The Effect of Tibial and Femoral Component Adjustments on Soft Tissue Balance in TKA

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Talk available at:

www.vumedi.com/video/kinematic-versus-mechanical-alignment-evidence-and-further-directions/

Ideal goals for alignment and balance in total knee arthroplasty (TKA) remain controversial. Some authors propose balance and alignment targets that more closely approximate the native knee.

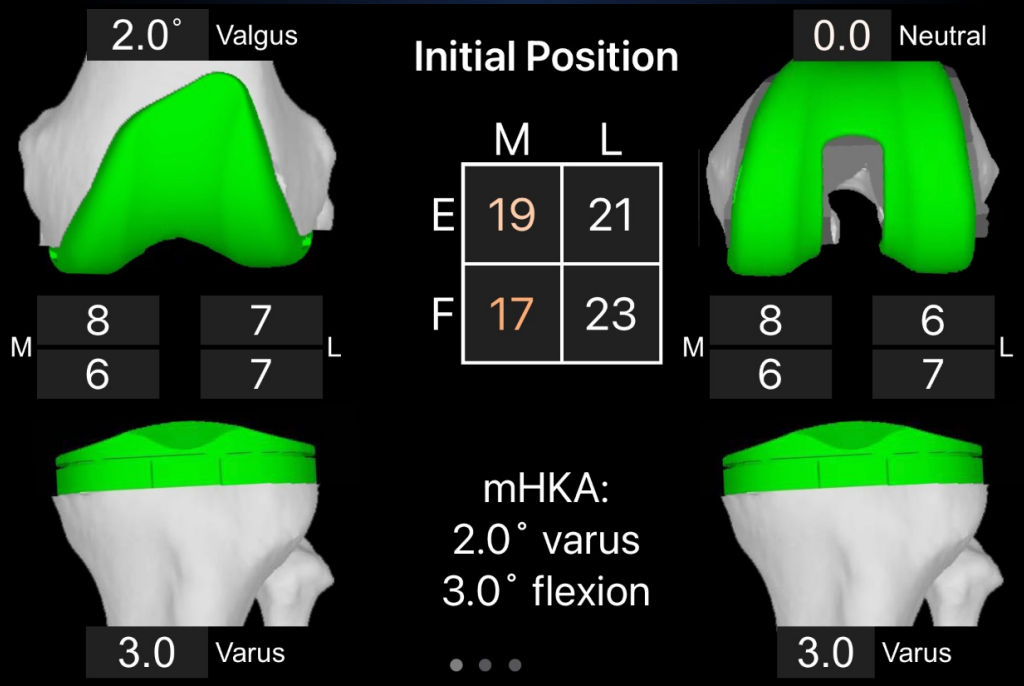
Study Aim

What percentage of MA and KA TKAs

achieve ‘balance’ without soft tissue release?

Prospective data on 388 primary robotic TKAs (154 MA and 234 KA) was analysed.

Medial extension, lateral extension, medial flexion and lateral flexion virtual gaps were recorded.



