

# Joint Line Obliquity and TKA Survivorship

Yang HY, Song EK, Seo JH, Kang SJ, Seon JK. *Joint Line Obliquity Affects Survivorship Following Total Knee Arthroplasty: 12.7-Year Follow-Up of 800 Cases*.

**Citation:** J Arthroplasty 2026;41:2034–2042. doi:10.1016/j.arth.2025.10.114.

**Study type / level of evidence:** Therapeutic/prognostic study; retrospective cohort with Kaplan–Meier survivorship and Cox regression. Level III.

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## Part 1 — Leopold Five-Minute Critical Appraisal

### 1. What kind of study and what design?

A prognostic therapy study using a single-center retrospective cohort (Level III). 800 mechanically aligned, cruciate-retaining (NexGen CR) primary TKAs were analyzed with Kaplan–Meier survivorship and multivariable Cox regression, with aseptic revision for mechanical failure as the endpoint.

### 2. Does it study an important question?

Yes. As the field shifts from mechanical toward functional/kinematic and CPAK-based alignment, whether joint line obliquity (JLO) independently drives long-term failure is central to how aggressively we should reproduce the native joint line. Long-term (>12 yr) survivorship data tied specifically to JLO are scarce.

### 3. To whom does it apply, and to whom not?

Applies to primary OA treated with mechanically aligned, cemented CR TKA in a predominantly Asian, varus, female (91%) population. It does not directly apply to deliberate kinematic/functional/robotic alignment, valgus knees, PS designs, or non-Asian cohorts. Critically, every knee targeted mechanical alignment — so the 'outlier' group represents unintended deviations, not a planned alignment strategy.

### 4. Describe the methods — anything to watch for?

Two JLO systems were compared: the original CPAK calculation (LDFA+MPTA sum) and Bae's modified JLO (tibial joint surface vs the hip–knee–ankle axis). Only the modified classification produced a signal, which raises a multiple-classification concern. Measurements were 2D long-leg radiographs (rotation-sensitive). The endpoint excluded PJI and periprosthetic fracture. Subgroup event counts are small (outlier group n=106–193 depending on stratification), producing wide confidence intervals.

### 5. Were hypotheses clearly stated?

Yes — the authors hypothesized that a postoperative parallel JLO would be associated with superior survivorship versus medial or lateral JLO.

### 6. Key results — any counterintuitive findings?

Overall mechanical failure was 3.5% (28/800) at 12.7 years. Mechanically aligned knees survived 98.6% vs 92.6% for outliers ( $P<0.001$ ). The worst subgroup was outlier + nonparallel JLO, especially lateral inclination, at 87.7%. Modified JLO was an independent risk factor (HR 1.58,  $P=0.042$ ); the 2.5° cutoff had only modest discrimination (AUC 0.70, sensitivity 78%, specificity 55%). Counterintuitively, the original CPAK JLO showed no association with revision — only the modified measure did — and lateral inclination was worse than medial.

### 7. Strengths?

Large cohort (n=800), long mean follow-up (12.7 yr), blinded duplicate radiographic measurement with good ICC, multivariable adjustment, and a hard, clinically meaningful endpoint (aseptic mechanical revision).

## 8. Weaknesses?

Retrospective design with selection bias; the outlier group reflects failed execution of mechanical alignment (often with soft-tissue imbalance), confounding the JLO interpretation; 2D radiographs; modest predictive discrimination; a homogeneous Asian/varus/female cohort; no PROMs, sagittal, or ligament-balance data; possible classification multiplicity; and small absolute event numbers yielding wide CIs (outlier+nonparallel OR 7.16, CI 2.91–17.61).

## 9. How does it fit with what is known, and what remains?

It aligns with Bae 2024 (the modified-JLO origin), the MacDessi CPAK framework, and Ritter's alignment work, while contrasting with Abdel's 20-year data showing no survival difference between aligned and malaligned knees. It reinforces that gross obliquity and lateral inclination are undesirable but does not resolve the mechanical-vs-functional debate. Open questions: does deliberately restoring constitutional JLO (functional/kinematic) improve survivorship versus incidental obliquity, and do these findings hold with 3D imaging, PROMs, and non-Asian populations?

## 10. Would it change your practice?

It reinforces avoiding a laterally inclined, malaligned joint line and paying attention to JLO when adopting functional alignment — but as Level III retrospective data on unintended outliers, it should not by itself shift an alignment philosophy. Practical takeaway for outpatient MA/functional cases at the ASC: do not leave a grossly outlier, laterally inclined joint line.

