next six years. Iorio et al.<sup>4</sup> added data regarding surgeon attitudes and economic trends. They surveyed a large portion of the American Association of Hip and Knee Surgeons (AAHKS) regarding attitudes and economic challenges that may result from decreasing reimbursements. They found that if Medicare reimbursement were to decrease by as much as 20%, about half of the AAHKS surgeons would be unable to provide care for Medicare patients. This would create an unmet need of >92,000 procedures among AAHKS surgeons alone. Therefore, considering the increasing numbers of hip and knee arthroplasty procedures needed, a supply side crisis that will result in fewer available specialists, and decreasing reimbursement that will hinder many surgeons' ability to treat Medicare patients, there is clear reason for serious concern that patient access to hip and knee arthroplasty will be at serious risk during the next decade.

### Venous Thromboembolism

The optimal form of venous thromboprophylaxis after total knee arthroplasty remains unclear. The main disagreement continues to revolve around the risk of pulmonary embolism compared with the risk of perioperative bleeding complications. Clinical protocols for joint replacement have evolved to include a faster operative time, rapid postoperative ambulation, and a multimodal strategy for thromboprophylaxis. The risk of fatal pulmonary embolism is low enough that prospective

studies of unreasonable magnitude would be required to reveal significant differences in mortality between drugs.

Bozic et al.<sup>5</sup> utilized the Perspective database to identify 93,840 patients who were managed with either aspirin (5%), warfarin (55%), or injectable agents (40%) over a two-year period. Statistical tools were utilized to adjust the data for patient allocation biases that may have driven the use of one anticoagulant over another. While some centers contributing to the database utilized aspirin for <5% of patients, others appeared to use aspirin as a standard, with >75% of patients being managed with aspirin. Analysis of patient groups revealed very small but significant differences as patients who were managed with aspirin were slightly less likely to have medical comorbidities. The authors found that aspirin was associated with a lower adjusted risk for venous thromboembolic events in comparison with warfarin and with a similar adjusted risk for thromboembolism as compared with injectable agents. Aspirin also was found to have similar adjusted complication and mortality rates when compared with warfarin and injectable agents. The authors also noted that the patients who were managed with aspirin generally had shorter hospital stays and more frequently were discharged to home, suggesting that they were involved in a multimodal strategy promoting rapid return to walking. Additional studies are needed to demonstrate the efficacy of aspirin, as well as other drugs, in preventing fatal embolism. Nevertheless, it is interesting to find that, in such a large retrospective database, the actual drug utilized for thromboprophylaxis made very little difference to patient outcomes. Perhaps other factors such as patient predispositions, surgical techniques, management protocols, and time to walking outweigh the drug effect on thromboembolic events.

Fuji et al.<sup>6</sup> performed a prospective, randomized, double-blind, placebo-controlled study in which three doses of oral dabigatran etexilate (110, 150, or 220 mg, administered once daily) were compared with placebo. The study included 597 patients undergoing primary total knee arthroplasty. The authors did not allow for intermittent pneumatic compression devices or antiplatelet drugs in the study. The study revealed that dabigatran etexilate was effective for reducing asymptomatic deep-vein thrombosis (DVT) (with rates of 39.6%, 32.7%, and 24.0% for the three doses) compared with placebo (56.4%). The authors stated that the rates of total venous thromboembolism and all-cause mortality were lower for patients receiving dabigatran. Interestingly, neither the placebo group nor the treatment groups included even one case of death, pulmonary embolism, or symptomatic DVT.

### Navigation

The use of computer navigation for total knee arthroplasty has evolved to become a more efficient and safe procedure. Two recent publications specifically addressed the potential medical advantages of using computer navigation, which enables the surgeon to avoid the use of intramedullary alignment devices.

