Influence of Sagittal Implant Alignment in Total Knee Replacement (TKR) on Patient Outcomes (PROMs): A Systematic Review and Meta-Analysis

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INTRODUCTION:

With enhanced implant precision facilitated by new robots, there is renewed attention on the contribution of TKR alignment to enduring issues post-TKR, including 20% patient dissatisfaction and 55% residual symptom rate. While coronal alignment has been extensively studied, the impact of post-operative sagittal alignment on PROMs remains unclear. This review examines its relationship with PROMs.

METHODS:

We searched five electronic databases (to 30/01/2025) for studies reporting post-TKR sagittal alignment and PROMs. Case-weighted meta-regression models assessed sagittal alignment–PROM relationships across individual timepoints post-TKR, with pooled effects calculated across all timepoints. Results are reported as regression coefficient (RC) and 95% confidence intervals (95%CI).

RESULTS:

Of 622 studies, 51 were included(N=10,769 TKRs).

Pooled analysis across all timepoints showed that higher Femoral-Flexion(FF), measured between anatomical axis of distal femur and either anterior flange of femoral prosthesis(FF1) or bottom of femoral component(FF2), was associated with improved Knee-Society-Score (KSS; FF1:RC=2.07,95%CI=0.16-4.0,n=229 TKRs, FF2:RC=0.83,95%CI=0.53-1.14,n=510) Knee-Injury-and-Osteoarthritis-Outcome-Score(FF2:RC=1.42,95%CI=0.62-2.21,n=400).

Pooled analysis showed that lower Femoral-Sagittal-Angle(FSA, range:0.90-3.80) was associated with improved KSS(RC=-6.09,95%CI=-7.63- -4.54,n=280), markedly at 12 months(RC=-6.29,95%CI=8.68- -3.903,n=160).

Pooled analysis showed that higher Posterior-Condylar-Offset(PCO, range:24.00-33.60) was associated with improved KSS(RC=31.6,95%CI=23.52-39.76,n=338), particularly at 12 months(RC=31.9,95%CI=19.8-43.9,n=613).

Despite higher Posterior-Tibia-Slope(PTS, range:-5.00-8.86) being associated with improved Visual-Analogue-Scale-Pain scores at 1 month(RC=1.00,p<0.001,n=90), Oxford-Knee-Score at 6 months(RC=3.28,p=0.009,n=117), and KSS-Knee at 24 months(RC=3.29,p=0.002,n=150), pooled analysis across all timepoints didn't show significant relationship with PROMs.

DISCUSSION AND CONCLUSION:

This review shows that sagittal alignment influences PROMs, with higher FF, lower FSA, and greater PCO associated with improved outcomes, while PTS shows inconsistent effects. Clarifying the relationships between these alignment parameters and PROMs, along with consideration of patient-specific factors such as natural preoperative alignment, may support more individualised approaches to knee arthroplasty. To strengthen future research and improve the comparability of studies, there is a need to establish a consensus on core sagittal alignment parameters, standardised measurement protocols, and relevant outcome measures.