

EXACTECH | KNEE

LITERATURE REVIEW

OPTETRAK LOGIC

Longevity	2
Femur	3
Tibia	4
CR.....	5
PS.....	7
CC.....	7

EXACTECH GPS

Accuracy and Alignment with Computer-Assisted Surgery.....	1
Patient Satisfaction after Conventional TKA.....	3
Reduced Risks and Complications Through the Use of Computer-Assisted Surgery.....	4
Computer-Assisted Surgery Impact on Revision Rates.....	6

Literature Review

LONGEVITY

ELEVEN-YEAR IMPLANT SURVIVAL RATES OF THE ALL-POLYETHYLENE AND METAL-BACKED MODULAR OPTETRAK POSTERIOR STABILIZED KNEE IN BILATERAL SIMULTANEOUS CASES.

Robinson RP, Green TM. *J Arthroplasty*. 2011 Dec;26(8):1165-9. Epub 2011 Mar 16.

Abstract: A prospective randomized study was conducted to determine if a design change in the articular surface geometry introduced in the Optetrak total knee to increase prosthetic joint conformity and further reduce polyethylene stress had any impact on implant survival, particularly when the all-polyethylene version of the implant was used. Forty-seven patients undergoing bilateral simultaneous total knee arthroplasties were randomized for the side, receiving an all-polyethylene tibial component and followed up for a mean 11.6 years. Survival rates for the all-polyethylene and metal-backed modular versions of the implant were both 98%, excluding a single case of deep infection. Survival rates with revision for aseptic loosening as an end point were 100%. The increase in tibial and femoral radii in the coronal plane of the Optetrak posterior stabilized knee did not result in a reduced implant survival rate in either the metal-backed modular or all-polyethylene versions of the implant.

FIVE-YEAR FOLLOW-UP OF PRIMARY OPTETRAK POSTERIOR STABILIZED KNEE ARTHROPLASTIES IN OSTEOARTHRITIS.

Robinson RP. *J Arthroplasty*. 2005 Oct;20(7):927-31.

Abstract: A series of 66 primary Optetrak Posterior Stabilized total knees with modular tibial components were followed prospectively for a minimum of 5 years in patients with osteoarthritis. Fifty-one percent of the patients were obese based on body mass index greater than 30. There was a statistically significant negative correlation between body mass index and both Hospital for Special Surgery and Knee Society scores. Despite reduced ratings due to obesity, 90% of the patients were rated good or excellent. Patellofemoral design changes nearly eliminated patellofemoral crepitation and soft tissue entrapment. Design changes did not compromise implant survival. Predicted implant survival at 93 months using reoperation for any reason as an end point was 97%.

CLINICAL PERFORMANCE OF THE OPTETRAK® TOTAL KNEE PROSTHESIS

Ivan A. Gradisar, Jr., M.D., Michael Askew, Ph.D., and Albert H. Burstein, Ph.D.

Purpose: This report details the performance of the Optetrak® total knee system, a knee replacement design introduced in 1994. The femoral/tibial articulation is a bi-concave "sphere on sphere" geometry. Precise femoral/tibial articular matching is designed into the system, eliminating potential mismatch that might compromise polyethylene contact stresses. Patellar flange geometries are optimized to reduce lateral retinacular tissue tension. This report is confined to posterior cruciate retaining prostheses of the system, which is used only in

primary cases. All reconstructions were performed using: a bio-ingrowth femoral prosthesis; a cemented modular, polyethylene, metal-backed tibial prosthesis; and a cemented, all polyethylene patellar prosthesis.

COMPARISON OF CLINICAL RESULTS OF THE THIRD, FOURTH, AND FIFTH GENERATIONS OF THE HOSPITAL FOR SPECIAL SURGERY PROSTHETIC KNEE IMPLANT

Raymond P. Robinson, M.D.

Purpose: This report outlines the design evolution of the Hospital for Special Surgery (HSS) series of knee implant designs and their progress over 28 years through five generations of the series. Throughout the history of this design, a systematic endeavor has been in progress that involved: a) defining the clinical problem of the arthritic knee, b) determining knee design objectives to solve identified problems, c) implant design, d) clinical evaluation, e) retrieval analysis, and f) implant redesign. To aid in the continuing evaluation of this lineage, a comparison of clinical results in the latest three generations was carried out using data compiled prospectively in the author's practice.

FIFTEEN-YEAR TO 19-YEAR FOLLOW-UP OF THE INSALL-BURSTEIN-1 TOTAL KNEE ARTHROPLASTY

Ayesha R. Abdeen, MD, FRCSC,* Stacy B. Collen, BSc,y and Kelly G. Vince, MD, FRCSC*

Abstract: This represents a 15-year to 19-year follow-up of 100 Insall-Burstein-I posterior-stabilized knee prostheses implanted in 86 patients from 1986 to 1989 and originally reported at 10 to 12 years (Thadani et al, 2000). In the original cohort, 6 failures occurred by 10 years. At 15 to 19 years, 55 patients (66 knees) had died; 18 patients were followed with clinical examination and radiographs, and 11 by telephone; 3 knees in 2 patients were lost. There were no new failures or additional surgeries from 10 to 19 years. Three knees exhibited osteolytic lesions. No case required revision due to symptomatic osteolysis or polyethylene wear. Using revision as end point, survival was 92.4% at 19 years. In summary, the prosthesis is likely to outlive the patients when classic indications for age and activity are respected.

LONG-TERM RESULTS OF THE TOTAL CONDYLAR KNEE ARTHROPLASTY. A 15-YEAR SURVIVORSHIP STUDY.

Ranawat CS, Flynn WF Jr, Saddler S, Hansraj KK, Maynard MJ. *Clin Orthop Relat Res*. 1993 Jan;(286):94-102.

Abstract: This study reports the 15-year survivorship of 112 consecutive Total Condylar knee arthroplasties that have been followed since 1974. Two endpoints were chosen for survivorship: (1) Revision attributable to septic or aseptic loosening or malalignment. (2) Revision or roentgenographic evidence of component loosening. Life table analysis reveals a 94.1% clinical survivorship

at 15 years, with an 90.9% survivorship when roentgenographic failures are included. There were five revisions: one for infection, one for instability, and three for tibial loosening. In addition, two tibiae and one patella were considered roentgenographically loose, but were not symptomatic. As of May 1992, 34 patients with 48 knees are known deceased, 15 knees are lost to follow-up evaluation, and 49 knees are available for clinical evaluation. Follow-up data was available on 62 knees for greater than 11 years. Ninety-two percent had good or excellent results, with 1.6% fair and 6.5% poor. Average range of motion was 99 degrees. The average Hospital for Special Surgery knee score was 85. Roentgenographic study revealed lucencies around 72% of tibiae, but only two components were loose. There was a correlation between body weight and the presence of radiolucencies, and patients who weighed more than 80 kg had the lowest survivorship at 15 years: 89.2% clinical survival and 70.6% clinical plus roentgenographic survival. Total Condylar knee arthroplasty has a 94.6% clinical survival at 15 years, with predictably good clinical results.

“This study represents the longest survivorship series of a single total knee prosthesis.” pg. 97 “Nevertheless, this clinical survivorship of 94.1 percent at 15 years agrees well with the previously reported 90.56 percent.” pg. 98

TOTAL CONDYLAR KNEE ARTHROPLASTY. 16- TO 21-YEAR RESULTS.

Gill GS, Joshi AB, Mills DM. *Clin Orthop Relat Res.* 1999 Oct;(367):210-5.

Abstract: This study presents long term results of arthroplasty with posterior cruciate retention using the Total Condylar Knee implant. From 1976 to 1982, 139 patients had 159 knee arthroplasties using Total Condylar Knee prostheses. Sixty-three patients (72 knees) were available for followup at a minimum of 16 years (range, 16-21 years). The average age of the patients at the time of surgery was 61 years. There were 21 men and 42 women. Patients with 68 knees had osteoarthritis, three had rheumatoid arthritis and one had posttraumatic arthritis. There were five delayed complications. One patient (one knee) underwent revision surgery and two patients (two knees) declined revision surgery because they were considered to be high surgical risks, as determined by their internists. The average preoperative score was 40.3 points and improved to 88.4 points at followup. Eighty-seven percent of the patients had a score equal to or more than 85 points at last evaluation. Prosthesis survivorship at 20 years was 98.6% for patients who had revision surgery. No femoral components were revised for aseptic loosening. Retention of the posterior cruciate in Total Condylar Knee prosthesis produces results comparable with the results of the original Total Condylar Knee prosthesis with cruciate sacrifice.

THE INSALL-BURSTEIN TOTAL KNEE REPLACEMENT IN OSTEOARTHRITIS: A 10-YEAR MINIMUM FOLLOW-UP.

Aglietti P, Buzzi R, De Felice R, Giron F. *J Arthroplasty.* 1999 Aug;14(5):560-5.

Abstract: A total of 99 Insall-Burstein posterior stabilized (IBPS) knee replacements were implanted in 86 osteoarthritic patients. We reviewed 60 knees with a 10- to 15-year follow-up. Using the Knee Society score, 35 knees (58%) were excellent, 15 (25%) good, 4 (7%) fair, and 6 (10%) poor. Flexion at follow-up was 106 degrees on average. Moderate patellofemoral crepitation was present in 5 knees (9%), and 11 knee required excision of a synovial nodule proximal to the patella. Radiographic analysis showed 5 osteolytic lesions (8%) around well-fixed tibial and femoral components and minimal (1 mm) narrowing of the medial polyethylene thickness in 7 knees (12%). There were 6 (10%) failures requiring reoperation because of aseptic loosening (4 knees), deep infection (1 knee), and recurrent patellar dislocation (1 knee). Survivorship analysis using revision as the endpoint showed a cumulative success rate of 92% at 10 years. In this study, the IBPS knee has shown good long-term results with low rates of aseptic loosening and no failures attributable to polyethylene wear.