## WHAT'S NEW IN ADULT RECONSTRUCTIVE KNEE SURGERY

O'Connor et al.<sup>7</sup> conducted a prospective exploratory study on the effect of computer navigation on fat emboli after total knee arthroplasty. Forty-four patients were randomly assigned to standard or computer-assisted total knee arthroplasty, with an intramedullary femoral guide only used in the standard group. It is important to note that the authors irrigated and suctioned the femoral canal before instrumentation. Trans-esophageal echocardiography was utilized to quantify embolic material passing through the right atrium after tourniquet deflation. The authors found very little difference between the groups, with both standard and computer-assisted total knee arthroplasties creating similar amounts of fat emboli that passed through the atrium. The authors concluded that any effect of computer navigation on minimizing fat emboli is likely to be clinically unimportant. Haytmanek et al.<sup>8</sup> conducted a similar study in which patients were evaluated for cognitive changes after standard and computer-assisted total knee arthroplasty. Theoretically, computer-assisted total knee arthroplasty could minimize vascular fat emboli and marrow debris, reducing the rate of cognitive changes after total knee arthroplasty. The study included forty-seven patients undergoing computer-assisted total knee arthroplasty and forty-eight patients undergoing standard total knee arthroplasty. The Folstein mini-mental state examination was performed before and after surgery. There were no significant differences between the standard and computer-assisted total knee arthroplasty groups in terms of pain medication, oxygen requirements, or the results of the Folstein examination. The authors concluded that any differences between standard and computer-assisted total knee arthroplasty in terms of embolic material produced are likely not clinically relevant. Although there may be other advantages, the minimization of embolic material should not be considered an advantage of computer-assisted total knee arthroplasty.

### Minimally Invasive Surgery: Approaches to the Knee

The popularity of minimally invasive surgery and the ensuing clinical research resulted in several advances in knee arthroplasty. Multimodal pain protocols emerged, coupled with the new surgical techniques, providing surgeons with options that avoid parenteral narcotics and minimize their postoperative side effects. Additionally, rapid therapy protocols gained traction, allowing patients to walk soon after surgery and to return home within days after arthroplasty. Interestingly, while enthusiasm for multimodal pain management and rapid therapy programs continues, there is a general sense that minimally invasive approaches provide an exceedingly small incremental benefit for the patient.

The subvastus approach gained popularity as a less-invasive approach that avoids injury to the quadriceps mechanism. Bourke et al.<sup>9</sup> conducted a systematic review in which the outcomes of the medial parapatellar approach were compared with those of the subvastus approach. They identified five studies that were included by three blinded independent assessors for quality (level III-1 evidence or higher) and suitability

for inclusion in the review. The combined studies included 284 total knee arthroplasties, with similar numbers of procedures having been performed with use of the parapatellar and subvastus approaches. The authors found that there was no significant difference between the groups in terms of the length of hospital stay, the number of days of walking, the range of knee extension motion, patellar avascular necrosis, or patient preference. Bonutti et al.<sup>10</sup> conducted a prospective randomized study in which the mini-subvastus approach was compared with the mini-midvastus approach using a bilateral total knee arthroplasty model. Fifty-one patients were managed with a mini-subvastus approach for one total knee arthroplasty and a simultaneous mini-midvastus approach for the contralateral total knee arthroplasty. The authors measured isokinetic strength of the knees at twelve weeks after total knee arthroplasty and collected data (including blood loss, knee motion, patient preference, and Knee Society scores) at two years of follow-up. In this prospective simultaneous bilateral model comparing the mini-subvastus and mini-midvastus approaches for total knee arthroplasty, there were no significant differences in terms of any of the data analyzed.

Nestor et al.<sup>11</sup> conducted a prospective, randomized, double-blind study in which the mini-midvastus approach was compared with the medial parapatellar approach using a simultaneous bilateral total knee arthroplasty model. Twenty-seven patients participated, with the mini-midvastus approach being used on one side and the standard medial parapatellar approach being used on the contralateral side. Although the authors found significantly increased isokinetic and isometric extension torque at three weeks after surgery in the mini-midvastus group, they found no differences between the groups in terms of stride length, stance time, pain scale scores, or knee motion after surgery. The authors concluded that the mini-midvastus approach provided a negligible benefit in terms of the speed of recovery and ultimate function after total knee arthroplasty. Wülker et al.<sup>12</sup> also conducted a prospective randomized study in which minimally invasive total knee arthroplasty was compared with standard total knee arthroplasty. The study included 134 patients, and the authors defined a minimally invasive approach as one associated with an incision of <15 cm in which the surgeon used minimally invasive instruments. Both groups were subject to the same arthrotomy (medial parapatellar or midvastus) as the skin incision and instruments were the defining qualities of a minimally invasive approach. Not surprisingly, the authors found no significant differences between the groups in terms of pain, activities, or the Knee Society score. The conclusion that the skin incision does not influence patient outcomes after total knee arthroplasty is now well understood and acknowledged by arthroplasty surgeons.

