1. **FREEMAN MA, PINSKEROVA V**

**THE MOVEMENT OF THE NORMAL TIBIO-FEMORAL JOINT. J BIOMECH. 2005 FEB;38(2):197-208. REVIEW.**

**Abstract**

This review describes the anatomy of the articular surfaces and their movement in the normal tibio-femoral joint, together with methods of measurement in volunteers. Forces and soft tissues are excluded. To measure movement, the articular surfaces and natural or inserted movement markers must be imaged by some combination of MRI, CT, RSA or fluoroscopy. With the aid of computer-imaging, the movements can then be related to an anatomy-based co-ordinate system to avoid kinematic cross-talk. Methods of depicting these movements which are understandable to engineers and clinicians are discussed. The shapes of the articular surfaces are reported. They are relevant to landmarks and co-ordinate systems and form a basis for inferring the nature of the movements which take place in the knee. The movements of the condyles are described from hyperextension to full passive flexion. Medially the condyle hardly moves antero-posteriorly from 0 degrees to 120 degrees but the contact area transfers from an anterior pair of tibio-femoral surfaces at 10 degrees to a posterior pair at about 30 degrees . Thus because of the shapes of the bones, the medial contact area moves backwards with flexion to 30 degrees but the condyle does not. Laterally the femoral condyle and the contact area move posteriorly but to a variable extent in the mid-range causing tibial internal rotation to occur with flexion around a medial axis. From 120 degrees to full flexion both condyles roll back onto the posterior horn so that the tibio-femoral joint subluxes.

1. **HIRSCHMANN MT, BECKER R, TANDOGAN R, VENDITTOLI PA, HOWELL S.**

**ALIGNMENT IN TKA: WHAT HAS BEEN CLEAR IS NOT ANYMORE! KNEE SURG SPORTS TRAUMATOL ARTHROSC 2019 JUL;27(7):2037-2039.**

**DOI: 10.1007/S00167-019-05558-4. EPUB 2019 JUN 12**

No abstract available. Letter to the editor

The optimal implant orientation when performing a total knee arthroplasty (TKA) remains a timely, pertinent, and unanswered question. For many years, the alignment debate has filled journals and congresses, and monopolised discussions among knee surgeons all around the globe. In the development of TKA surgery, Michael Freeman introduced the concept of right-angled femoral and tibial bone cuts (mechanical alignment) and the idea of parallel and equal flexion and extension spaces. Using the mechanical alignment target, the knee surgeon strived to create a neutral lower limb alignment represented by a hip-knee-ankle angle target of 180° ± 3° [4, 12]. Although the mean hip-kneeankle angle (HKA) of patients scheduled for TKA is near neutral, there is a wide variation and only 0.1% have neutral femoral and tibial mechanical axes [1]. With a systematic approach, mechanical alignment introduces anatomic

modifications for many individuals and results in unequal medial–lateral or flexion–extension bone resections. Multiple

ligament release techniques and algorithms have been proposed to re-balance the unbalanced gaps created. In the past years we have seen increased questioning of the concept of mechanical alignment, which has been considered the gold standard for decades. Historically, the alignment philosophy for TKA was driven by the desire to maximize durability and relieve pain with less regard for restoring normal knee kinematics and function. However,

several landmark studies have shown the concept of neutrally aligning every TKA is dogma and not true anymore

[23]. Questioning such a dogma leads to a certain amount of uncertainty among knee surgeons and opens the door to non-scientific subjective definitions and personal opinions of what alignment targets are preferred and which ones to safely recommend. Hence, it is important to unambiguously describe and define the current implant orientation

and alignment options [18]. Only when knee surgeons use the same definitions to discuss alignment progress can be