“So far in our experience, no IB PS prosthesis has been revised for wear. We believe this success is due to the design of the surfaces (round on round), conformity in the frontal plane [25], predictability of motion and rollback, and tolerance to some degrees of malalignment without the possibility of edge loading. pg. 564 Flexion at follow-up was 106 ° on average (range, 30°-130°). pg. 561

SURVIVORSHIP OF CEMENTED TOTAL KNEE ARTHROPLASTY

Font-Rodriguez DE, Scuderi GR, Insall JN. *Clin Orthop Relat Res.* 1997 Dec;(345):79-86.

Abstract: The survivorship method of analysis was used to compare the failure rate and overall success of 2629 cemented primary total knee arthroplasties during a 22-year period by the senior surgeon. There were 215 Total Condylar prostheses with a polyethylene tibia, 265 of the Posterior Stabilized type with an all polyethylene tibia, 2036 Posterior Stabilized with a metal backed tibial component, 49 Posterior Stabilized with modular augmented components, and 64 with the Constrained Condylar system. Failure was considered revision or planned revision. The Total Condylar series had an average annual failure rate of 0.46% and a 21-year success rate of 90.77%. The Posterior Stabilized prosthesis with an all polyethylene tibia had an average annual rate of failure of 0.38% and a 16-year success rate of 94.10%, and this prosthesis with a metal backed tibial component had an annual failure rate of 0.14% and a 14-year success rate of 98.10%. The Posterior Stabilized series with modular components had an average annual rate of failure of 0.59% and a 10-year success rate of 93.63%. The Constrained Condylar knee series had an average annual failure rate of 0.26% and a 7-year success rate of 98.12%. This review represents a retrospective analysis of consecutive series of cemented, total knee arthroplasties, whose annual failure and success rates were done during differing time spans. The overall success rate was not influenced by gender, age, diagnosis, or percentage of ideal body weight. Failure was considered revision or planned revision. The best and worse case scenarios were calculated for each series. Long term results of cemented, total knee arthroplasty with a relatively conforming articular surface has been shown to be a reliable procedure with excellent survivorship.

FEMUR

PATELLOFEMORAL FUNCTION AFTER TOTAL KNEE ARTHROPLASTY: A COMPARISON OF 2 POSTERIOR-STABILIZED DESIGNS.

Anderson JA, Baldini A, Sculco TP. *J Knee Surg.* 2008 Apr;21(2):91-6.

Abstract: Knee complications and function were analyzed in patients with 2 different posterior-stabilized total knee arthroplasty (TKA) designs, Optetrak 913 and Insall-Burstein II. Three hundred Insall-Burstein II knees with mean follow-up of 8 years (range: 5-9 years) and 300 Optetrak knees with mean follow-up of 6 years (range: 5-7 years) were studied. Lateral retinacular release was performed in 30% of Insall-Burstein II patients and 16% of Optetrak patients ($P = 0.001$), and patellar clunk was 4% for the Insall-Burstein II prosthesis and 0.3% for the Optetrak prosthesis ($P = 0.003$). No statistically significant differences in dislocation, fracture, or loosening rates were observed between the 2 groups. Knee Society scores were similar in 2 groups of 50 patients brought back to the office. Mean Knee Society knee scores were 92 and 94 for the Insall-Burstein II and Optetrak groups, respectively ($P > 0.05$), and function scores were 80 and 84 for the 2 groups, respectively ($P > 0.05$). At mid-term follow-up, Optetrak patients were less likely than Insall-Burstein II patients to require lateral retinacular release and experience patellar clunk.

“At intermediate follow-up, both the Insall-Burstein II and Optetrak prosthesis had good overall clinical outcomes. However, patients with the Optetrak prosthesis were less likely to require lateral retinacular release and experience patellar clunk than patients with the Insall-Burstein II prosthesis.” pg. 94

“In the intermediate term, we found that a constrained condylar knee implant without stem extensions functions well in patients with valgus knees having primary TKAs.” pg. 202

BEARING SURFACE DESIGN CHANGES AFFECT CONTACT PATTERNS IN TOTAL KNEE ARTHROPLASTY.

Cottrell JM, Townsend E, Lipman J, Sculco TP, Wright TM. *Clin Orthop Relat Res.* 2007 Nov;464:127-31.

Abstract: The impact of design changes intended to improve wear of knee replacements can be assessed from analysis of retrieved implants. We hypothesized changes in bearing surface conformity from the Insall-Burstein II knee to a successor, the Optetrak, intended to improve contact stresses would be apparent in wear patterns observed on retrieved tibial inserts. From 151 Insall-Burstein II and 54 Optetrak retrieved components, 35 pairs (Insall-Burstein II and Optetrak) were matched on length of implantation, body mass index, and age. Digital images of the bearing surfaces were used to identify and measure wear modes, which were then converted to a percentage of the total possible contact area. Burnishing was the most prevalent mode for both designs followed by scratching and then pitting. The percentage of involved area was greater for the Optetrak for 23 pairs. Interestingly, for the nine matched pairs with length of implantation longer than 2 years, six of the Insall-Burstein II inserts had considerably greater scratching and pitting and five exhibited abrasion and creep absent from Optetrak implants. Bearing surface design is a major factor that can affect kinematics and contact patterns. Our observations confirm the considerable impact of small changes in conformity and suggest models predicting contact stresses adequately reflect in vivo performance.

“Our results demonstrate the Optetrak’s increased conformity did indeed lead to increased contact area and therefore decreased wear related damage as was predicted by numerical analyses.” “From the numerical analysis, the conformity changes (an alteration in ML ratios of the femoral to tibial radii from 0.94-0.96) reduced contact stress by approximately one-third.” pg. 130

PRIMARY CONSTRAINED CONDYLAR KNEE ARTHROPLASTY WITHOUT STEM EXTENSIONS FOR THE VALGUS KNEE.

Anderson J, Baldini A, et al. *Clin Orthop Relat Res.* 2006 Jan;442:199-203.

Avoiding stem extensions in total knee arthroplasties may decrease operative time, prosthetic cost, and canal invasion at surgery. A constrained condylar knee implant without stem extensions also likely will be easier to revise and will eliminate the risk of end of stem pain. Our hypothesis was that a constrained condylar knee implant for primary severely deformed knees would show excellent midterm results with a low rate of aseptic loosening, even without diaphyseal-engaging stems. We retrospectively reviewed 70 consecutive primary constrained condylar knee implants without stem extensions from 1998 to 2001 in 61 patients with knees in 15 degrees valgus or greater. Forty-nine patients (55 knees) were followed up for 44.5 months (range, 2-6 years). Outcome was assessed using the Knee Society scoring system. Knee Society score and functional scores improved from 34 points and 40 points to 93 and 74 points, respectively. No radiographic loosening or wear was found. There were no peroneal nerve palsies, and no patients had flexion or medial instability. One patient was affected by chronic patellar dislocation. Constrained condylar knee implants in patients with severe valgus deformity resulted in pain relief and improved function, without substantial complications at midterm followup, without diaphyseal-engaging stem extensions. Level of Evidence: Therapeutic study, Level IV (case series). See the Guidelines for Authors for a complete description of levels of evidence.

TIBIA

STRESSES IN POLYETHYLENE COMPONENTS OF CONTEMPORARY TOTAL KNEE REPLACEMENTS.

Bartel DL, Rawlinson JJ, Burstein AH, Ranawat CS, Flynn WF Jr. *Clin Orthop Relat Res.* 1995 Aug;(317):76-82.

Abstract: Contemporary knee designs differ considerably in the conformity that exists between the articulating surfaces of the femoral and tibial components. The thickness of the polyethylene components also varies from design to design. Conformity and thickness affect the stresses associated with surface damage and the subsequent generation of harmful polyethylene debris. In this study, the stresses and strains caused by contact were calculated for 8 contemporary knee prostheses. Finite element analysis using large-strain theory was used to determine the stresses and strains for the minimum available polyethylene thickness and for the knee in flexion. The greatest differences among designs was for the von Mises strain, which reached its maximum beneath the surface. The differences in stresses were less notable because of the nonlinear material behavior of the polyethylene. This study also confirmed the advantages of designs that have more conforming articulating surfaces and thicker polyethylene components.

“The conformity of the articulating surfaces plays a prominent role in the stresses caused by contact.” pg. 80 “The contact stress was greater for the more nonconforming designs.” pg. 79

A COMPARISON OF KNEE SIMULATOR WEAR RATES BETWEEN DIRECTLY MOLDED AND EXTRUDED UHMWPE.

Furman BD, Lai S, Li S. Presented at Society for Biomaterials, 2001.

Abstract: Tibial inserts made by direct molding of a resin other than 1900 (1020HP) provide components which are resistant to post gamma irradiation aging and also provide a 83% reduction in wear rate and 52% less damaged area than tibial inserts of a similar design made by machining extruded UHMWPE. This demonstrates that directly molded contemporary knee designs made from resins other than 1900 may continue to benefit from the historical advantages of the directly molded 1900 products.

“The damage area of the components averaged is presented in Table 1 and 20.9 percent. The average wear rate was 2 mg/million cycles. “The average damage area for directly molded inserts in this case was 52 percent less than that for the IB II machined inserts.” pg. 1

BACKSIDE WEAR IN MODERN TOTAL KNEE DESIGNS.

Jayabalan P, Furman BD, Cottrell JM, Wright TM. *HSS J.* 2007 Feb;3(1):30-4.