Auckland

Perth

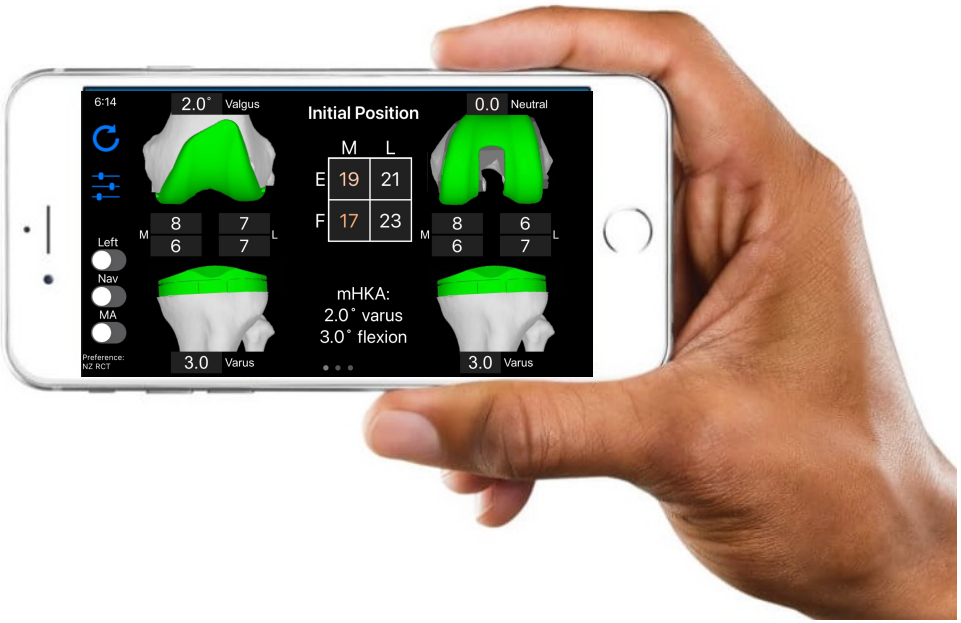
331 TKAs

2019-2021

6 Surgeons
Robotic
Manual Stress Gap Measurement

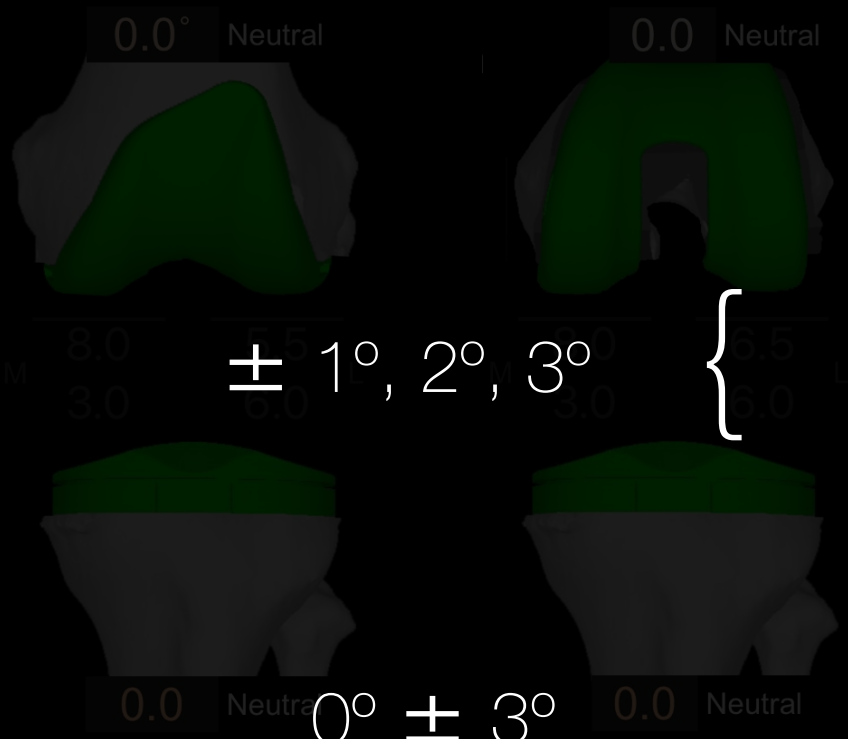
A computer algorithm calculated potential solutions to achieve soft tissue balance, utilizing virtual angular and translational adjustments of the tibial and femoral components (±1°, ±2°, or ±3° from initial).

The percentage of knees that could achieve balance without soft tissue release was compared. We also analyzed the effect of balance targets with greater lateral gap tolerances (1-3mm).