made and misinterpretation be limited. Anatomical alignment was introduced in the 1980s by Hungerford and Krackow with the goal to improve functionality by closer mimicking the native knee alignment [18]. With a systematic approach, anatomical alignment still aims for a neutral HKA, but the bones are cut 3° oblique to their mechanical axes to reflect the population’s mean native joint line orientation (3° femoral valgus and 3° tibial varus) [18]. Kinematic alignment, first proposed in 2006 by Howell et al., is an ‘individualised’ or patient-specific technique, aiming to restore the pre-arthritic or native limb and joint line alignment of each patient [3, 8, 9, 11]. By resurfacing the knee joint, kinematic alignment technique aims to coalign the axes and joint lines of the components with the three ‘kinematic’ axes and joint lines of the pre-arthritic or native knee. Femoral and tibial bone resection thicknesses checked with caliper measurements should match the thickness of the components after compensating for wear and the kerf of the saw cut. Intrinsically, it preserves/restores native ligament laxities, does not create gap imbalance and thus minimises the need for ligament release [14]. In his protocol, Howell does not place restrictions on the patient’s anatomy and post-operative correction. Kinematic alignment requires a precise surgical technique which can be performed by different techniques: manual instruments, computer navigation, personalised instruments, and computer guidance, with caliper verification that the executed resections are correct [10, 14]. Some knee anatomies may be inherently biomechanically inferior, or may have been altered by metabolic bone disease, childhood deformity, etc. Concerns remain about restoring severe patho-anatomies, which may not be compatible with current TKA prostheses and fixation methods [9, 22]. Keeping in mind these uncertainties, Vendittoli et al. recommended “safe zones” for TKA alignment and suggested the use of a restricted kinematic alignment protocol [1]. The algorithm involves modifications of bony cuts within a “safe range” defined by the following criteria: independent tibial and femoral cuts must be within ± 5° of the mechanical axis of the respective bone and the overall resulting hip-knee ankle angle (HKA) must fall within ± 3° of neutral. However, these concerns about the need to restrict the degree of preoperative deformity and post-operative correction when performing kinematically aligned TKA are not supported by available knowledge. In a mid-term study, of unrestricted kinematic alignment the 10-year implant survival (i.e., 1.5% revised for aseptic reasons) and yearlyrevision rate (i.e., 0.3%) met the expected gold standard of mechanically aligned TKA, and the 2 to 9-year incidence of tibial component failure was negligible [9, 13]. Despite restoring a more varus limb alignment, kinematic alignment,in gait analyses, produced a lower knee adduction moment and medial tibial compartment load and more normal gaitthan mechanical alignment [2, 15]. The intra-operative forces in the medial and lateral compartments of patients with outlier alignment of the limb, knee, and tibia are comparable with those with in-range alignment, with no evidence of overload of the tibial compartments [19, 20, 22]. Accurate restoration of the distal femoral, posterior femoral, and tibial joint lines within ± 1 mm is needed as deviations as small as 2 mm and 2° increase tibial compartment forces beyond those of the native knee, which patients may perceive as stiffness or limited motion [16, 17, 21]. The latest and most compelling support for use of kinematic or an ‘individualised’ alignment philosophy in place of mechanical alignment is from the systematic classification of the phenotype of the native limb and knee joint line by Hirschmann et al. [5–7]. Guided by the individual phenotype identified the optimal alignment for each knee is found. It is about a more meticulous planning in 3D and the decision if an off the shelf knee could do it or if the knee needs a customised TKA. Due to the significant deficiencies in both our knowledge and technology in the past, we were far from replicating normal knee kinematics with TKA. Current limitations in TKA function and patient satisfaction should stimulate us to question our practice. Implant design and surgical techniques need to be advanced to better reproduce the anatomy and kinematics of native knees and ultimately provide a forgotten joint. As with many things in life there are different phases of adoption of a newer alignment philosophy such as kinematic or individualised alignment. The surgeons that are early adopters are on the forefront of change and their concepts need examination and vetting. The late adopters are conservative and remain critical until the newer alignment philosophy is proven superior to mechanical alignment. The mass in between, the middle adopters, remain rather indecisive and somewhat confused about the definition and benefits and short-comings of available alignment philosophies. In one of our previously published papers the authors stated they used kinematic alignment; however, their surgical method was challenged as not meeting the definition of kinematic alignment in a letter to the editor by Riviere et al. The correction will be published in this issue. It appears that what was clear for decades is not so clear anymore. The discussion needs to go on and will go on. Our understanding will be enhanced by the use of an unambiguous definition of alignment by those that report outcomes of TKA.

