Postoperative Radiographic Assessment of the Vega Posterior-Stabilized TKA

AUSTIN M. BEASON, BSC; HAINING ZHANG, MD, PHD; AFSHIN A. ANOUSHIRAVANI, BSC; ZAIN SAYEED, MSC, MHA; MONIQUE C. CHAMBERS, MD, MSL; MOUHANAD M. EL-OUTHMANI, MD; WILLIAM M. MIHALKO, MD, PHD; KHALED J. SALEH, MD, MSC, FRCS(C), MHCM, CPE

Different biomechanical designs are incorporated into various total knee arthroplasty (TKA) implants. The posterior-stabilized prosthesis design utilizes a polyethylene post and femoral cam in place of the posterior cruciate ligament. This produces a more stable component interface, increased range of motion, and potentially a less technical procedure. This study aimed to assess the short-term (>2 year) outcomes associated with the Vega System posterior-stabilized knee prosthesis (Aesculap Implant Systems, Center Valley, Pennsylvania) based on postoperative radiographs using the Knee Society Roentgenographic Evaluation and Scoring System (KSRESS). Thirty-seven TKA patients who had received the Vega posterior-stabilized knee prosthesis and had postoperative radiographs at each follow-up for a minimum of 2 years were enrolled, retrospectively. Two independent observers evaluated the radiographs using KSRESS. Descriptive statistics were used to analyze the data. The average age and body mass index of patients enrolled was 67 years (range, 51-89 years) and 38.5 kg/m$^2$ (range, 21.2-54 kg/m$^2$), respectively. Patients had radiographic follow-up for an average of 36 months (range, 24-58 months). Comparison between first and last available postoperative radiographs revealed a stable femoral and tibial interface with no significant change in prosthesis alignment over the follow-up period. Assessment of the short-term survivorship of the Vega posterior-stabilized prosthesis using KSRESS revealed no significant change in alignment after 2 years of follow-up; however, mid- to long-term studies assessing this junction are needed. A future prospective study using KSRESS in combination with clinical follow-up is recommended to allow comparison of the Vega posterior-stabilized to other prostheses. [Orthopedics. 2016; 39(3):S56-S60.]

Total knee arthroplasty (TKA) is one of the most effective surgical procedures for the definitive management of degenerative joint disease.\(^1\)\(^-\)\(^3\) If current trends continue, it is projected that demand for primary TKA in the United States will reach 3.48 million annual procedures by 2030, representing an increase of 673% from 2005.\(^4\) The expected growth in demand has been at least partially attributed to longer life expectancies and an increase in the number of patients younger than 65 undergoing TKA.\(^5\) The rise in TKAs in the younger population has been attributed to...
increasingly active lifestyles, higher numbers of sports-related injuries, and improvements in prosthesis longevity, making TKA a favorable option earlier in life. As younger patients are opting for TKA, it has become critical to assess the survivorship of available implants.

One of the most common controversies surrounding TKA is the decision between using a posterior-stabilized or posterior cruciate-retaining prosthesis. Proponents of cruciate-retaining prostheses have cited advantages including a more natural recreation of joint kinematics, bone and soft tissue preservation, as well as retention of ligamentous proprioception. Advocates of the posterior-stabilized design, which utilizes a cam and post mechanism as a substitute for the posterior cruciate ligament (PCL), have reported that the procedure is technically less demanding, provides a more stable bone-prosthesis-interface, and has improved range of motion. The posterior-stabilized prosthesis has been shown to reduce posterior femoral rollback and to achieve better results in weight-bearing at maximum flexion. Moreover, the posterior-stabilized prosthesis may correlate with reduced posterior knee pain with passive flexion resulting in higher patient satisfaction. Aseptic loosening, infection, instability, periprosthetic fracture, and arthrofibrosis have been reported as the leading causes of revision TKA in both posterior-stabilized and cruciate-retaining knee implants. However, instability as a mode of failure has been demonstrated to be less prevalent in posterior-stabilized prostheses compared with cruciate-retaining prostheses, suggesting proper alignment may be more reliably maintained with the posterior-stabilized design.

The Vega System (Aesculap Implant Systems, Center Valley, Pennsylvania) is a posterior-stabilized knee prosthesis designed with the purpose of enhancing joint biomechanics, implant stability, and ultimately improving prosthesis longevity. The purpose of this study is to use the Knee Society Roentgenographic Evaluation Scoring System (KSRESS) to assess the survivorship of the Vega System posterior-stabilized knee prosthesis.