Abstract: Although modularity affords various options to the orthopedic surgeon, these benefits come at a price. The unintended bearing surface between the back surface of the tibial insert and the metallic tray results in micromotion leading to polyethylene wear debris. The objective of this study was to examine the backside wear of tibial inserts from three modern total knee designs with very different locking mechanisms: Insall-Burstein II (IB II), Optetrak, and Advance. A random sample of 71 inserts were obtained from our institution’s retrieval collection and

examined to assess the extent of wear, depth of wear, and wear damage modes. Patient records were also obtained to determine patient age, body mass index, length of implantation, and reason for revision. Modes of wear damage (abrasion, burnishing, scratching, delamination, third body debris, surface deformation, and pitting) were then scored in each zone from 0 to 3 (0 = 0%, 1 = 0-10%, 2 = 10-50%, and 3 = >50%). The depth of wear was subjectively identified as removal of manufacturing identification markings stamped onto the inferior surface of the polyethylene. Both Advance and IB II polyethylene inserts showed significantly higher scores for backside wear than the Optetrak inserts. All IB II and Advance implants showed evidence of backside wear, whereas 17% (5 out of 30) of the retrieved Optetrak implants had no observable wear. There were no significant differences when comparing the depth of wear score between designs. The locking mechanism greatly affects the propensity for wear and should be considered when choosing a knee implant system.

“Both the IB II and Advance designs use a partial capture mechanism, restraining motion in one plane, but providing only partial restraint in other planes. The Optetrak design, however, uses a full peripheral capture to restrain motion in all directions. The result is a significant reduction in the amount of backside wear compared with the other two implants examined in this study.”
pg. 33

IN VIVO DETERIORATION OF TIBIAL BASEPLATE LOCKING MECHANISMS IN CONTEMPORARY MODULAR TOTAL KNEE COMPONENTS.

Engl GA, Lounici S, Rao AR, Collier MB. *J Bone Joint Surg Am.* 2001 Nov;83-A(11):1660-5.

Background: The results of recent studies documenting the backside wear of polyethylene inserts retrieved from total knee implants call into question the stability of the locking mechanisms of modular tibial components. Wear of the metal tibial baseplate suggests that the capture mechanisms of some modular fixed-bearing tibial components do not adequately restrict in vivo motion of the insert. The purposes of this study were (1) to present a method for evaluating locking-mechanism stability and (2) to investigate the stability of modular tibial components after an interval in vivo. **Methods:** We measured the anteroposterior and mediolateral motion between the polyethylene insert and the tibial tray in a variety of modular total knee tibial components. A uniaxial mechanical testing machine was used to evaluate the stability of ten unimplanted components (control group), fifteen implants obtained from patients who were undergoing revision total knee arthroplasty (revision group), and fifteen devices retrieved post mortem (autopsy group). We applied loads along the anteroposterior and mediolateral axes of the tibial component and recorded the maximum insert displacement that occurred. From this value, we calculated an insert-motion index, the magnitude of a two-dimensional vector that represented the total motion in the transverse plane.

This paper demonstrates the importance of having an effective locking mechanism. “The results of our study demonstrate that the instability inherent in contemporary modular tibial tray locking mechanisms increases with in vivo physiological loading.” pg. 1664

THE STABILITY OF THE CEMENTED TIBIAL COMPONENT OF TOTAL KNEE ARTHROPLASTY.

Catani F, Leardini A, Ensini A, Cucca G, Bragonzoni L, Toksvig-Larsen S, Giannini S. *J Arthroplasty.* 2004 Sep;19(6):775-82.

Abstract: Micromotion of the tibial component in 40 knee arthroplasties for gonarthrosis was studied using Roentgen stereophotogrammetric analysis. The stability of this component was assessed for 2 years' postoperatively. In all arthroplasties, an attempt was made to reconstruct the preoperative posterior slope. Posterior cruciate-retaining (CR) and posterior-stabilized (PS) components showed at 2 years a maximum total point motion of 0.6 +/- 0.4 mm and 0.7 +/- 0.5 mm, respectively. Whereas 92.5% of the implants were determined to be stable, 1 of the CR group and 2 of the PS group displayed migration between the first and the second year of at least 0.2 mm. A negative correlation between subsidence of the tibial component at 2 years of follow-up and the difference between preoperative and postoperative tibial slope was found. Consequently, we suggest that restoring the original posterior slope of the tibial plateau must be a goal of tibial component implantation.

ASSESSMENT OF BACKSIDE WEAR FROM THE ANALYSIS OF 55 RETRIEVED TIBIAL INSERTS.

Li S, Scuderi G, Furman BD, Bhattacharyya S, Schmiegg JJ, Insall JN. *Clin Orthop Relat Res.* 2002 Nov;(404):75-82.

Abstract: Fifty-five retrieved tibial inserts with four different locking mechanisms were evaluated for evidence for polyethylene wear between the inferior surface of the tibial insert and metal tray. This type of wear will be referred to as backside wear. Backside wear was assessed by evaluating manufacturer's stamped markings on the inferior polyethylene surface. Because these markings are embossed into the polyethylene surface, they were used as indicators of backside wear. Decreases in the depths of markings indicated that backside wear was clearly evident, regardless of design, in 24 (44%) of the inserts. In eight of these 24 inserts, the manufacturer's stamped markings were removed completely. The amount of polyethylene wear was as high as 591 mg from the inferior surface. This corresponds to a polyethylene wear rate from the backside of the tibial insert of greater than 100 mg per year, which is two to four times higher than wear rates associated with total hip replacements. The current work provides direct evidence of backside wear in all four tibial insert designs. Backside wear of tibial inserts can be a significant contributor to polyethylene wear in total knee arthroplasty. Close attention should be given to the fixation of tibial inserts to metal trays by manufacturers and surgeons.

“The current results provide additional direct evidence that backside wear in tibial inserts can be a major contributor to polyethylene wear in total knee replacements.” pg.79-80



INTRODUCING A NEW TECHNIQUE FOR IMPROVING PREDICTABILITY IN CRUCIATE-RETAINING TOTAL KNEE ARTHROPLASTY: THE POSTERIOR CRUCIATE REFERENCING TECHNIQUE

Covall, David J. MD; Stulberg, Bernard N. MD; Mabrey, Jay MD; Burstein, Albert H. PhD; Angibaud, Laurent D. BS; Smith, Keisha BS; Zadzilka, Jayson D. MS. *Techniques in Knee Surgery: December 2009 - Volume 8 - Issue 4 - pp 271-275.*

Abstract: Posterior cruciate ligament (PCL) retention in total knee arthroplasty has a number of theoretical and functional advantages, provided the procedure can be carried out predictably. Many knee designs and implantation techniques have been developed to address kinematics and wear performance of cruciate-retaining designs. However, these interventions base theoretical performance on proper tensioning of the PCL. Techniques used to insure proper PCL function include adjusting tibial resection slope, increased resection of the posterior femoral condyle, and selective release of the PCL (or recessing). We present an alternative approach: a technique and a series of implants to optimize PCL function in a predictable manner—"the posterior cruciate referencing technique." Instrumentation has been designed to identify, use, and protect the PCL origins. Sloped tibial insert trials are then used to balance the flexion/extension gap; that is, balance PCL tension to achieve optimal range of motion and stability before final implant selection and insertion. In addition, a study has been conducted to examine intraoperative passive flexion, and illustrate the PCL referencing operative technique with the use of posterior cruciate-retaining tibial implants of varying slopes.

BALANCING THE POSTERIOR CRUCIATE LIGAMENT DURING CRUCIATE-RETAINING FIXED AND MOBILE-BEARING TOTAL KNEE ARTHROPLASTY: DESCRIPTION OF THE PULL-OUT LIFT-OFF AND SLIDE-BACK TESTS.

Scott RD, Chmell MJ. *J Arthroplasty*. 2008 Jun;23(4):605-8.

Abstract: Total knee arthroplasty (TKA) with posterior cruciate ligament (PCL) preservation is a technically demanding procedure but one that has been associated with excellent long-term results. It is crucial during this procedure that the PCL be placed under appropriate tension such that the kinetic benefits of its retention can be gained and so that the adverse affects of its being excessively tight or lax can be avoided. We describe 2 simple intraoperative tests that assess PCL tension in fixed-and mobile-bearing TKA. Performance of the "pull-out lift-off" (POLO) test in fixed bearing knees and the "slide-back test" in rotating platform knees will assure appropriate PCL tension after TKA by determining that it is neither too loose nor too tight. The authors have previously described the POLO test; however, this publication is no longer in print and, therefore, is not accessible as a reference (Chmell MJ, Scott RD. Balancing the posterior cruciate ligament during cruciate-retaining total knee arthroplasty: description of the POLO test. *J Orthop Techniques* 1996;4:12.). We therefore deemed it appropriate to once again describe it along with the analogous test for rotating platform TKAs.

"The long-term results of PCL-retaining TKA have proven to be excellent, with survivorship rates of more than 90 percent at greater than 10 years in several series." pg. 605 Use of the intraoperative POLO test for fixed bearings...will help to assure appropriate tension in the PCL after TKA and should decrease complications because of excessive tightness or ligament laxity." pg. 608

THE POSTERIOR CRUCIATE LIGAMENT-PRESERVING TOTAL KNEE REPLACEMENT: DO WE 'PRESERVE' IT? A RADIOLOGICAL STUDY.

Shannon FJ, Cronin JJ, Cleary MS, Eustace SJ, O'Byrne JM. *J Bone Joint Surg Br*. 2007 Jun;89(6):766-71.