### Perioperative Care

Perioperative management protocols for total knee arthroplasty have evolved to include not only pain management but

## WHAT'S NEW IN ADULT RECONSTRUCTIVE KNEE SURGERY

also rapid ambulation protocols, blood conservation strategies, and patient education. The beneficial effects of organized, procedure-directed management protocols are in the process of being described and have gained tremendous favor among surgeons.

The effect of patient education on perioperative milestones and outcomes has not been well defined. Yoon et al.<sup>13</sup> began a one-on-one patient education program at their institution to preoperatively teach patients about arthroplasty and appropriate expectations. Program educators followed a course guide that reviewed the procedure and various perioperative events and expectation, and patients were allowed to ask questions. Although the study design could have allowed for patient selection bias, the authors did find a one-day shorter length of stay for patients who participated in the education program as compared with those who did not (3.1 compared with 4.1 days). The success of such programs appears to be encouraging, and the cost effectiveness of such programs is unclear.

Considering recent national guidelines regarding preoperative prophylactic antibiotic usage and timing, there are surprisingly scant data driving evidence-based decision-making. Tyllianakis et al.<sup>14</sup> studied antibiotic usage at an institution in Greece at which methicillin-resistant staphylococcal infections represented >25% of all orthopaedic infections. In that study, 470 patients were prospectively randomized to receive cefuroxime, fusidic acid, or vancomycin and were followed for superficial or deep infection after hip or knee arthroplasty. The authors found no significant difference between the antibiotic choices and concluded that they did not recommend antistaphylococcal agents before total knee arthroplasty. However, considering that the authors identified only two deep infections in the entire series, it is highly likely that the study lacked the power to answer any questions regarding antibiotic use. The authors acknowledged this point and stated that it was difficult to provide any definitive conclusions based on the data.

Blood management protocols attempt to limit blood loss during total knee arthroplasty as well as to limit transfusions after total knee arthroplasty. Efforts to increase the preoperative hemoglobin level and evolving perspectives regarding the medical need for transfusion have led to a decrease in allogeneic transfusions. There has been a recent growing interest in the use of tranexamic acid to limit the bleeding and the postoperative hemoglobin drop associated with arthroplasty. Tranexamic acid can be administered parenterally or topically at the time of surgery. Wong et al.<sup>15</sup> addressed the efficacy of topical tranexamic acid after total knee arthroplasty in a randomized, prospective, double-blind, placebo-controlled trial. The authors randomized 124 patients undergoing total knee arthroplasty into three groups. The first group received 1.5 g of tranexamic acid in 100 mL of saline solution, the second group received 3.0 g of tranexamic acid in 100 mL of saline solution, and the third group received 100 mL of saline solution without

drug. The treatment was applied into the knee for five minutes at the end of surgery, and postoperative hemoglobin levels, transfusions, and ultrasound testing for venous thrombi were monitored. The authors found a significant drug effect, as tranexamic acid reduced blood loss and was associated with a higher postoperative hemoglobin level without an increase in thrombus formation. Specifically, blood loss was reduced by about 25% (400 mL) and postoperative hemoglobin levels were higher by 17%. The authors also found minimal drug levels in the blood, reflecting a very low systemic absorption. It appears that tranexamic acid is quite effective for limiting blood loss when applied topically during total knee arthroplasty. Another potential method of decreasing bleeding relates to the method of component implantation. Demey et al.<sup>16</sup> conducted a randomized study to determine whether cementing the femoral component has any effect on blood loss. The medial parapatellar approach was utilized on 107 patients undergoing total knee arthroplasty who were randomized to receive a cemented or an uncemented femoral implant. The total measured blood loss in the study was about 1750 mL, and no significant differences in blood loss, the transfusion rate, or hemoglobin levels were identified. There are several reasons why surgeons may utilize cemented femoral components; however, decreasing perioperative bleeding appears not to be a valid reason.