**Materials and Methods**

Data for this study were attained through retrospective chart review at a level 1 academic trauma center in central Illinois. Before retrospective analysis, Institutional Review Board approval was obtained for patients operated on between September 2009 and May 2013. Patients included in this study all received the Vega System knee prosthesis through an anteromedial parapatellar approach and were followed for a minimum of 2 years as confirmed with radiographs. In total, 37 (n=37) consecutive TKA patients were identified and included in this study. All procedures were performed at one institution by a single fellowship-trained orthopedic surgeon. Demographic and clinical data were gathered from the patient’s electronic medical record and linked to follow-up radiographs. All patient information was recorded on a password-protected computer using Excel software (Excel, Microsoft Corporation, Redmond, Washington) and patient identifiers were removed.

**Radiographs**

At each follow-up visit, all patients received radiographic assessment for a minimum of 2 years postoperatively. Two independent scorers trained in the KSRESS evaluated all postoperative radiographs for each patient. For radiographic assessment, a weight-bearing anterior-posterior view and a lateral view were obtained. All radiographs were scored according to the KSRESS (Figure 1 and Figure 2). The KSRESS is a validated scoring technique that uses standardized methods to measure component alignment on radiographs of the femoral and tibial interface. Furthermore, no other equivalent standardized scoring system exists for evaluating post-operative TKA radiographs.

**Surgical Approach**

All patients received spinal anesthesia and a femoral nerve block with sedation. The Vega System posterior-stabilized knee prosthesis was implanted using the anteromedial parapatellar approach briefly described below. Aseptic technique was utilized, and appropriate prophylactic antibiotics were administered 30 minutes before initial incision. The leg was exsanguinated, and the tourniquet was inflated. The knee was then exposed via an anterior midline incision, medial and lateral flaps were created, and a subsequent medial parapatellar bony...
arthrotomy was performed. Distal femoral cuts were made using the OrthoPilot KneeSuite navigation system (Aesculap) consisting of femoral and tibial pins and tracker balls. After removal of the navigation system, the total knee procedure was continued. The anterior cruciate ligament and PCL were excised to allow mobility and proper balancing of the posterior-stabilized knee prosthesis. Femoral component size was determined by posterior referencing. Laminar spreaders were used to confirm medial and lateral balance and to determine the distance of space present within the joint in flexion and extension. The tibial and femoral components were cemented in that order. Residual cement was removed from each component following insertion. Next, the patella was everted, and the articulating surface of the patella was removed and replaced with a polyethylene button cemented on the posterior aspect of the patella. Placement of the patellar button was then assessed to make certain patellar maltracking was not present. Once all components had been inserted and the cement had adequately hardened, the leg was thoroughly irrigated twice with betadine and normal saline. The arthrotomy was then closed using a medial reefing suture technique, allowing for extra strength and medial tracking of the patella. Postoperatively, all patients received pain control, thromboprophylactic therapy, and a physical rehabilitation regimen to enhance recovery. Full-weight bearing activity was encouraged as tolerated immediately postoperatively.

**Prosthesis**

The Vega System (Aesculap) is a cemented posterior-stabilized knee prosthesis that utilizes an innovative 7-layer advanced surface coating designed to enhance joint articulation and provide improved stability against mechanical stresses. Enhanced scratch resistance and wettability is the intention of the zirconium nitride ceramic surface layer of the coating employed by the Vega System. No design changes have been made to the prosthesis since its introduction to the market.

**Statistical Analysis**

De-identified data were recorded by each scorer in 2 independent Excel spreadsheets. After the completion of radiographic scoring, scorer spreadsheets were merged, respective scores were averaged, and the measurements were evaluated for discrepancies. Radiographs with discrepancies were reevaluated by a third reviewer also trained in KSRESS. Descriptive statistical analysis was then performed to objectively examine the collected data. Femoral flexion (α and γ), tibial angle and tibial slope (β and δ), and femorotibial angle (α+β) as defined by the KSRESS were reported as mean, range, and standard deviation. All statistical analysis was performed using SAS 9.3 (SAS Institute Inc, Cary, North Carolina) software package.