Abstract: Our aims were to map the tibial footprint of the posterior cruciate ligament (PCL) using MRI in patients undergoing PCL-preserving total knee replacement, and to document the disruption of this footprint as a result of the tibial cut. In 26 consecutive patients plain radiography and MRI of the knee were performed pre-operatively, and plain radiography post-operatively. The lower margin of the PCL footprint was located a mean of 1 mm (-10 to 8) above the upper aspect of the fibular head. The mean surface area was 83 mm² (49 to 142).

One-third of patients (8 of 22) had tibial cuts made below the lowest aspect of the PCL footprint (complete removal) and one-third (9 of 22) had cuts extending into the footprint (partial removal). The remaining patients (5 of 22) had footprints unaffected by the cuts, keeping them intact. Our study highlights the wide variation in the location of the tibial PCL footprint when referenced against the fibula. Proximal tibial cuts using conventional jigs resulted in the removal of a significant portion, if not all of the PCL footprint in most of the patients in our study. Our findings suggest that when performing PCL-retaining total knee replacement the tibial attachment of the PCL is often removed.

INFLUENCE OF TIBIAL COMPONENT POSTERIOR SLOPE ON IN VIVO KNEE KINEMATICS IN FIXED-BEARING TOTAL KNEE ARTHROPLASTY.

Catani F, Fantozzi S, Ensini A, Leardini A, Moschella D, Giannini S. *J Orthop Res*. 2006 Apr;24(4):581-7.

Abstract: The relation between prosthesis component kinematics and posterior slope of the tibial component in total knee arthroplasty is much debated. Three-dimensional kinematics of the replaced knee was obtained by video fluoroscopy in 23 knees treated by cruciate-retaining or cruciate-substituting arthroplasty. Relative position and orientation of the metal components were calculated in stair ascending, getting up from and sitting down on a chair, and single step up-and-down. Significant correlations were found between tibial component posterior slope and anteroposterior position of tibiofemoral lateral contact and between this slope and maximum knee flexion. These correlations were task and design specific. However, the average of the tibiofemoral contact positions over all three motor tasks was slightly posterior to the midline of the tibial base plate, reaching at most 84% of its anteroposterior dimension. Performing a posterior slope of the tibial cut does not put total knee arthroplasty with high conforming designs at higher risk of failure, even when large posterior inclinations need to be achieved.

THE INFLUENCE OF TIBIAL SLOPE ON MAXIMAL FLEXION AFTER TOTAL KNEE ARTHROPLASTY.

Bellemans J, Robijns F, Duerinckx J, Banks S, Vandenneucker H. *Knee Surg Sports Traumatol Arthrosc*. 2005 Apr;13(3):193-6. Epub 2004 Oct 26.

Abstract: Many surgeons believe that increasing the tibial slope in total knee arthroplasty (TKA) is beneficial with regard to maximal postoperative flexion. Review of the clinical literature, however, does not confirm this hypothesis, neither does it give an answer to the question of how much flexion gain can be expected per degree extra tibial slope. The purpose of this study was, therefore, to evaluate and quantify the influence of tibial slope on maximal postoperative flexion in contemporary posterior cruciate ligament (PCL)-retaining TKA. Twenty-one cadaver simulations of a standard PCL-retaining TKA were studied while reproducing identical deep flexion femorotibial kinematics as documented by three-dimensional computer-aided videofluoroscopy from patients with well-functioning TKAs of the same design. In each knee the tibial component was consecutively implanted with 0 degrees posterior slope, 4 degrees posterior slope, and 7 degrees posterior slope. Maximal flexion was recorded for each configuration. Average maximal flexion at 0 degrees tibial slope was 104 degrees, and increased significantly to 112 degrees when the same knees were implanted with 4 degrees tibial slope. Increasing the slope further to 7 degrees again significantly improved average maximal flexion to 120 degrees. When postoperative radiographic tibial slope was compared to maximal flexion, an average gain of 1.7 degrees flexion for every degree extra tibial slope was noted. Increasing the tibial slope in PCL-retaining TKA does indeed improve maximal flexion before tibial insert impingement occurs against the femoral bone. The surgeon can expect an average gain of 1.7 degrees flexion for every degree extra tibial slope.



INTERCONDYLAR FEMORAL NOTCH PREPARATION FOR POSTERIOR STABILIZED KNEE ARTHROPLASTY – VOLUMETRIC BONE RESECTION ACCORDING TO TWO METHODS

Angibaud LD, Kubo MB, Steffens JG, Steiler CA, Myers SL, Rice J. 2010.

Abstract: Posterior stabilized (PS) knee implants account for more than 50% of total knee arthroplasty (TKA) surgeries these day. A PS knee prosthesis compensates for posterior cruciate ligament function through a tibial post-femoral cam mechanism that requires an intercondylar notch on the femur to accommodate the cam housing. Minimizing bone resection during notch preparation is a goal of modern PS prosthesis designs, especially for PS implants with high-flexion (HF) capability which usually requires even more bone resection. Studies have been performed to evaluate bone resection volumes during notch preparation for different PS prostheses at ideal implant alignment [1, 2]. However, in reality, prostheses may be implanted with deviations from its ideal position due to patient anatomy, surgeon preference, operational accuracy, etc. The effects of implant alignment deviation on notch resection volume have not been well understood. The objective of this study was to evaluate the effects of implant alignment on bone resection volume during intercondylar notch preparation. This study systematically evaluated the effect of implant alignment on bone resection volume during femoral intercondylar notch preparation for a contemporary HF PS prosthesis. In general, the resection volume was more sensitive to translational deviations and internal/external rotation, while less sensitive to varus/valgus and flexion/extension deviations.

“The standard deviation associated with the Logic RG method was significantly less than the ones associated with the conventional NG method; which demonstrates greater repeatability.” “Logic RG method removes less bone when compared to the NG method used for the PS and HF” pg. 2



METAPHYSEAL FIXATION IN REVISION TOTAL KNEE ARTHROPLASTY: INDICATIONS AND TECHNIQUES

Haidukewych et al. *J Am Acad Orthop Surg.* 2011 Jun;19(6):311-8.

The need for revision total knee arthroplasty (TKA) is on the rise. Challenges to attaining durable, stable, well-functioning revision TKA include bony deficiency, periarticular osteopenia, deformity, and soft-tissue imbalance. Defect management often requires the use of stems, cement, metal augmentation, or allograft. Recently, there has been interest in obtaining fixation in the metaphyseal region in an attempt to improve construct stability while managing bony deficiency. Often, the metaphyseal bone is well vascularized, which provides an opportunity for additional fixation with cement, allograft, trabecular metal cones, or stepped porous-coated sleeves. Multiple series have documented good survivorship at short-term follow-up with trabecular metal cones and porous-coated sleeves. These newer technologies offer biologic fixation and are useful for treating bony defects that are not easily managed with other methods. Long-term studies are needed to determine the durability of these constructs. Concerns persist regarding stress shielding and difficulty of removal. Familiarity with the rationale and strategies for metaphyseal fixation in revision TKA is a valuable addition to the armamentarium of the revision surgeon.

REBUILDING THE SKELETON, STEMS, METAL AUGMENTS, AND DISCIPLINE

Haidukewych et al. *Semin Arthro* 21:110-112. 2010.

Bony deficiencies are commonly encountered during revision total knee arthroplasty. Stems are used routinely to offload epiphyseal fixation, and both fully cemented and press-fit stems have demonstrated excellent survivorship in recent studies. Ease of removal, if needed, end of stem pain concerns, anatomic variability, and bone quality can influence stem-fixation method selection. Metal augments are available in various shapes and sizes to allow efficient management of epiphyseal defects and a modular approach to gap balancing. Larger defects can be managed with trabecular metal cones and metaphyseal filling sleeves, which have demonstrated encouraging results in recent studies. These newer implants are available in a variety of shapes and sizes and allow the efficient management of larger defects not handled easily by other methods.

REVISION TOTAL KNEE ARTHROPLASTY

Dennis et al. *J Am Acad Orthop Surg.* 2008 Aug;16(8):442-54.

Revision total knee arthroplasty presents numerous technical challenges and decisions for the operating surgeon. Preoperative planning includes critically reviewing radiographs and ordering necessary equipment, including prosthetic components, extraction devices, and bone graft materials. In some cases, surgical exposure requires the use of extensile exposure techniques. Component removal is facilitated by the use of appropriate tools (eg, specialized osteotomes) as well as by the patience to ensure preservation of host bone. Bone loss is managed with bone grafts or prosthetic augmentation.

Attention to balancing the flexion and extension gaps is essential to avoid problems with instability as well as excessively constrained prosthetic components. Intramedullary stem extensions improve long-term clinical results. Intraoperative extensor mechanism complications can be avoided with meticulous surgical technique; late complications may require surgical intervention.

THE ROLE OF STEMS AND AUGMENTS FOR BONE LOSS IN REVISION KNEE ARTHROPLASTY

Mabry et al. *J Arthroplasty.* 2007 Jun;22(4 Suppl 1):56-60.

The treatment of bone deficiencies during revision knee arthroplasty remains a challenging problem. The primary treatment options for these bone deficiencies include the use of structural allografts, impaction bone grafting, and the use of prosthetic augments. There have been no comparative series demonstrating the superiority of any of these techniques. Supplemental stem fixation should be used when using one of these treatment approaches. Although the use of cementless stems is currently more popular, the available literature suggests that cemented stem fixation provides a more reliable and durable construct for revision knee arthroplasty associated with severe bone deficiency.

AN ACCURATE AND REPRODUCIBLE METHOD FOR LOCATING THE JOINT LINE DURING A REVISION TOTAL KNEE ARTHROPLASTY

Mason et al. *J Arthroplasty*. 2006 Dec;21(8):1147-53.