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1. **HOWELL SM, SHELTON TJ, HULL ML.**

**IMPLANT SURVIVAL AND FUNCTION TEN YEARS AFTER KINEMATICALLY ALIGNED TOTAL KNEE ARTHROPLASTY. J ARTHROPLASTY 2018**

**DEC;33(12):3678-3684. DOI: 10.1016/J.ARTH.2018.07.020**

**Abstract**

**BACKGROUND:**

Alignment in the varus or valgus outlier range of the tibial component, knee, and limb might adversely affect the long-term results of kinematically aligned total knee arthroplasty (TKA) particularly when patients are selected without restricting the degree of preoperative varus-valgus and flexion deformity.

**METHODS:**

A retrospective review of all patients treated in 2007 with a primary TKA determined the 10-year implant survivorship, yearly revision rate, Oxford Knee Score, and WOMAC. All 222 knees (217 patients) were aligned kinematically using patient-specific instrumentation without restricting the degree of preoperative deformity and with the restoration of the native joint lines and limb alignment. Mechanical alignment criteria categorized the alignments of the tibial component, knee, and limb as in-range or in a varus or valgus outlier range.

**RESULTS:**

The implant survivorship (yearly revision rate) was 97.5% (0.3%) for revision for any reason and 98.4% (0.2%) for aseptic failure. The percentage postoperatively aligned in the varus outlier (valgus outlier) range was 78% (0%) for the angle between the tibial component and mechanical axis of the tibia, 31% (5%) for the tibiofemoral angle of the knee according to the criteria by Ritter et al, and 7% (21%) for the hip-knee-ankle angle of the limb according to the criteria by Parratte et al. Patients grouped in the varus outlier range, valgus outlier range, and in-range had similar implant survival and function scores. The 10-year Oxford Knee Score (48 best) and WOMAC (0 best) averaged 43 and 7 points, respectively.

**CONCLUSION:**

With the limitation that a large case series unlikely represents the full range of preoperative deformities and native alignments, treatment of patients with kinematically aligned TKA with patient-specific instrumentation without restricting the preoperative deformity did not adversely affect the 10-year implant survival, yearly revision rate, and level of function.

LEVEL OF EVIDENCE:

Level III, therapeutic study.

1. **NAM D, LIN KM, HOWELL SM, HULL ML.**

**FEMORAL BONE AND CARTILAGE WEAR IS PREDICTABLE AT 0° AND 90° IN THE OSTEOARTHRITIC KNEE TREATED WITH TOTAL KNEE ARTHROPLASTY**

**KNEE SURG SPORTS TRAUMATOL ARTHROSC. 2014 DEC;22(12):2975-81. DOI:**

**10.1007/S00167-014-3080-8**

**Abstract**

**PURPOSE:**

Kinematically aligned total knee arthroplasty (TKA) positions the femoral component at the natural angle and level of the distal (0°) and posterior (90°) joint line. This technique applies referencing guides at 0° and 90° that are adjusted to compensate for wear and kerf and perform resections equal in thickness to the femoral component. Knowing whether femoral bone and cartilage wear is predictable would assist in establishing general guidelines for adjusting the resection level of these two referencing guides. This study tests the hypothesis that femoral bone and cartilage wear is predictable at 0° and 90° in the varus and valgus osteoarthritic knee treated with TKA.

**METHODS:**

The study consists of 205 patients and 208 knees with Kellgren-Lawrence Grade 3 or 4 osteoarthritis and treated with a TKA. Each knee had a narrow slice (2 mm) preoperative 1.5 tesla magnetic resonance image in the sagittal plane. Femoral bone and cartilage wear at 0° and 90° was computed from best-fit circles superimposed on the peripheral boundary of the subchondral bone on the medial and lateral femoral condyles.