Boundary Limits

Mechanical Alignment



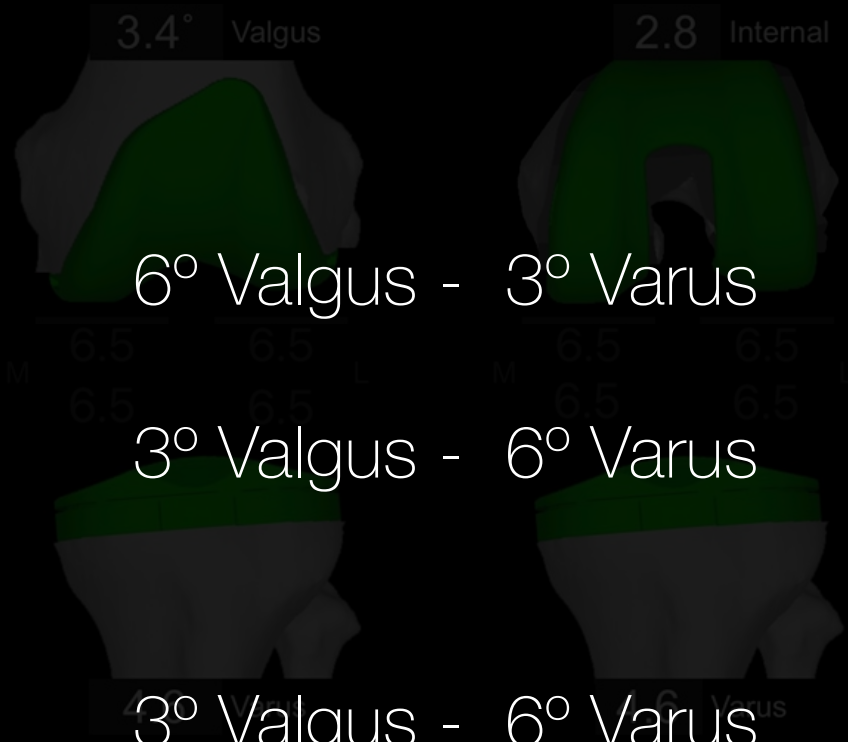
± 1°, 2°, 3°

0° ± 3°

Coronal

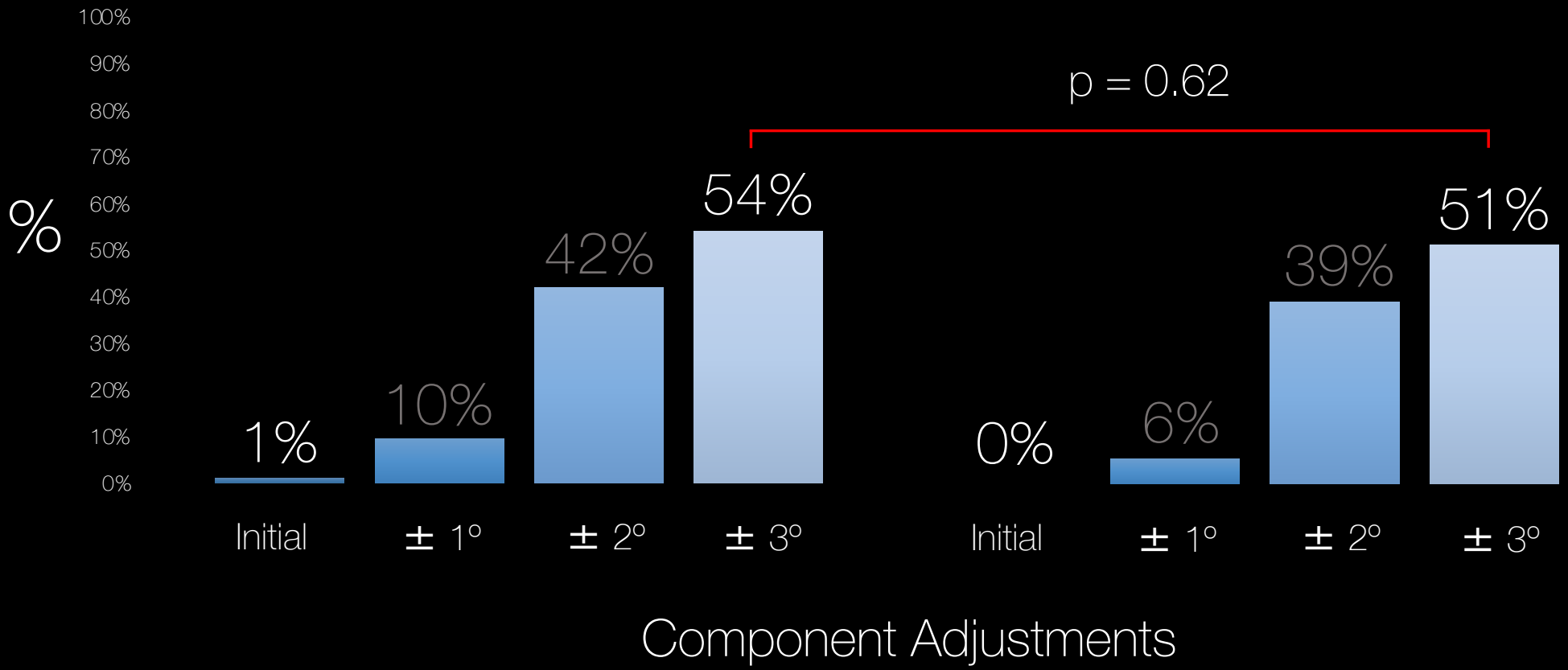
Femur	6° Valgus - 3° Varus
Tibia	3° Valgus - 6° Varus
HKA	3° Valgus - 6° Varus