Studies have shown that the position of the joint line has a direct effect on postoperative results, including range of motion, functional knee scores, and midflexion stability. Four anatomic landmarks were investigated as references for locating the joint line during a revision knee surgery—the medial femoral epicondyle, the fibular head, the tibial tubercle, and the inferior pole of the patella. Measurements from 6 cadaver knees identified the distance of each landmark to the joint line. These distances were used to design instruments to aid in the intraoperative positioning of the joint line. The instruments were validated on 94 primary total knees. The instrument referencing the medial epicondyle had 99% and 93% accuracy for locating the natural position of the joint line within 5 and 3 mm, respectively.

PRINCIPLES OF REVISION TOTAL KNEE ARTHROPLASTY

Thongtrangan et al. *Seminars in Arthroplasty*. 2003.

Revision total knee arthroplasty (TKA) is considered by some to be the most difficult procedure in the field of orthopaedic surgery. Good results can be consistently obtained if a meticulous and methodic approach is taken by the provider. Keeping the goals of treatment in mind as well as possible compounding factors specific to each individual case will aid in achieving optimal results. This article presents the schema one should undergo in a revision TKA, from mechanism of failure to preoperative assessment as well as intra-operative technique and a discussion on rehabilitation principles.

■ ACCURACY AND ALIGNMENT WITH COMPUTER-ASSISTED SURGERY

NAVIGATED TOTAL KNEE REPLACEMENT. A META-ANALYSIS.

Bauwens K, Matthes G, Wich M, Gebhard F, Hanson B, Ekkernkamp A, Stengel D. *J Bone Joint Surg Am.* 2007 Feb;89(2):261-9.

Background: Proponents of navigated knee arthroplasty stress its potential to increase the precision of component placement. We conducted a systematic review and meta-analysis to substantiate the validity and relevance of this contention.

Methods: We searched major medical and publishers' databases for randomized trials and any other studies comparing navigated with conventional knee arthroplasty. Major periodicals were searched manually. We made no restrictions for types of studies or language. Methodological features were rated independently by two reviewers. After testing for publication bias and heterogeneity was done, the data were aggregated by random-effects modeling. We estimated the weighted mean differences of mechanical limb axes and functional scales and the risk ratios of deviations from the straight axis with 95% confidence intervals.

Results: We included thirty-three studies (eleven randomized trials) of varying methodological quality involving 3423 patients with a mean age (and standard deviation) of 67.3 +/- 4.1 years (62.6% were women, and 83.7% had primary osteoarthritis). The mean preoperative deviation from the mechanical axis was 2.3 degrees +/- 5.1 degrees. There was no evidence of publication bias, but there was strong statistical heterogeneity. The alignment of the mechanical axes did not differ between the navigated and conventional surgery group (weighted mean difference, 0.2 degrees; 95% confidence interval, -0.2 degrees to 0.5 degrees). Patients managed with navigated surgery had a lower risk of malalignment at critical thresholds of >3 degrees (risk ratio, 0.79; 95% confidence interval, 0.71 to 0.87) and >2 degrees (risk ratio, 0.76; 95% confidence interval, 0.71 to 0.82). No conclusive inferences could be drawn on functional outcomes or complication rates. Navigation lengthened the mean duration of surgery by 23%.

Conclusions: Navigated knee replacement provides few advantages over conventional surgery on the basis of radiographic end points. Its clinical benefits are unclear and remain to be defined on a larger scale.

META-ANALYSIS OF NAVIGATION VS CONVENTIONAL TOTAL KNEE ARTHROPLASTY.

Hetaimish BM, Khan MM, Simunovic N, Al-Harbi HH, Bhandari M, Zalzal PK. *J Arthroplasty.* 2012 Jun;27(6):1177-82. doi: 10.1016/j.arth.2011.12.028. Epub 2012 Feb 13.

Navigated total knee arthroplasty (TKA) is promoted as a means to improve limb and prosthesis alignment. This study involved a systematic review and meta-analysis for all randomized controlled trials in the literature from 1986

to 2009 comparing alignment outcomes between navigated and conventional TKA. Alignment outcomes were pooled using a random-effects model, and heterogeneity was explored. Twenty-three randomized controlled trials were identified comparing navigated vs conventional TKA involving 2541 patients. Patients who underwent navigated TKA had a significantly lower risk of implant malalignment at more than 3 as well as more than 2. In addition, the risk of malalignment was reduced for the coronal plane tibial and femoral components as well as femoral and tibial slope. This meta-analysis demonstrates that navigated TKA provides significant improvement in prosthesis alignment.

ALIGNMENT OUTCOMES IN NAVIGATED TOTAL KNEE ARTHROPLASTY: A META-ANALYSIS.

Fu Y, Wang M, Liu Y, Fu Q. *Knee Surg Sports Traumatol Arthrosc.* 2012 Jun;20(6):1075-82. doi: 10.1007/s00167-011-1695-6. Epub 2011 Oct 15.

Purpose: Whether navigated total knee arthroplasty can improve the limb and component alignment is a matter of debate. This systematic literature review analyzed the differences on alignment outcomes between navigated total knee arthroplasty and conventional total knee arthroplasty.

Methods: Multiple databases, online registers of randomized controlled trials were searched. Published and unpublished randomized controlled trials were included, and data on methodological quality, population, intervention, and outcomes were abstracted in duplicate. Data were pooled across studies, and odds ratios for categorical outcomes were calculated according to study sample size.

Results: Twenty-one randomized controlled trials of varying methodological quality involving 2,414 patients were included. Statistically significant differences were observed between navigated group and conventional group in mechanical axis malalignment of >3 (odds ratio, 0.26; 95% confidence interval, 0.17-0.38) and mechanical axis malalignment of >2 (odds ratio, 0.33; 95% confidence interval, 0.26-0.42). Navigated group had a lower risk of malalignment for both coronal femoral component and coronal tibial component of >3 and >2. Both sagittal femoral component alignment and tibial slope showed statistical significance in favor of navigated arthroplasty at >2 and 3 malalignment.

Conclusion: Meta-analysis indicates significant improvement in alignment of the limb and the component position with use of computer navigation system. Its clinical benefits are unclear and remain to be defined on a larger scale randomized controlled trials with long-term follow-up.

Level Of Evidence: Therapeutic study (Systematic review of Level-I studies with inconsistent results), Level II.

IMAGELESS COMPUTER NAVIGATION IN TOTAL KNEE ARTHROPLASTY PROVIDES SUPERIOR SHORT TERM FUNCTIONAL OUTCOMES: A META-ANALYSIS.

Rebal BA, Babatunde OM, Lee JH, Geller JA, Patrick DA Jr, Macaulay W. *J Arthroplasty*. 2013 Oct 17. pii: S0883-5403(13)00699-2. doi: 10.1016/j.arth.2013.09.018. [Epub ahead of print]

Computer navigation in total knee arthroplasty (TKA) is intended to produce more reliable results, but its impact on functional outcomes has not been firmly demonstrated. Literature searches were performed for Level I randomized trials that compared TKA using imageless computer navigation to those performed with conventional instruments. Radiographic and functional outcomes were extracted and statistically analyzed. TKA performed with computer navigation was more likely to be within 3° of ideal mechanical alignment (87.1% vs. 73.7%, $P < .01$). Navigated TKAs had a higher increase in Knee Society Score at 3-month follow-up (68.5 vs. 58.1, $P = .03$) and at 12-32month follow-up (53.1 vs. 45.8, $P < .01$). Computer navigation in TKA provides more accurate alignment and superior functional outcomes at short-term follow-up.

FUNCTIONAL OUTCOME AND ALIGNMENT IN COMPUTER-ASSISTED AND CONVENTIONALLY OPERATED TOTAL KNEE REPLACEMENTS: A MULTICENTRE PARALLEL-GROUP RANDOMISED CONTROLLED TRIAL.

Gøthesen et al. *Bone Joint J*. 2014 May;96-B(5):609-18.

Abstract: We performed a randomised controlled trial comparing computer-assisted surgery (CAS) with conventional surgery (CONV) in total knee replacement (TKR). Between 2009 and 2011 a total of 192 patients with a mean age of 68 years (55 to 85) with osteoarthritis or arthritic disease of the knee were recruited from four Norwegian hospitals. At three months follow-up, functional results were marginally better for the CAS group. Mean differences (MD) in favour of CAS were found for the Knee Society function score (MD: 5.9, 95% confidence interval (CI) 0.3 to 11.4, $p = 0.039$), the Knee Injury and Osteoarthritis Outcome Score (KOOS) subscales for 'pain' (MD: 7.7, 95% CI 1.7 to 13.6, $p = 0.012$), 'sports' (MD: 13.5, 95% CI 5.6 to 21.4, $p = 0.001$) and 'quality of life' (MD: 7.2, 95% CI 0.1 to 14.3, $p = 0.046$). At one-year follow-up, differences favouring CAS were found for KOOS 'sports' (MD: 11.0, 95% CI 3.0 to 19.0, $p = 0.007$) and KOOS 'symptoms' (MD: 6.7, 95% CI 0.5 to 13.0, $p = 0.035$). The use of CAS resulted in fewer outliers in frontal alignment ($> 3^\circ$ malalignment), both for the entire TKR (37.9% vs. 17.9%, $p = 0.042$) and for the tibial component separately (28.4% vs 6.3%, $p = 0.002$). Tibial slope was better achieved with CAS (58.9% vs. 26.3%, $p < 0.001$). Operation time was 20 minutes longer with CAS. In conclusion, functional results were, statistically, marginally in favour of CAS. Also, CAS was more predictable than CONV for mechanical alignment and positioning of the prosthesis. However, the long-term outcomes must be further investigated.

FUNCTIONAL OUTCOMES FOLLOWING TOTAL KNEE ARTHROPLASTY: A RANDOMISED TRIAL COMPARING COMPUTER-ASSISTED SURGERY WITH CONVENTIONAL TECHNIQUES.