**RESULTS:**

Overall, 99.5% of knees had minimal bone wear (<1 mm) at 0° and 90°. In the 74% (154 of 208) of knees with a varus deformity, 92% at 0° and 2 % at 90° had >1 mm cartilage wear on the medial femoral condyle. In the 26% (54 of 208) of knees with a valgus deformity, 78% at 0° and 55% at 90° had ≥1 mm cartilage wear on the lateral femoral condyle.

**CONCLUSIONS:**

As a general guideline, adjustment for femoral bone wear is rarely required when performing kinematically aligned TKA. Most osteoarthritic knees require adjustment of the distal referencing guide to compensate for cartilage wear on the medial femoral condyle in the varus knee and the lateral femoral condyle in the valgus knee. Adjustment of the posterior referencing guide is required in about half of valgus osteoarthritic knees to compensate for lateral cartilage wear at 90°. Knowing that bone wear is rare and cartilage wear is predictable in varus and valgus Kellgren-Lawrence Grade 3 or 4 osteoarthritic knees helps establish general guidelines for adjusting the distal and posterior femoral referencing guides to restore the natural angle and level of the femoral joint lines when performing kinematically aligned TKA with generic instruments.

LEVEL OF EVIDENCE:

IV.

1. **NEDOPIL AJ, HOWELL SM, HULL ML**

**WHAT CLINICAL CHARACTERISTICS AND RADIOGRAPHIC PARAMETERS ARE ASSOCIATED WITH PATELLOFEMORAL INSTABILITY AFTER KINEMATICALLY ALIGNED TOTAL KNEE ARTHROPLASTY?**

**INT ORTHOP. 2017 FEB;41(2):283-291. DOI:10.1007/S00264-016-3287-Z. EPUB 2016 SEP 12.**

**Abstract**

**INTRODUCTION:**

Thirteen patients presented with patellofemoral instability out of 3212 knees treated with kinematically aligned total knee arthroplasty (KA TKA) during a nine year period. We determined the clinical characteristics and post-operative radiographic parameters associated with patellofemoral instability, and whether re-operation and patient reported outcome measures are different between patients with and without patellofemoral instability.

**METHODS:**

Patients with patellofemoral instability were matched 1:3 to a control cohort based on date of surgery (±3 months), age (±10 years), sex, pre-operative knee deformity (varus or valgus), and implant brand. We analyzed clinical characteristics and seven post-operative radiographic parameters.

**RESULTS:**

Patellofemoral instability presented atraumatically (12 of 13) at 5 ± 4.7 months for a 0.4 % incidence at a mean follow-up of 43 ± 36 months. No pre-operative clinical characteristics were associated with instability. Patients with patellofemoral instability had greater flexion of the femoral component (11° versus 5°; p = 0.0012), a trend toward greater external rotation of the tibial component (2° versus 0°; p = 0.2704), more reoperations (9 versus 0; p = 0.0026) and a lower Oxford Knee Score (36 versus 42; p = 0.0045) than controls.

**DISCUSSION:**

Patellofemoral instability after kinematically aligned TKA is infrequent, presents atraumatically, and is associated with greater flexion of the femoral component than the control group.

**CONCLUSION:**

Minimizing flexion of the femoral component might reduce the risk of patellofemoral instability by promoting early engagement of the patella in the trochlear during knee flexion.

# [**NEDOPIL AJ**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Nedopil%20AJ%5BAuthor%5D&cauthor=true&cauthor_uid=29074324)**,**[**SINGH AK**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Singh%20AK%5BAuthor%5D&cauthor=true&cauthor_uid=29074324)**,**[**HOWELL SM**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Howell%20SM%5BAuthor%5D&cauthor=true&cauthor_uid=29074324)**,**[**HULL ML**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Hull%20ML%5BAuthor%5D&cauthor=true&cauthor_uid=29074324)

# **DOES CALIPERED KINEMATICALLY ALIGNED TKA RESTORE NATIVE LEFT TO RIGHT SYMMETRY OF THE LOWERLIMB AND IMPROVE FUNCTION?**

# [**J ARTHROPLASTY.**](https://www.ncbi.nlm.nih.gov/pubmed/29074324)**2018 FEB;33(2):398-406**

#### **BACKGROUND:**

Kinematically aligned total knee arthroplasty (KA TKA) strives to restore the native left to right symmetry of the lowerlimb; however, the reproducibility of achieving this target is unknown. The present study determined the proportion of patients with left to right symmetry and the improvement in patient-reported function after calipered KA TKA.