In addition to blood management, pain control is a main focus of a perioperative protocol. A recent trend in anesthesia for arthroplasty is the move away from general anesthesia toward central and peripheral strategies. Although peripheral blocks can be effective, there remain concerns regarding the possibility of nerve-related complications, including paresthesias, weakness, and, potentially, palsies. McMenemy et al.<sup>17</sup> specifically compared femoral nerve and fascia iliaca anesthesia in a blinded, randomized study of ninety-eight primary total knee arthroplasties. They found no differences between groups in terms of the use of fentanyl after surgery and concluded that the fascia iliaca block is as effective as a femoral nerve block. Although not statistically significant, the authors noted one case of femoral nerve paresthesia in the femoral nerve block group and no nerve-related complications in the fascia iliaca group. In addition to the main anesthetic strategy, many groups have been proponents of periarticular injections during total knee arthroplasty for improved postoperative pain control. Mullaji et al.<sup>18</sup> evaluated the efficacy of a periarticular infiltration consisting of bupivacaine (2 mg/kg body weight), fentanyl (100 µg), methylprednisolone acetate (40 mg), and cefuroxime (750 mg) in a prospective, randomized study design. Forty patients undergoing bilateral total knee arthroplasty agreed to have one of the knees randomly chosen to be injected with the drug combination during surgery. The 25-mL injection was placed into the fat pad, posteromedial tissue sleeve, deep arthrotomy, quadriceps tendon, and medial collateral ligament. The knees were then followed for four weeks postoperatively and were monitored in terms of pain, knee flexion, and quadriceps

## WHAT'S NEW IN ADULT RECONSTRUCTIVE KNEE SURGERY

function. The authors found that pain scores and flexion were superior in the injected knees for up to four weeks, whereas quadriceps function was significantly better for two weeks. Most interesting was the finding that pain was reduced by almost 50% even at the time of the four-week follow-up. Although some have expressed concern regarding the effect of steroid injection on the infection rate, the authors did not report any acute postoperative infections in that study.

Two systematic reviews of prospective randomized studies were recently conducted, one regarding cryotherapy after total knee arthroplasty and one regarding drainage catheter clamping after total knee arthroplasty. Eleven studies involving 739 total knee arthroplasties were included in the systematic review on the efficacy of cryotherapy after total knee arthroplasty, conducted by Adie et al.<sup>19</sup>. The authors looked specifically at blood loss, knee motion, transfusion need, pain, analgesia requirements, swelling, and length of hospital stay. Cryotherapy was associated with a minor decrease in blood loss and a minor improvement in knee motion at the time of hospital discharge, but no other clinical benefits were attributable to cryotherapy. The authors suggested that current evidence does not support the use of cryotherapy after total knee arthroplasty. In a separate systematic review, Tai et al.<sup>20</sup> identified six randomized controlled trials (involving 603 total knee arthroplasties) in which temporary postoperative clamping of the drainage tube was compared with no clamping. A review of the trials demonstrated that although clamping the drainage tube could decrease blood loss, clamping for four hours or more was necessary to result in a true reduction of blood loss. Despite this finding, the authors found no significant differences between the groups with regard to transfusion, knee motion, or wound complications.

Ergometer cycling has been suggested as one strategy to increase patient satisfaction and health-related quality of life after surgery. Liebs et al.<sup>21</sup>, in a randomized study of 362 patients, studied the effect of ergometer cycling beginning two weeks after hip and knee arthroplasty. The authors found that although ergometer cycling was associated with significant improvements in health-related quality of life and satisfaction after total hip replacement, the same benefit was not observed after knee replacement.