Blakeney et al. *Knee*. 2014 Mar;21(2):364-8.

Background: A number of trials have shown improved radiological alignment following total knee arthroplasty using computer-assisted surgery (CAS) compared with conventional surgery. Few studies, however, have looked at functional outcomes.

Methods: We prospectively studied a cohort of 107 patients that underwent TKA by a single surgeon. Patients were randomised into 3 groups: computer-assisted surgery for both the femur and the tibia, intramedullary guides for both the femur

and the tibia, and an intramedullary guide for the femur and an extramedullary guide for the tibia. Patients were followed-up post-operatively with the Short Form Health Survey (SF-12) and Oxford Knee Score (OKS) questionnaires.

Results: At a median follow-up of 46 months (range 30-69 months), there was a trend towards higher OKS results in the CAS group, with a mean score of 40.6 in the CAS group compared to 37.6 in the extramedullary group and 36.8 in the intramedullary group. The difference seen in the OKS between CAS and the conventional groups had a significant unadjusted p -value (0.024), and approached significance when adjusted for age and sex (0.054). There was a significant improvement in the OKS when the mechanical axis was within $\pm 3^\circ$ of neutral, versus those outside this range (median of 41.0 compared to 38.3, $p = 0.045$).

Discussion: This study shows that clinically significant differences are being seen in functional scores of patients treated with CAS versus conventional guides, at medium-term follow up. Our findings reinforce the tenet that a coronal mechanical axis of within 3° of neutral equates to significantly better functional outcomes.

RADIOLOGICAL AND FUNCTIONAL OUTCOMES IN COMPUTER ASSISTED TOTAL KNEE ARTHROPLASTY BETWEEN CONSULTANTS AND TRAINEES - A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

Khakha RS, Chowdhry M, Sivaprakasam M, Kheiran A, Chauhan SK. *J Arthroplasty*. 2015 Aug.

Computer Aided Surgery has consistently shown superior alignment of components when compared to non-navigated jig based techniques. The aim of this study is to assess the mid-term clinical outcome of TKA performed by a consultant orthopedic surgeon, compared to trainee surgeons. Ninety-two patients were matched and randomly allocated to have CAS surgery performed by either a consultant or trainee and followed up prospectively for 5-years. Knee society scores, mechanical axis, tourniquet time and blood loss data were collected. Our study demonstrated that trainees were able to achieve equal coronal alignment ($P = 0.15$), blood loss ($P = 0.45$) and functional scores ($P = 0.15$). The Consultant group had a significantly ($P < 0.001$) shorter tourniquet time. We confirm that CAS can assist less experienced surgeons to reliably achieve good mid-term outcomes in TKA.

SYSTEMATIC REVIEW OF PATIENT-SPECIFIC INSTRUMENTATION IN TOTAL KNEE ARTHROPLASTY: NEW BUT NOT IMPROVED

Sassoon A, Nam D, Nunley R, Barrack R. *Clin Orthop Relat Res*. 2015 Jan.

Background: Patient-specific cutting blocks have been touted as a more efficient and reliable means of achieving neutral mechanical alignment during TKA with the proposed downstream effect of improved clinical outcomes. However, it is not clear to what degree published studies support these assumptions.

Questions/Purposes: We asked: (1) Do patient-specific cutting blocks achieve neutral mechanical alignment more reliably during TKA when compared with conventional methods? (2) Does patient-specific instrumentation (PSI) provide financial benefit through improved surgical efficiency? (3) Does the use of patient-specific cutting blocks translate to improved clinical results after TKA when compared with conventional instrumentation?

Methods: We performed a systematic review in accordance with Cochrane guidelines of controlled studies (prospective and retrospective) in MEDLINE® and EMBASE® with respect to patient-specific cutting blocks and their effect

on alignment, cost, operative time, clinical outcome scores, complications, and survivorship. Sixteen studies (Level I-III on the levels of evidence rubric) were identified and used in addressing the first question, 13 (Level I-III) for the second question, and two (Level III) for the third question. Qualitative assessment of the selected Level I studies was performed using the modified Jadad score; Level II and III studies were rated based on the Newcastle-Ottawa scoring system.

Results: The majority of studies did not show an improvement in overall limb alignment when PSI was compared with standard instrumentation. Mixed results were seen across studies with regard to the prevalence of alignment outliers when PSI was compared with conventional cutting blocks with some studies demonstrating no difference, some showing an improvement with PSI, and a single study showing worse results with PSI. The studies demonstrated mixed results regarding the influence of PSI on operative times. Decreased operative times were not uniformly observed, and when noted, they were found to be of minimal clinical or financial significance. PSI did reliably reduce the number of instrument trays required for processing perioperatively. The accuracy of the preoperative plan, generated by the PSI manufacturers, was found lacking, often leading to multiple intraoperative changes, thereby disrupting the flow of the operation and negatively impacting efficiency. Limited data exist with regard to the effect of PSI on postoperative function, improvement in pain, and patient satisfaction. Neither of the two studies we identified provided strong evidence to support an advantage favoring the use of PSI. No identified studies addressed survivorship of components placed with PSI compared with those placed with standard instrumentation.

Conclusions: PSI for TKA has not reliably demonstrated improvement of postoperative limb or component alignment when compared with standard instrumentation. Although decisive evidence exists to support that PSI requires fewer surgical trays, PSI has not clearly been shown to improve overall surgical efficiency or the cost-effectiveness of TKA. Mid- and long-term data regarding PSI's effect on functional outcomes and component survivorship do not exist and short-term data are scarce. Limited available literature does not clearly support any improvement of postoperative pain, activity, function, or ROM when PSI is compared with traditional instrumentation.

PATIENT SATISFACTION AFTER CONVENTIONAL TKA

DOES TKA RESTORE NORMAL KNEE FUNCTION?

Bauwens K, Matthes G, Wich M, Gebhard F, Hanson B, Ekkernkamp A, Noble Et Al. Clin Orthop Relat Res. 2005 Feb;(431):157-65.

Abstract: Despite the advanced age of many patients having total knee arthroplasty, previous attempts to quantify patient function postoperatively have not allowed for normal deterioration of musculoskeletal function that occurs with aging. We determined the effects of aging on knee function, thereby providing a realistic level of normal, healthy knee function for patients and surgeons after total knee arthroplasties. A self-administered, validated knee function questionnaire consisting of 55 scaled multiple choice questions was used in this study. Responses were collected from 243 patients at least 1 year after they had total knee arthroplasties, and from 257 individuals (age- and gender-matched) who had no previous history of knee disorders. Many of these latter subjects reported that they could do most of the activities cited in the questionnaire without symptoms attributable to their knees. However, knee symptoms were experienced more frequently during activities that placed greater loads on the extremity. There was no difference in the knee function of men and women, and both groups had

continuous deterioration in knee function with increasing age. There were large differences in the functional capacity to do activities involving the knee between the group of patients who had total knee arthroplasties and the age- and gender-matched patients with no previous knee disorders. Overall, 52% of the patients who had total knee arthroplasties reported some degree of limitation in doing functional activities, versus 22% of subjects with no previous knee disorders. Two groups of activities were identified: activities in which the patients and control subjects had essentially similar knee function (swimming, golfing, and stationary biking), and activities in which the function scores of the control group exceeded the scores of the patients who had total knee arthroplasties (kneeling, squatting, moving laterally, turning and cutting, carrying loads, stretching, leg strengthening, tennis, dancing, gardening, and sexual activity). Our data show that many of the limitations reported by patients after total knee arthroplasties are shared by individuals with no previous knee disorders. However, only approximately 40% of the functional deficit present after a total knee arthroplasty seems to be attributable to the normal physiologic effects of aging. Patients who had total knee replacements still experienced substantial functional impairment compared with their age- and gender-matched peers, especially when doing biomechanically demanding activities. This suggests that significant improvements in the procedure and prosthetic designs are needed to restore normal knee function after a total knee arthroplasty.

PATIENT SATISFACTION AFTER TOTAL KNEE ARTHROPLASTY: WHO IS SATISFIED AND WHO IS NOT?

Bourne et al. Clin Orthop Relat Res. 2010 Jan;468(1):57-63.

Abstract: Despite substantial advances in primary TKA, numerous studies using historic TKA implants suggest only 82% to 89% of primary TKA patients are satisfied. We reexamined this issue to determine if contemporary TKA implants might be associated with improved patient satisfaction. We performed a cross-sectional study of patient satisfaction after 1703 primary TKAs performed in the province of Ontario. Our data confirmed that approximately one in five (19%) primary TKA patients were not satisfied with the outcome. Satisfaction with pain relief varied from 72-86% and with function from 70-84% for specific activities of daily living. The strongest predictors of patient dissatisfaction after primary TKA were expectations not met (10.7x greater risk), a low 1-year WOMAC (2.5x greater risk), preoperative pain at rest (2.4x greater risk) and a postoperative complication requiring hospital readmission (1.9x greater risk).

WHAT FUNCTIONAL ACTIVITIES ARE IMPORTANT TO PATIENTS WITH KNEE REPLACEMENTS?

Weiss et al. Clin Orthop Relat Res. 2002 Nov;(404):172-88.

