

Introduction: Total knee arthroplasty (TKA) reliably improves pain and function, yet a substantial proportion of patients remain dissatisfied. Functional alignment (FA), enabled by robotic-assisted TKA, aims to better respect individual anatomy and soft-tissue balance compared with the conventional mechanical alignment (MA) approach.

Methods: A PRISMA-guided meta-analysis searched Medline, the Cochrane Library, and Google Scholar (inception to December 29, 2025) for comparative studies of robotic-assisted primary TKA using FA versus MA in adults. Outcomes included operative duration, need for soft-tissue release, range of motion (ROM; ≤ 6 weeks and 6 months), Forgotten Joint Score-12 (FJS-12; 3 and 6 months), and 1-year functional scores (OKS and WOMAC converted to a common scale). Review Manager 5.4 was used to pool mean differences (MD) and odds ratios (OR) with 95% confidence intervals.

Results: Six studies (645 TKAs; 324 FA, 321 MA) were included. FA reduced soft-tissue releases (MA higher odds: OR 5.38; 95% CI 2.71–10.69; $p < 0.00001$) and improved early ROM gains at ≤ 6 weeks (MD 4.64°; 95% CI 2.21–7.07; $p = 0.0002$), with no ROM difference at 6 months ($p = 0.76$). FJS-12 did not differ at 3 months ($p = 0.07$) but favored FA at 6 months (MD 10.74; $p < 0.00001$) without meeting the reported MCID threshold. One-year functional scores were similar ($p = 0.71$). FA showed a small reduction in operative time (MD 1.42 minutes; $p = 0.03$).

Conclusion: In robotic-assisted primary TKA, FA confers clear intraoperative benefits (fewer releases) and faster early recovery (greater early ROM), while mid-term PROM advantages appear statistically significant but may not be clinically meaningful; by one year, functional outcomes are comparable. Longer, higher-quality trials are needed to assess durability and patient-relevant differences.