#### **METHODS:**

A review of 562 postoperative scanograms identified 102 patients (53 women) with a KA TKA in one limb, no other skeletal abnormalities in either limb, and symmetrical rotation between limbs on the scanogram. All patients were treated with primary TKA that used caliper measurement of the thicknesses of the femoral bone and tibial bone resections to kinematically align the components. The hip-knee-ankle (HKA) angle, distal lateral femoral angle (DLFA), and proximal medial tibial angle (PMTA) were measured. Patient-reported Oxford Knee Score (OKS) measured preoperative and postoperative functions.

#### **RESULTS:**

The proportion of patients with a difference in the HKA angle, DLFA, and PMTA between limbs within ±3°, >3° varus, and <-3° valgus was 95%, 2%, and 3%, respectively, for the HKA angle; 97%, 1%, and 2%, respectively, for the DLFA; and 97%, 2%, and 1%, respectively, for the PMTA. The mean OKS improved from 20 preoperatively to 44 points (range 18-48 points) at 15 months postoperatively.

#### **CONCLUSION:**

Calipered KA TKA restored native left to right symmetry of the HKA angle, DLFA, and PMTA in nearly all patients with negligible risk of varus alignment of the tibial component with respect to the native tibial joint line. The mean postoperative OKS indicated clinically important improvement in patient-reported function.

7) **NEDOPIL AJ, HOWELL SM, HULL ML.**

**WHAT MECHANISMS ARE ASSOCIATED WITH TIBIAL COMPONENT FAILURE AFTER KINEMATICALLY-ALIGNED TOTAL KNEE ARTHROPLASTY?**

**INT ORTHOP. 2017 AUG;41(8):1561-1569. DOI: 10.1007/S00264-017-3490-6.**

**Abstract**

**PURPOSE:**

Eight patients treated with kinematically-aligned (KA) total knee arthroplasty (TKA) presented with tibial component failure. We determined whether radiographic measurements and clinical characteristics are different between patients with and without tibial component failure to identify mechanisms of failure and strategies to reduce the risk.

**METHODS:**

Out of 3,212 primary TKAs (2,725 TKAs with a two-year minimum follow up), of which all were performed with KA, eight patients presented with tibial component failure. Radiographic measurements, clinical characteristics (e.g. age, gender, BMI, etc.), revision surgical records, and Oxford knee scores were compared to control cohort patients matched 1:3.

**RESULTS:**

Tibial component failure presented at an average of 28 ± 15 months after primary TKA. Patients with tibial component failure had a 6 kg/m2 greater body mass index (p = 0.034) and 5° greater posterior slope of the tibia component (p = 0.002) than controls. Final follow-up averaged 56 ± 19 months after the primary TKA and 28 ± 24 months after the revision TKA. The final Oxford knee score was 39 ± 4.6 for patients with tibial component failure and 44 ± 6.5 for the controls (p = 0.005).

**CONCLUSIONS:**

The incidence of tibial component failure after KA TKA was 0.3% and was caused by posterior subsidence or posterior edge wear and not varus subsidence. The strategy for lowering the risk of tibial component failure when performing KA is to set the tibial component parallel to the flexion-extension plane (slope) and varus-valgus plane of the native joint line.