Abstract: There is interest in quantifying the patient's function and mobility after joint replacement. The current study identified activities important to patients having total knee replacement and the prevalence of limitations to participation in these activities. A Total Knee Function Questionnaire consisting of 55 questions addressing the patient's participation in various activities was developed, validated, and mailed to 367 patients at least 1 year after knee replacement. Patients were asked the frequency with which they did each activity, the activity's importance to them, and the extent to which their participation was limited by their knee replacement. The questionnaire was returned by 176 patients, 40% men and 60% women, with an average age of 70.5 years. The most prevalent activities were stretching exercises (73%), leg strengthening exercises (70%), kneeling (58%), and gardening (57%). The activities most important to the patients were stretching exercises (56%), kneeling (52%), and gardening (50%); those most difficult were squatting (75%), kneeling (72%), and gardening (54%). The current study showed a high correlation between the importance of activities and frequency of patient

participation confirming that knee replacement successfully restores a significant degree of function. However, after knee replacement, improvements in knee function still are needed to allow patients to do all activities that they consider important.

■ REDUCED RISKS & COMPLICATIONS THROUGH THE USE OF COMPUTER-ASSISTED SURGERY

BLOOD LOSS AFTER TOTAL KNEE REPLACEMENT: EFFECTS OF COMPUTER-ASSISTED SURGERY.

Kalairajah Y, Simpson D, Cossey AJ, Verrall GM, Spriggins AJ. *J Bone Joint Surg Br.* 2005 Nov;87(11):1480-2.

We carried out a prospective randomised study to evaluate the blood loss in 60 patients having a total knee arthroplasty and divided randomly into two equal groups, one having a computer-assisted procedure and the other a standard operation. The surgery was carried out by a single surgeon at one institution using a uniform approach. The only variable in the groups was the use of intramedullary femoral and tibial alignment jigs in the standard group and single tracker pins of the imageless navigation system in the tibia and femur in the navigated group. The mean drainage of blood was 1351 ml (715 to 2890; 95% confidence interval (CI) 1183 to 1518) in the computer-aided group and 1747 ml (1100 to 3030; CI 1581 to 1912) in the conventional group. This difference was statistically significant ($p = 0.001$). The mean calculated loss of haemoglobin was 36 g/dl in the navigated group versus 53 g/dl in the conventional group; this was significant at $p < 0.00001$. There was a highly significant reduction in blood drainage and the calculated Hb loss between the computer-assisted and the conventional techniques. This allows the ordering of less blood before the operation, reduces risks at transfusion and gives financial saving. Computer-assisted surgery may also be useful for patients in whom blood products are not acceptable.

THE EFFECT OF COMPUTER NAVIGATION ON BLOOD LOSS AND TRANSFUSION RATE IN TKA.

Schnurr C, Csécséi G, Eysel P, König DP. *Orthopedics.* 2010 Jul 13;33(7):474. doi: 10.3928/01477447-20100526-08.

The blood loss that accompanies total knee arthroplasty (TKA) can be substantial. Many patients need perioperative blood transfusions. To avoid anemia and transfusion-related complications, the amount of blood loss and need for blood transfusions must be reduced. If standard jig instruments are used, an opening of the femoral medullary canal is required. This operative step has been recognized as a reason for elevated blood loss; it is not required if computer navigation is used. Hence, the purpose of this study was to investigate the effect of computer navigation on blood loss and transfusion rate in TKA. The data of 500 consecutive patients undergoing TKA were analyzed, and patient- and operation-related data and blood loss and transfusion rates were recorded. The total blood loss was calculated by use of the Orthopedic Surgery Transfusion Hemoglobin European Overview (OSTHEO) formula. The average blood loss in the drainages (standard procedures, 880 mL; navigated procedures, 761 mL; $P=.001$) and the calculated total blood loss (standard procedures, 1375 mL; navigated procedures, 1242 mL; $P=.036$) were significantly reduced in the navigation group. The transfusion rate of navigated procedures was almost halved (standard procedures, 0.23 transfusions/patient; navigated procedures, 0.12 transfusions/patient; $P=.035$). Our study demonstrated a reduced blood loss if TKAs were implanted by use of computer navigation. The diminished blood loss resulted in a 50% reduction of allogenic

blood transfusions. Hence, computer navigation may be attractive for patients with a high risk of transfusions or uncommon blood groups. Prospective studies are required to verify this potential benefit of computer navigation.

COMPUTER-ASSISTED SURGERY CAN REDUCE BLOOD LOSS AFTER TOTAL KNEE ARTHROPLASTY.

Hinarejos P, Corrales M, Matamalas A, Bisbe E, Cáceres E. *Knee Surg Sports Traumatol Arthrosc.* 2009 Apr;17(4):356-60. doi: 10.1007/s00167-008-0683-y. Epub 2008 Dec 16.

The aim of this study was to compare blood loss and transfusion requirements in patients undergoing computer-assisted total knee arthroplasty (TKA) and patients operated with conventional instrumentation with intra-medullary guides. A prospective randomized study of 87 patients undergoing a TKA assigned to conventional technique ($n = 44$) or computer-assisted surgery ($n = 43$) was conducted. All patients were operated by the same surgeon and in all cases a cemented arthroplasty and deep recovery drainage were used. Both groups were comparable in all variables except for duration of ischemia, which was 13.7 min higher in the computer-assisted group. Blood loss due to drainage was higher in the conventional technique group (613 vs. 447 ml), as was the number of patients in which blood from the blood recovery system was reinfused (53 vs. 23%). Those patients undergoing computer-assisted surgery experienced less bleeding than those operated with the conventional technique. However, hemoglobin drop and allogenic transfusion rate were not statistically different in both groups.

BLOOD LOSS IN COMPUTER-ASSISTED MOBILE BEARING TOTAL KNEE ARTHROPLASTY. A COMPARISON OF COMPUTER-ASSISTED SURGERY WITH A CONVENTIONAL TECHNIQUE.

Conteduca F, Massai F, Iorio R, Zanzotto E, Luzon D, Ferretti A. *Int Orthop.* 2009 Dec;33(6):1609-13. doi: 10.1007/s00264-008-0651-7. Epub 2008 Sep 2.

Computer-assisted surgery (CAS) in total knee arthroplasty (TKA) could be useful in reducing the overall blood loss. A prospective randomised study was performed with two groups of 50 patients each of whom were treated for knee arthritis. Patients of group A were treated by a conventional standard procedure, while for patients of group B a specific CAS procedure was used. We determined the intraoperative blood loss according to the Orthopaedic Surgery Transfusion Haemoglobin European Overview (OSTHEO) study. The average blood loss in patients of group A was 1,974 ml (range: 450-3,930 ml) compared to 1,677 ml of patients of group B (range: 500-2,634 ml). A statistically significant difference was found between the two groups ($p = 0.0283$). Computer-assisted surgery is highly recommended in TKR to save blood. It creates more possibilities to operate on anaemic patients and subjects who cannot accept blood products by reducing blood loss risk.

NAVIGATION-ASSISTED TOTAL KNEE ARTHROPLASTY WITH NORMAL PRESSURE DRAINAGE REDUCES BLOOD LOSS - A PROSPECTIVE COMPARATIVE STUDY OF THREE MODALITIES.

Chou, WY; Ko, JY; Wong, T; Wang, FS; Siu, KK. *Life Science Journal-Acta Zhengzhou University Overseas Edition,* 2012; 9 (2): 191

Several modalities have been developed to reduce perioperative blood loss during total knee arthroplasty (TKA) and a navigation system has been successfully introduced in TKA. This study compared the blood loss of navigation-assisted TKA and conventional TKA in the presence of negative or normal pressure drainage. Patients were separated into 3 groups. We enrolled 60 patients undergoing conventional TKA with negative pressure drainage in Group A, and those undergoing navigation-assisted TKA with negative or normal pressure

drainage were enrolled in Group B (64 patients) and C (66 patients), respectively. Haemovac drainage volume, reduction of haemoglobin, estimated total blood loss, range of motion at 3 months after surgery, number of blood transfusions and hospitalisation days were all recorded. There were no differences in the demographic data of these 3 groups. Patients in Group B had significantly decreased total drainage volume, estimated total blood loss and blood transfusion rate than those in Group A. The significant reduction of total drainage volume, estimated total blood loss and blood transfusion rate were also noted in Group C when compared with Group B. Patients in Group C had a significant reduction in haemoglobin, haemovac drainage volume, estimated total blood loss, blood transfusion rate and hospitalisation days when compared with Group A. Navigation-assisted TKA with normal pressure drainage is a potential modality for the reduction of the haemovac drainage volume, perioperative blood loss and transfusion rate without compromising range of motion at 3 months after surgery.

LOWER POST-OPERATIVE D-DIMER LEVEL IN NAVIGATION-ASSISTED TKA THAN IN CONVENTIONAL TKA: A PROSPECTIVE RANDOMISED CONTROL STUDY

Siu et al. British Editorial Society of Bone & Joint Surgery. 2014.

Abstract: D-dimer is one of the useful laboratory tests to evaluate the incidence of venous thromboembolism (VTE) after the total knee arthroplasty (TKA). The most recent guideline for the prophylaxis of VTE points out the surgical procedure itself is a major risk factor for developing VTE. Only a few literatures discuss the relationship of surgical procedures and the risk of venous thromboembolism. We therefore prospectively compare the difference of the perioperative plasma D-dimer levels between the patients undergoing navigation and conventional TKA. Two hundred consecutive total knee arthroplasties were performed between September 2011 and March 2013. The patients were randomised according to their registration to the orthopaedic clinic. Ninety-six patients (100 knees) underwent a navigation-assisted TKA and ninety-four patients (100 knees) had a conventional TKA. No intramedullary violation was done in the navigation-assisted TKA, while the intramedullary femoral guiding was adapted in the conventional group. Pre-operative and post-operation day 1 plasma D-dimer levels were recorded and evaluated using Mann-Whitney U test. There was no difference in the demographic data and pre-operative D-dimer between the two groups ($p=0.443$). Significantly lower D-dimer levels on the post-operative day 1 were noted in the navigation group, when compared with the conventional group. (6.0 ± 4.4 mg/L vs 11.3 ± 9.6 mg/L, $p = 0.000$). We demonstrated that lower D-dimer level is developed after the navigation-assisted TKA than the conventional one. Less incidence of VTE is expected and the finding may help to explain the fact that less systemic emboli in the navigation assisted TKA.