**RESULTS**

**Demographic and Baseline Characteristics**

Thirty-seven TKA patients had clinical and radiographic follow-up for an average of 36 months (range, 24-58 months). The cohort consisted of 13 men and 24 women, with an average age and body mass index of 67 years (range, 51-89 years) and 38.5 kg/m² (range, 21.2-54.0 kg/m²), respectively. The most prevalent comorbidities in the current authors’ patient population were: diabetes mellitus (n=8, 21.6%), osteoporosis (n=5, 13.5%), osteopenia (n=2, 5.4%), chronic obstructive pulmonary disease (n=2, 5.4%), chronic kidney disease (n=2, 5.4%), and irritable bowel syndrome (n=2, 5.4%). No patients included in this study underwent revision TKA for any reason. History of substance abuse was reported in 11 patients, 6 were current smokers (16.2%), 4 were former smokers (10.8%), 1 reported a history of marijuana use (2.7%), and the remaining 26 patients reported no substance abuse (70.3%).

**Radiographic**

On the first available postoperative radiograph the mean femoral flexion (α) was 94° (SD, 2°; range, 89°-98°), the mean tibial angle (β) was 88° (SD, 2°; range, 83°-93°), the mean femoral flexion (γ) was 21° (SD, 5°; range, 4°-30°), the mean tibial slope (δ) was 92° (SD, 3°; range, 86°-99°), and the mean femorotibial angle (α+β) was 182° varus (SD, 3°; range, 172°-190°) (Table 1).

On the last available postoperative radiograph (at minimum of 2 years follow-up) the mean femoral flexion (α) was 94° (SD, 2°; range, 90°-98°), the mean tibial angle (β) was 88° (SD, 3°; range, 80°-93°), the mean femoral flexion (γ) was 21° (SD, 5°; range, 5°-32°), the mean tibial slope (δ) was 92° (SD, 3°; range, 85°-98°), and the mean femorotibial angle (α+β) was 183° varus (SD, 3°; range, 170°-188°) (Table 1).

The mean differences between the first and last postoperative radiographic femoral and tibial angles were: Δα -0.05° (SD, 1.56°; range, -2.48°-3.61°), Δβ -0.18° (SD 1.38° range, -2.54°-3.67°), Δγ -0.61° (SD, 2.14°; range, -9.30°-3.79°), Δδ 0.34° (SD, 1.41°; range, -3.08°-4.07°), and Δfemorotibial angle was -0.23° valgus (SD, 2.24°; range, -3.26° valgus-6.03° varus) (Table 1).

The initial postoperative radiograph displayed that joint line alignment of the knee (femorotibial angle, α+β) was neutral (176°-184°) in 25 (67.6%) patients, varus (≥184°) in 11 (29.7%), and valgus (≤175.9°) in 1 (2.7%). The final postoperative radiograph demonstrated overall joint line alignment of the knee (femorotibial angle, α+β) was neutral in 17 (45.9%) patients, varus in 18 (48.6%), and valgus in 2 (5.4%) (Table 2).

**DISCUSSION**

This study aims to evaluate the 2-year radiographic outcomes after primary TKA in patients receiving the Vega System posterior-stabilized knee. This is the first reported survivorship study of the Vega System using a validated radiographic scoring technique.

The KSRESS was first published in 1989 and continues to be endorsed by the American Knee Society (AKS) as a means to objectively evaluate postoperative radiographs after TKA. The AKS recommendations for assessing knee prosthesis component alignment suggest using serial postoperative
anteposterior and lateral radiographic evaluation. While there has been a recent shift toward measuring functional outcomes using the Knee Injury and Osteoarthritis Outcome Score, the Knee Outcome Survey Activities of Daily Living, Oxford Knee Score, or Western Ontario and McMaster Universities Osteoarthritis Index, such scoring systems lack an objective component that allows for radiographic assessment of the post-TKA knee. As the need for radiographic assessment of alignment continues to be an important aspect of postoperative evaluation, these functional assessment tools are often used in conjunction with the KSRESS. Furthermore, as the aim of the current authors’ study was to objectively assess the survivorship of the Vega System, the KSRESS was used exclusively to evaluate postoperative TKA radiographs.