### Outcomes Studies

#### *High-Flexion Knee Designs*

Most studies to date have failed to reveal a clinical advantage to the use of high-flexion designs for total knee arthroplasty. In fact, some have argued that the extra bone removal may lead to more difficult revisions that require greater use of augments. On the other hand, there is a theoretical possibility that a long-term benefit is found in association with high-flexion designs that also have lower contact stresses through flexion. Choi et al.<sup>22</sup> conducted a randomized study comparing standard and high-flexion knee implants that had a posterior cruciate-retaining, rotating-platform design. They randomized 170 knees

and followed the patients for a minimum of two years, focusing on clinical scores and radiographic outcomes. The authors found no difference between the groups in terms of maximum flexion or the proportion of patients who could perform activities of deep flexion. Furthermore, clinical scores and radiographic findings were not different between the groups. That study further emphasized the lack of functional benefit associated with high-flexion designs, but the long-term benefit of these designs in terms of implant survival is unknown.

#### *Mobile-Bearing versus Fixed-Bearing Knee Designs*

Although both fixed and mobile-bearing knee replacements have demonstrated excellent short and long-term results, there is no clear clinical evidence supporting the superiority of either design. The clinical equivalency between designs was demonstrated in recent studies. Rahman et al.<sup>23</sup>, in a blinded randomized study, evaluated fifty-one knees that were treated with a cemented cruciate-retaining knee replacement with either a fixed or a mobile-bearing design. The knees were followed radiographically and clinically for a minimum of two years. There was no demonstrable difference between the groups in terms of clinical or functional results, and there was no significant difference in terms of radiographic outcomes. Although the UCLA functional score was significantly better in the rotating-platform group, the authors believe that the effect was due to a difference in the percentage of patients with rheumatoid arthritis between study groups. Luna et al.<sup>24</sup> conducted a randomized study of 312 total knee arthroplasties performed with either a mobile-bearing or fixed-bearing cruciate-substituting design. They followed patients for a minimum of two years and recorded clinical and radiographic data, including Knee Society scores. At a mean of forty-two months of follow-up, the authors demonstrated no significant differences in terms of clinical scores, pain scores, or radiographic findings. Again, they concluded that rotating-platform designs do not confer a clinical advantage. In an extensive review of the literature, Post et al.<sup>25</sup> compared mobile-bearing and fixed-bearing total knee arthroplasties in terms of implant survival, clinical function, and patient preference. Seven articles met their search criteria, and there was no difference between implant designs with respect to implant survival, knee motion, patient preference, or knee scores. The authors concluded that there was no clinical superiority of mobile or fixed-bearing implants. Although they do not appear to have any meaningful clinical advantages over standard designs, mobile-bearing knees can provide excellent long-term outcomes. In a concise follow-up study with a minimum of twenty years of follow-up, Callaghan et al.<sup>26</sup> reported on twenty living patients from an original cohort of 119 consecutive total knee arthroplasties that had been performed with a cemented rotating-platform design. No implants had been revised during the twenty-year follow-up period, and six knees demonstrated radiographic osteolysis (with three demonstrating more osteolysis than they had at

## WHAT'S NEW IN ADULT RECONSTRUCTIVE KNEE SURGERY

the time of the fifteen year follow-up). The only reoperations were performed for the treatment of infection (one) or peri-prosthetic fracture (two). These results demonstrate the durability and functional success of cemented rotating-platform knees. As in previous studies with such long follow-up periods, the occurrence of osteolysis continued to increase through the lifetime of the implant.

### *Total Knee Arthroplasty Outcomes*

Ritter and Meneghini<sup>27</sup> retrospectively reviewed the twenty-year survival rate after cementless total knee arthroplasty. Seventy-three cementless total knee replacements were implanted without screws from 1984 to 1986, and all patients were followed for a minimum of ten years. Only two tibial components failed because of aseptic loosening, at one and two years after surgery. Unfortunately, the metal-backed patellar component used in that series had a high failure rate, with twelve such components requiring revision in the follow-up period. Considering the recent interest in cementless knee replacement, it is encouraging to observe a series of patients with cementless implants that fared so well. The twenty-year survival rate for the cementless tibial component was 96.8%.