1. **SHELTON TJ, GILL M, ATHWAL G, HOWELL SM, HULL ML.**

**OUTCOMES IN PATIENTS WITH A CALIPERED KINEMATICALLY ALIGNED TKA THAT ALREADY HAD A CONTRALATERAL MECHANICALLY ALIGNED TKA**

**J KNEE SURG. 2019 JUL 9. DOI: 10.1055/S-0039-1693000**

**Abstract**

Prior studies suggest kinematically aligned (KA) total knee arthroplasty (TKA) provides some clinical benefits. There are no reports of self-reported outcome measures in patients treated with a calipered KA TKA that already had a contralateral mechanically aligned (MA) TKA. We performed a retrospective study and asked the following questions: (1) Were you satisfied with your MA TKA when you were treated with the KA TKA? (2) What are the Forgotten Joint Scores (FJS) and Oxford Knee Scores (OKS) in each of your knees? (3) Do you favor one knee? and (4) Did one knee recover faster? From January 2013 to January 2017, 2,378 consecutive primary TKAs were performed of which all were treated with calipered KA that uses serial verification checks incorporating measurements of bone resections and positions to restore the prearthritic or native joint lines accurately. A records review identified patients with a prior primary MA TKA in the contralateral limb. Excluded were those with a history of fracture, osteotomy, infection, or revision knee surgery in either limb. In September 2018, 78 patients (57 females) with a mean age of 73 years (range, 50-91 years) completed a follow-up evaluation consisting of the FJS and OKS questionnaires and three anchor questions. A total of 83% of patients were satisfied with the MA TKA and 92% were satisfied with the KA TKA. The KA TKA had a 15 point higher median FJS and a comparable OKS to that of the MA TKA. Also, 56% of patients favored the KA TKA, and 8% favored the MA TKA. Seventy four percent of patients favored the recovery of the KA TKA, and 6% favored the recovery of the MA TKA. Accordingly, a patient considering a contralateral KA TKA can expect that more often than not the KA TKA will have a higher FJS, a similar OKS, be their favorite knee, and recover faster. Present study is therapeutic and reflects level IV evidence.

1. **SHELTON TJ, NEDOPIL AJ, HOWELL SM, HULL ML**

**DO VARUS OR VALGUS OUTLIERS HAVE HIGHER FORCES IN THE MEDIAL OR LATERAL COMPARTMENTS THAN THOSE WHICH ARE IN-RANGE AFTER A KINEMATICALLY ALIGNED TOTAL KNEE ARTHROPLASTY? LIMB AND JOINT LINE ALIGNMENT AFTER KINEMATICALLY ALIGNED TOTAL KNEE ARTHROPLASTY**

**BONE JOINT J. 2017 OCT;99-B(10):1319-1328. DOI: 10.1302/0301-620X.99B10.BJJ-2017-0066.R1.**

**FULL TEXT AVAILABLE**

**Abstract**

**AIMS:**

The aims of this study were to determine the proportion of patients with outlier varus or valgus alignment in kinematically aligned total knee arthroplasty (TKA), whether those with outlier varus or valgus alignment have higher forces in the medial or lateral compartments of the knee than those with in-range alignment and whether measurements of the alignment of the limb, knee and components predict compartment forces.

**PATIENTS AND METHODS:**

The intra-operative forces in the medial and lateral compartments were measured with an instrumented tibial insert in 67 patients who underwent a kinematically aligned TKA during passive movement. The mean of the forces at full extension, 45° and 90° of flexion determined the force in the medial and lateral compartments. Measurements of the alignment of the limb and the components included the hip-knee-ankle (HKA) angle, proximal medial tibial angle (PMTA), and distal lateral femoral angle (DLFA). Measurements of the alignment of the knee and the components included the tibiofemoral angle (TFA), tibial component angle (TCA) and femoral component angle (FCA). Alignment was measured on post-operative, non-weight-bearing anteroposterior (AP) scanograms and categorised as varus or valgus outlier or in-range in relation to mechanically aligned criteria.