The AKS acknowledges that no rating system is perfect; however, an established scoring system enables standardized reporting and comparisons regarding various implants. In addition to being an intuitive scoring system, the KSRESS can be completed for a set of radiographs in less than 10 minutes, making it efficient to use. Standardization in terms of radiograph positioning, rotation, and alignment in any scoring system is inherently difficult; however, the current authors’ cohort reported minimal standard deviation suggesting strong concordance. To ensure standardization in the current authors’ study, both scorers were trained and evaluated prior to data analysis. Trained researchers scored multiple sample radiographs together to practice using the KSRESS and ensure consistent scoring methods. Radiographs in this study were scored on the Picture Achieving Collections System (PACS, Rochester, New York) at a preset resolution with zoom capabilities. Additionally, if a discrepancy was observed between independent scores, a third scorer evaluated the radiographs. A commonly cited concern with the KSRESS is that it was originally designed when digital radiographs were not available. However, a study by Lohman et al reported no difference in scoring accuracy when the KSRESS technique was used on digital images and plain films.

The KSRESS provides a reliable means of assessing the osteo-implant interface, leg and knee alignment, and component position. Furthermore, restoration of anatomic alignment, as assessed by KSRESS, has been linked to improved prosthesis survival and optimal functionality following TKA. Within the current authors’ cohort, the majority

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<tr>
<th>Angle Measurement</th>
<th>Mean Initial Available Postoperative Radiographic Follow-up (SD, Range)</th>
<th>Mean Last Available Postoperative Radiographic Follow-up (SD, Range)</th>
<th>Mean Angle Difference Between Initial and Last Available Postoperative Radiograph (SD, Range)</th>
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</thead>
<tbody>
<tr>
<td>Femoral flexion (α)</td>
<td>94° (1.98°, 89°-98°)</td>
<td>94° (1.56°, 90°-98°)</td>
<td>-0.05° (1.56°, -2.48°-3.61°)</td>
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<tr>
<td>Tibial angle (β)</td>
<td>88° (2.11°, 83°-93°)</td>
<td>88° (2.51°, 80°-93°)</td>
<td>-0.18° (1.38°, -2.54°-3.67°)</td>
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<tr>
<td>Femoral flexion (γ)</td>
<td>21° (4.59°, 4°-30°)</td>
<td>21° (4.86°, 50°-32°)</td>
<td>-0.61° (2.14°, -9.30°-3.79°)</td>
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<tr>
<td>Tibial slope (δ)</td>
<td>92° (2.76°, 86°-99°)</td>
<td>92° (2.65°, 85°-98°)</td>
<td>0.34° (1.41°, -3.08°-4.07°)</td>
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<tr>
<td>Femorotibial angle (α+β)</td>
<td>182° varus (3.26, 172° valgus-190° varus)</td>
<td>183° varus (3.29, 170° valgus-188° varus)</td>
<td>-0.23° varus (2.24°, -3.26° valgus-6.03° varus)</td>
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Abbreviation: KSRESS, Knee Society Roentgenographic Evaluation and Scoring System.
of patients with the Vega System were noted to have normal alignment of the knee upon last available follow-up, defined as 2° to 3° of varus by KSRESS measurement.19

The current authors’ results demonstrated minimal component migration through the interim of this study. Mean differences between all angles scored on the initial postoperative radiographs and the last available radiographs were less than 1°. Such minimal difference suggests that the Vega System provides a stable fixation while maintaining leg and knee alignment. Furthermore, consistent prosthetic alignment contributes positively to long-term implant survival, suggesting the favorable short-term alignment properties of the Vega System observed in this study may translate to implant longevity.18,20-24 Future long-term studies assessing both clinical and radiographic outcomes are warranted to corroborate these short-term findings.

The current authors’ study has limitations that include a short duration and a small sample size from a single institution. Such limitations are inherent to any assessment of a new prosthesis. Furthermore, as the aim of this study was to assess implant properties and survivorship, the analysis of other non-radiographic findings such as functional outcomes and quality-of-life are best suited for report in future studies. Moreover, long-term analysis, comparative reporting, and multi-surgeon studies are, justifiably, the current authors’ study is unique in that it reports robust radiographic findings that suggest favorable fixation and alignment trends with the Vega System.

CONCLUSION

As the demand for TKA continues to rise, surgeons and manufacturers will continue to refine future prostheses with the aim of improving implant survivorship, while minimizing cost and complications. In conclusion, the current authors’ study demonstrates that the Vega System has favorable short-term radiographic outcomes, and future studies assessing long-term survivorship are warranted.

REFERENCES