Kinematic Alignment



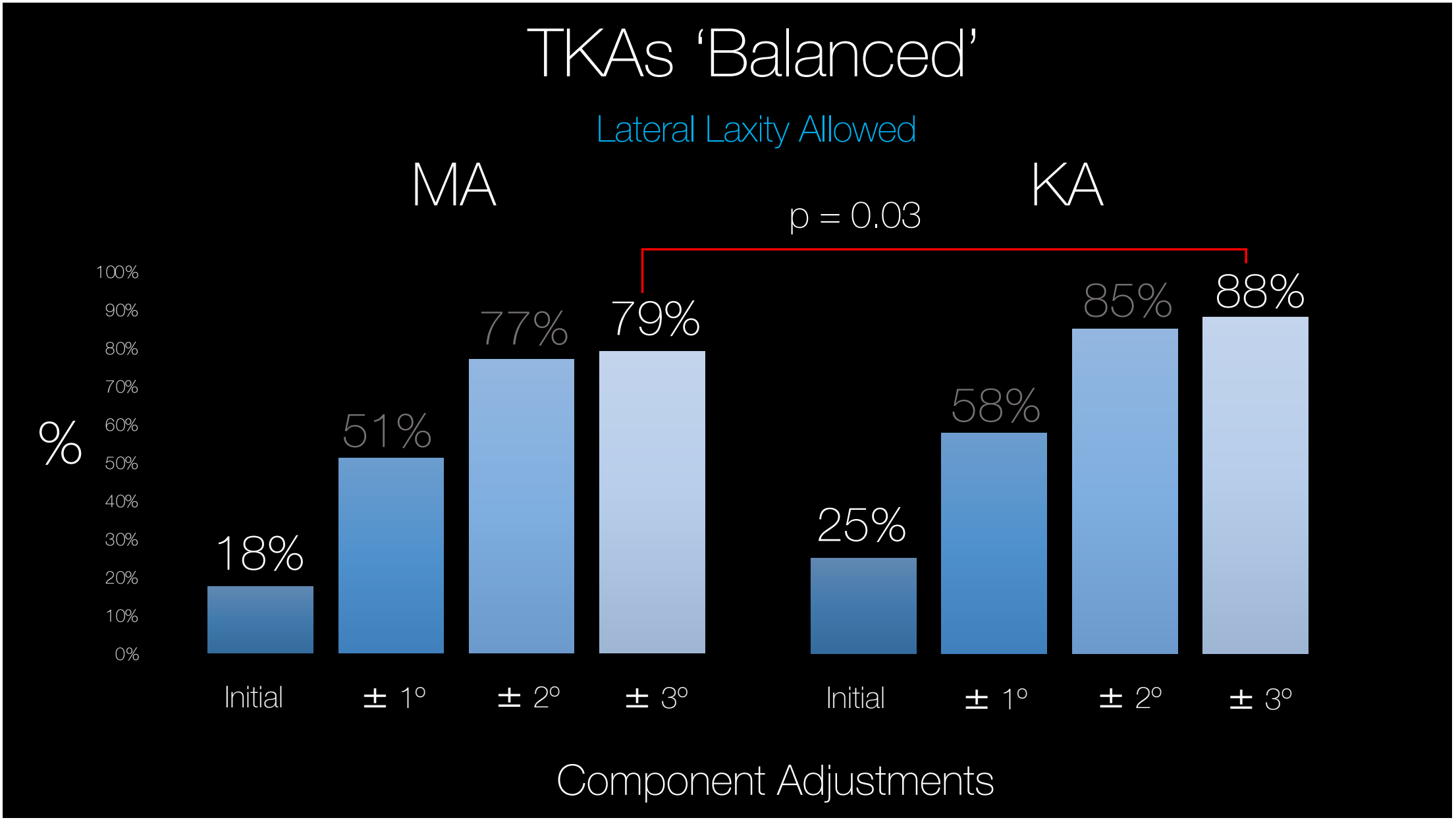
TKAs ‘Balanced’

All Gaps Equal



Less than 5% of TKAs were initially balanced in both KA and MA cohorts. Limited adjustments to component position increased the percentage of TKAs that could be balanced in a graduated manner, with no difference between MA and KA start points.