Kim et al.<sup>28</sup> conducted a prospective randomized study in which a sex-specific total knee replacement was compared with a standard knee replacement. Eighty-five women undergoing bilateral total knee arthroplasty received the standard design in one knee and the sex-specific design in the contralateral knee. The patients were followed for a mean of two years and were monitored with use of a variety of scoring systems and radiographic reviews. Although postoperative radiographs revealed significant improvement in matching the distal femoral aspect ratio in association with the sex-specific implants, the authors found no clinically relevant differences between the sex-specific and standard designs. Longer-term follow-up is necessary to ascertain differences in implant survival that may result from differences in patellofemoral or posterior condylar contact stress between designs. Interestingly, Mahoney and Kinsey<sup>29</sup> looked specifically at femoral component overhang in relation to outcomes after total knee arthroplasty. The investigators intraoperatively measured femoral component medial and lateral overhang at various points in 437 knees that had received the same type of total knee replacement. They identified overhang in one or more areas in 40% of male patients and 68% of female patients, most often at the distal part of the lateral aspect of the femur. Female sex, short height, and large femoral sizing were predictive of overhang. Importantly, overhang of  $\geq 3$  mm was associated with an almost twofold increase in knee pain that was more severe than occasional or mild at two years after surgery. The clinical importance of the distal femoral aspect ratio and implant overhang requires further study to warrant appropriate clinical recommendations or conclusions.

There also have been more reports in the literature focusing on a monoblock porous metal tibial implant. Porous

metal implants, which can be made with titanium, tantalum, and other metals, have become increasingly used for primary and revision total knee arthroplasty. O'Keefe et al.<sup>30</sup> reported the minimum five-year results of 125 total knee arthroplasties that had been performed with use of a monoblock pegged tibial component made of porous tantalum. The plateau was cemented and the pegged areas were left uncemented for ingrowth. The authors reported 100% implant survival at five years. The absence of loosening, osteolysis, or changes in bone density are extremely encouraging for these implants; however, larger numbers of patients are required to make firm conclusions. Using the same implant, without cementing the tibial plateau, Wilson et al.<sup>31</sup> studied the inducible displacement of tantalum porous metal tibial implants as compared with standard cemented implants. They utilized radiostereometric analysis at six, twelve, and twenty-four months postoperatively to study fourteen tantalum porous tibiae and eleven uncemented tibiae. The tantalum porous metal tibial implants demonstrated a significant decrease in inducible motion for all tests applied, suggesting excellent fixation and likely a promising long-term prognosis. It appears that the use of porous metal ingrowth materials such as tantalum can provide excellent fixation and intermediate-term survival.

There has been recent discussion and controversy regarding the importance of the mechanical axis as the target axis for total knee arthroplasty alignment. Although several studies have suggested the importance of the mechanical axis to function and implant survival after total knee arthroplasty, Parratte et al.<sup>32</sup>, in a report on a cohort of 398 patients, concluded that deviation from the mechanical axis does not cause decreased implant survival after total knee arthroplasty. The authors identified a group of 292 patients with a neutral mechanical axis (an axis within  $3^\circ$  of neutral) and an outlier group of 106 implants. The authors found no significant differences between the groups in terms of the fifteen-year Kaplan-Meier survival curves and concluded that the mechanical axis is of little practical value as a dichotomous value. However, there are two main sources of potential effect dilution that could compromise the conclusions. First, varus and valgus outliers were grouped together, potentially diluting any poor outcomes that could have resulted from the knees aligned in varus. Second, the total knee arthroplasties were performed by a master surgeon whose outliers were generally not considerable, leaving a large population of outliers in the range of  $4^\circ$  or  $5^\circ$  from neutral. Even assuming a minimal standard radiographic measurement error of  $1^\circ$ , the knees measured at  $3^\circ$  and  $4^\circ$  would be often misclassified, further diluting the outlier group. Although one can likely conclude that small deviations from a neutral mechanical axis are not catastrophic, larger studies are likely more appropriate to make conclusions about the relationship between implant alignment and survival.

## WHAT'S NEW IN ADULT RECONSTRUCTIVE KNEE SURGERY

Carl A. Deirmengian, MD  
Jess H. Lonner, MD  
The Rothman Institute, Thomas Jefferson University,  
925 Chestnut Street, 5th floor,

Philadelphia, PA 19107.  
E-mail address for J.H. Lonner: jess.lonner@rothmaninstitute.com  
(C.A. Deirmengian is also affiliated with The Lankenau Institute  
for Medical Research.)

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