## Validity and Bias

**Internal validity:** Reasonable within a retrospective frame; blinded duplicate radiographic reads with good ICC limit detection bias, and multivariable Cox adjustment is appropriate. The central threat is susceptibility/confounding — outliers are prognostically different and represent imperfect MA execution rather than a defined alignment target.

**External validity (generalizability):** Limited. Asian, varus, predominantly female, mechanical-alignment-only, single CR design (NexGen CR), two expert surgeons.

**Principal biases:** Susceptibility bias (prognostically dissimilar outlier group), possible classification multiplicity (signal only with the modified JLO), transfer bias (uncontactable patients excluded), and 2D measurement error.

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## Part 2 — Comparison to the Existing Literature

**Search method:** PubMed searched across three windows — the past 20 years (2006–2026), the past 2 years (2024–2026), and the trailing 30 days (29 May–29 June 2026). Citations below include DOIs (source: PubMed).

### Foundational / landmark context (20-year window)

The conceptual backbone is the CPAK classification (MacDessi 2021, Bone Joint J), which formalized constitutional phenotypes from arithmetic HKA and JLO. Ritter's alignment-and-survival work and Abdel's concise 20-year follow-up (no survival difference between neutral and malaligned modern cemented TKA) frame the long-standing debate that neutral mechanical alignment is not the only durable target. Clark 2023 (J Arthroplasty) showed that maintaining

JLO optimizes functional-alignment outcomes in constitutionally varus knees — directly supportive of the present paper's thesis.

### Past two years (2024–2026)

Bae 2024 (KSSTA) introduced the modified postoperative-phenotype JLO measure this study adopts and is its closest methodological predecessor. Konishi 2024 (Bone Joint J) linked pre- and post-operative CPAK class to clinical outcomes, and MacDessi 2024 ('Not all knees are the same', Bone Joint J) reinforced phenotype-specific targeting. These corroborate the premise that JLO and phenotype matter, though most report PROMs rather than the hard survivorship endpoint used here.

### Trailing 30 days

A dedicated PubMed search of 29 May–29 June 2026 returned general TKA-alignment papers but no study pairing JLO specifically to implant survivorship. The most current closely related work is Sadoghi 2025 (KSSTA, Oct 2025), on the broader scientific value of knee phenotyping. In other words, this 12.7-year cohort is, at present, among the most recent hard-endpoint contributions on JLO and survivorship.

### Where this paper sits in the literature

This is one of the largest and longest-follow-up cohorts to tie JLO specifically to mechanical survivorship. It is consistent with the emerging phenotype literature (CPAK/Bae) but distinguishes itself by using aseptic mechanical revision at 12.7 years rather than short-term PROMs. Its main limitation relative to that literature is that its 'outliers' are unintended malalignments, so it speaks more to avoiding gross obliquity than to validating deliberate constitutional restoration.

### Key comparator references

1. MacDessi SJ, et al. Coronal Plane Alignment of the Knee (CPAK) classification. Bone Joint J 2021;103-B:329–337. [doi:10.1302/0301-620X.103B2.BJJ-2020-1050.R1](https://doi.org/10.1302/0301-620X.103B2.BJJ-2020-1050.R1)
2. MacDessi SJ, et al. Not all knees are the same. Bone Joint J 2024;106-B:525–531. [doi:10.1302/0301-620X.106B6.BJJ-2023-1292.R1](https://doi.org/10.1302/0301-620X.106B6.BJJ-2023-1292.R1)
3. Konishi T, et al. Pre- and postoperative CPAK classification and its impact on clinical outcomes in TKA. Bone Joint J 2024;106-B:1059–1066. [doi:10.1302/0301-620X.106B10.BJJ-2023-1425.R1](https://doi.org/10.1302/0301-620X.106B10.BJJ-2023-1425.R1)
4. Clark GW, et al. Maintaining Joint Line Obliquity Optimizes Outcomes of Functional Alignment in TKA in Constitutionally Varus Knees. J Arthroplasty 2023;38(7 Suppl 2):S239–S244. [doi:10.1016/j.arth.2023.04.004](https://doi.org/10.1016/j.arth.2023.04.004)
5. Sadoghi P, et al. Unlocking the scientific and clinical value of knee phenotyping beyond knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2025. [doi:10.1002/ksa.70142](https://doi.org/10.1002/ksa.70142)