A higher percentage of TKAs could be balanced when a greater tolerance for lateral gap laxity (up to 3mm) was allowed, in both KA and MA cohorts .


TKAs 'Balanced'
Lateral Laxity Allowed
MA
KA
p = 0.03
%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
18%
51%
77%
79%
25%
58%
85%
88%
Initial
± 1°
± 2°
± 3°
Initial
± 1°
± 2°
± 3°
Component Adjustments

Conclusions

Component Adjustments – 'Bony Balancing'

A high percentage of TKAs can be balanced without soft tissue release using minor adjustments to component position, from both MA and KA start points.

KA positioning alone did not lead to a more balanced knee. Surgeons should consider the relationship between alignment and balance goals when optimizing component positioning in TKA.

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The Effect of Minor Adjustments to Tibial and Femoral Component Position on Soft Tissue Balance in Robotic Total Knee Arthroplasty

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ABSTRACT

Background: Ideal goals for alignment and balance in total knee arthroplasty (TKA) remain controversial. We aimed to compare initial alignment and balance using mechanical alignment (MA) and kinematic alignment (KA) techniques and to analyze the percentage of knees that could achieve balance using limited adjustments to component position.

Methods: Prospective data on 331 primary robotic TKAs (115 MAs and 216 KAs) were analyzed. Medial and lateral virtual gaps were recorded in both flexion and extension. A computer algorithm was used to calculate potential (theoretical) implant alignment solutions to achieve balance within 1 millimeter (mm) without soft tissue release given an alignment philosophy (MA or KA), angular boundaries (±1, ±2, or ±3°), and gap targets (equal gaps or lateral laxity allowed). The percentage of knees that could theoretically achieve balance was compared.

Results: Less than 5% of TKAs were initially balanced. Limited adjustments to component position increased the percentage of TKAs that could be balanced in a graduated manner, with no difference between MA and KA start points: adjustments of ±1 (10% versus 6%, $P = .17$), ±2 (42% versus 39%, $P = .61$), or of ±3 (54% versus 51%, $P = .66$). A higher percentage of TKAs could be balanced when a greater range for lateral gap laxity was allowed. Balancing from KA resulted in increased joint line obliquity in the final implant alignment.

Conclusion: A high percentage of TKAs can be balanced without soft tissue release using minor adjustments to component position. Surgeons should consider the relationship between alignment and balance goals when optimizing component positioning in TKA.

Total knee arthroplasty (TKA) aims to restore limb alignment and soft tissue balance in the arthritic knee. Mechanical alignment (MA) technique targets a neutral limb alignment through perpendicular bone resections relative to the mechanical axis of the femur and tibia. It also aims for symmetrical and balanced gaps in flexion and extension, which may require soft tissue releases [1]. In contrast, kinematic alignment (KA) aims to restore the patient's native prearthritic knee anatomy through symmetrical bone resections after adjusting for wear, relative to the femoral and tibial joint lines. Advocates of KA argue that as this schema more closely replicates native anatomy, balanced gaps are more likely to be achieved without ligamentous release [2,3].

With the development of modern navigation and robotic technologies, surgeons can virtually position TKA components and assess balance and alignment prior to performing bone resections. This provides the opportunity to adjust tibial and femoral component position virtually to achieve gap balance, from either MA or KA initial start points, minimizing the need for soft tissue releases. This may be beneficial to TKA patients, with a recent study reporting reduced pain postoperatively in those without ligamentous releases versus those who had releases performed [4]. Surgeons may also consider individualized or unequal gap targets because knee laxity has been shown to vary between 0 and 90 of flexion, with lateral laxity increasing as the knee moves into flexion [5,6].

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