EFFECTS OF COMPUTER NAVIGATION VERSUS CONVENTIONAL TOTAL KNEE ARTHROPLASTY ON ENDOTHELIAL DAMAGE MARKER LEVELS: A PROSPECTIVE COMPARATIVE STUDY

Kuo SJ, Wang FS, Wang CJ, Ko JY, Chen SH, Siu KK. PLoS One. 2015 May 8.

Total knee arthroplasty (TKA) inevitably perturbs the femoral medullary canal, which increases blood loss or morbidities associated with marrow embolization postoperatively. Computer navigation TKA reportedly minimizes medullary disturbance to alleviate perioperative blood loss. We performed a prospective comparative study, enrolling 87 patients with osteoarthritic knees from March 2011 to December 2011 in our hospital. The patients were separated into two groups, according to the surgeon they visited. Fifty-four patients underwent computer navigation TKAs and 33 had conventional TKAs. Levels of cell adhesion

molecules (CAMs), including intercellular adhesion molecule-1 (ICAM-1), vascular cell adhesion molecule-1 (VCAM-1), and platelet endothelial cellular adhesion molecule-1 (PECAM-1) in sera and hemovac drainage were measured by ELISA before and 24 hours after the surgery. We showed that patients receiving computer navigation TKAs had less blood loss and lower CAMs in serum and hemovac drainage after the operation. Less postoperative elevation of serum ICAM-1 ($p=0.022$) and PECAM-1 ($p=0.003$) from the preoperative baseline after the surgery was also noted. This study provides molecular evidence for the differential extent in vascular injury between conventional and navigation TKAs and sheds light on the possible benefits of computer navigation TKAs.

A PROSPECTIVE RANDOMIZED STUDY TO COMPARE SYSTEMIC EMBOLI USING THE COMPUTER-ASSISTED AND CONVENTIONAL TECHNIQUES OF TOTAL KNEE ARTHROPLASTY

Malhotra R, Singla A, Lekha C, Kumar V, Karthikeyan G, Malik V, Mridha AR. *J Bone Joint Surg Am.* 2015 Jun 3.

Background: Conventional total knee arthroplasty is performed with use of an intramedullary alignment guide, which produces elevated intramedullary pressure that can create fat emboli. Total knee arthroplasty performed via computer-assisted surgery does not require an intramedullary femoral rod, raising the question of whether computer-assisted surgery generates less embolic material than conventional total knee arthroplasty. The purpose of this study was to compare the emboli produced in the two techniques.

Methods: Fifty-seven patients were randomized into two groups: the computer-assisted surgery group ($n = 29$) and the conventional total knee arthroplasty group ($n = 28$). An intramedullary femoral alignment jig was used in the conventional total knee arthroplasty group but not in the computer-assisted surgery group. Intraoperative invasive monitoring was performed with use of transesophageal echocardiography and a pulmonary artery catheter.

Results: The mean embolic score was 6.21 points for the conventional technique group and 5.48 points for the computer-assisted surgery group ($p = 0.0161$). After tourniquet deflation, fat emboli were observed in the blood of five patients in the conventional surgery group and one patient in the computer-assisted surgery group.

Conclusions: The patients in the computer-assisted surgery group had lower embolic loads compared with the patients in the conventional total knee arthroplasty group. In patients with an uncompromised cardiopulmonary system, the embolic load difference between the techniques was not clinically relevant.

Level of Evidence: Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

A COMPARISON OF PATIENT-SPECIFIC AND CONVENTIONAL INSTRUMENTATION FOR TOTAL KNEE ARTHROPLASTY: A MULTICENTRE RANDOMISED CONTROLLED TRIAL.

Abane L, Anract P, Boisgard S, Descamps S, Courpied JP, Hamadouche M. *Bone Joint J.* 2015 Jan.

In this study we randomised 140 patients who were due to undergo primary total knee arthroplasty (TKA) to have the procedure performed using either patient-specific cutting guides (PSCG) or conventional instrumentation (CI). The primary outcome measure was the mechanical axis, as measured at three months

on a standing long-leg radiograph by the hip-knee-ankle (HKA) angle. This was undertaken by an independent observer who was blinded to the instrumentation. Secondary outcome measures were component positioning, operating time, Knee Society and Oxford knee scores, blood loss and length of hospital stay. A total of 126 patients (67 in the CI group and 59 in the PSCG group) had complete clinical and radiological data. There were 88 females and 52 males with a mean age of 69.3 years (47 to 84) and a mean BMI of 28.6 kg/m² (20.2 to 40.8). The mean HKA angle was 178.9° (172.5 to 183.4) in the CI group and 178.2° (172.4 to 183.4) in the PSCG group (p = 0.34). Outliers were identified in 22 of 67 knees (32.8%) in the CI group and 19 of 59 knees (32.2%) in the PSCG group (p = 0.99). There was no significant difference in the clinical results (p = 0.95 and 0.59, respectively). Operating time, blood loss and length of hospital stay were not significantly reduced (p = 0.09, 0.58 and 0.50, respectively) when using PSCG. The use of PSCG in primary TKA did not reduce the proportion of outliers as measured by post-operative coronal alignment.

■ COMPUTER-ASSISTED SURGERY IMPACT ON REVISION RATES

INFLUENCE OF COMPUTER NAVIGATION ON TKA REVISION RATES.

Schnurr et al. Int Orthop. 2012 Nov;36(11):2255-60. Epub 2012 Sep 5.

Purpose: We performed this study to determine whether the use of imageless navigation reduces revision rates after total knee arthroplasty (TKA).

Methods: Data of 1,121 consecutive primary TKA with a follow-up of one to six years were retrospectively analysed. Following the conversion of the standard technique from conventional to navigated procedures, these data included the last 342 conventional and first 779 navigated procedures performed in our clinic. Demographic and perioperative covariates were recorded. All patients were asked by post to report instances of revisions.

Results: Data of 1,054 patients (94 %) were complete. Mean follow-up was 3.9 years for conventional and 2.4 years for navigated operations. Cumulative revision rate averaged 4.7 % for conventional and 2.3 % for navigated procedures. Cox's proportional hazard model was used to assess the effect of covariates on survival, resulting in significantly lower revision rates for older patients (p < 0.001) and for the navigated technique (p = 0.012). The reduced revision rate for navigated operations was mainly caused by a significantly reduced rate of aseptic implant loosening (1.9 % vs. 0.1 %, p = 0.024).

Conclusions: Our study showed lower revision rates when computer navigation was used. However, due to the retrospective uncontrolled design, further prospective trials will be necessary to further evaluate this effect.

AUSTRALIAN ORTHOPAEDIC ASSOCIATION NATIONAL JOINT REPLACEMENT REGISTRY

Annual Report. Adelaide:AOA; 2014

There have been 53,928 knee replacement procedures reported to the Registry that have used computer navigation. In 2013, computer navigation was used in 23.8% of all primary total knee replacements. There was no difference overall in the rate of revision between non-navigated and navigated knee replacement after 10 years. However there was a difference in the rate of revision for patients aged less than 65 years. In this group, there is a reduction in the rate of revision for navigated knee replacement for loosening/lysis

WHY ARE TOTAL KNEES FAILING TODAY? ETIOLOGY OF TOTAL KNEE REVISION IN 2013

Schroer WC, Berend KR, Lombardi AV, Barnes CL, Bolognesi MP, Berend ME, Ritter MA, Nunley RM. J Arthroplasty. 2013 Sep;28(8 Suppl):116-9. doi: 10.1016/j.arth.2013.04.056. Epub 2013 Aug 15.

Revision knee data from six joint arthroplasty centers were compiled for 2010 and 2011 to determine mechanism of failure and time to failure. Aseptic loosening was the predominant mechanism of failure (31.2%), followed by instability (18.7%), infection (16.2%), polyethylene wear (10.0%), arthrofibrosis (6.9%), and malalignment (6.6%). Mean time to failure was 5.9 years (range 10 days to 31 years). 35.3% of all revisions occurred less than 2 years after the index arthroplasty, 60.2% in the first 5 years. In contrast to previous reports, polyethylene wear is not a leading failure mechanism and rarely presents before 15 years. Implant performance is not a predominant factor of knee failure. Early failure mechanisms are primarily surgeon-dependent.

"Implant performance was not a predominant factor of knee failure.

Improving surgeon performance through training, instrumentation, and technique development may reduce early revisions.

WHY ARE TOTAL KNEE ARTHROPLASTIES BEING REVISED?

Dalury DF, Pomeroy DL, Gorab RS, Adams MJ. J Arthroplasty. 2013 Sep;28(8 Suppl):120-1. doi: 10.1016/j.arth.2013.04.051. Epub 2013 Jul 23.

Despite technical improvements, revision rates for total knee arthroplasties (TKAs) remain high. Our goal was to report the reason(s) for revision TKA in a large, current, multicenter series and compare those reasons with previously published reasons. We retrospectively identified 820 consecutive revision TKAs (693 patients, 2000-2012) from our 3 centers and recorded the primary reason for the revision. The top seven reasons for the revision were aseptic loosening (23.1%), infection (18.4%), polyethylene wear (18.1%), instability (17.7%), pain/stiffness (9.3%), osteolysis (4.5%), and malposition/malalignment (2.9%). Comparison with previously published reasons showed fewer TKA revisions for polyethylene wear, osteolysis, instability, and malalignment. These changes may represent improvements in surgical technique and implants.

In conclusion a large percentage of the causes for revision continue to be under surgeon control.