**RESULTS:**

The proportion of patients with outlier varus or valgus alignment was 16%/24% for the HKA angle, 55%/0% for the PMTA, 0%/57% for the DLFA, 25%/12% for the TFA, 100%/0% for the TCA, and 0%/64% for the FCA. In general, the forces in the medial and lateral compartments of those with outlier alignment were not different from those with in-range alignment except for the TFA, in which patients with outlier varus alignment had a mean paradoxical force which was 6 lb higher in the lateral compartment than those with in-range alignment. None of the measurements of alignment of the limb, knee and components predicted the force in the medial or lateral compartment.

**CONCLUSION:**

Although kinematically aligned TKA has a high proportion of varus or valgus outliers using mechanically aligned criteria, the intra-operative forces in the medial and lateral compartments of patients with outlier alignment were comparable with those with in-range alignment, with no evidence of overload of the medial or lateral compartment of the knee.

1. **SHELTON TJ, HOWELL SM, HULL ML**

**IS THERE A FORCE TARGET THAT PREDICTS EARLY-REPORTED OUTCOMES AFTER KINEMATICALLY ALIGNED TKA?**

**CLIN ORTHOP RELAT RES. 2019 MAY;477(5):1200-1207. DOI:10.1097/CORR.0000000000000600.**

**Abstract**

**BACKGROUND:**

Four mechanical alignment force targets are used to predict early patient-reported outcomes and/or to indicate a balanced TKA. For surgeons who use kinematic alignment, there are no reported force targets. To date the usefulness of these mechanical alignment force targets with kinematic alignment has not been reported nor has a specific force target for kinematic alignment been identified.

**QUESTIONS/PURPOSES:**

(1) Does hitting one of four mechanical alignment force targets proposed by Gustke, Jacobs, Meere, and Menghini determine whether a patient with a kinematically aligned TKA had better patient-reported Oxford Knee and WOMAC scores at 6 months? (2) Can a new force target be identified for kinematic alignment that determines whether the patient had a good/excellent Oxford Knee Score of ≥ 34 points (48 best, 0 worst)?

**METHODS:**

Between July 2017 and November 2017, we performed 148 consecutive primary TKAs of which all were treated with kinematic alignment using 10 caliper measurements and verification checks. A total of 68 of the 148 (46%) TKAs performed during the study period had intraoperative measurements of medial and lateral tibial compartment forces during passive motion with an instrumented tibial insert and were evaluated in this retrospective study. Because the surgeon and surgical team were blinded from the display showing the compartment forces, there was no attempt to hit a mechanical alignment force target when balancing the knee. The Oxford Knee Score and WOMAC score measured patient-reported outcomes at 6 months postoperatively. For each mechanical alignment force target, a Wilcoxon rank-sum test determined whether patients who hit the target had better outcome scores than those who missed. An area under the curve (AUC) analysis tried to identify a new force target for kinematic alignment at full extension and 10°, 30°, 45°, 60°, 75°, and 90° of flexion that predicted whether patients had a good/excellent Oxford Knee Score, defined as a score of ≥ 34 points.

**RESULTS:**

Patients who hit or missed each of the four mechanical alignment force targets did not have higher or lower Oxford Knee Scores and WOMAC scores at 6 months. Using the Gustke force target as a representative example, the Oxford Knee Score of 41 ± 6 and WOMAC score of 13 ± 11 for the 31 patients who hit the target were not different from the Oxford Knee Score of 39 ± 8 (p = 0.436) and WOMAC score of 17 ± 17 (p = 0.463) for the 37 patients who missed the target. The low observed AUCs (from 0.56 to 0.58) at each of these flexion angles failed to identify a new kinematic alignment force target associated with a good/excellent (≥ 34) Oxford Knee Score.

**CONCLUSIONS:**

Tibial compartment forces comparable to those reported for the native knee and insufficient sensitivity of the Oxford Knee and WOMAC scores might explain why mechanical alignment force targets were not useful and a force target was not identified for kinematic alignment. Intraoperative sensors may allow surgeons to measure forces very precisely in the operating room, but that level of precision is not called for to achieve a good/excellent result after calipered kinematically aligned TKA, and so its use may simply add expense and time but does not improve the results from the patient's viewpoint.

LEVEL OF EVIDENCE:

Level III, therapeutic study.