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Patellar alignment in robotic-assisted total knee arthroplasty (TKA)

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Faculty Disclosure Information

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  - Stryker Consultant

Introduction

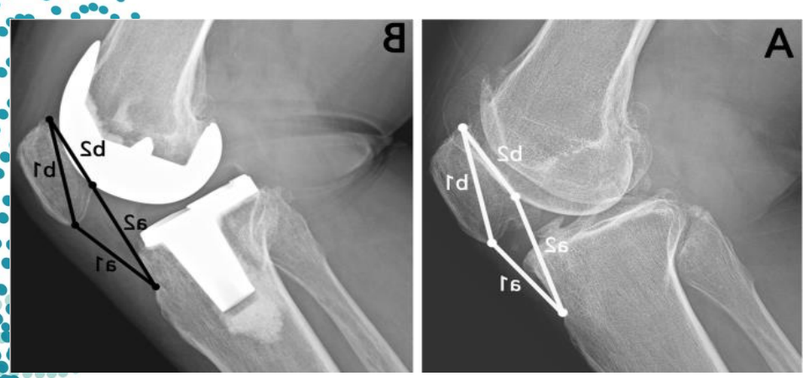
- Modern arthroplasty data demonstrate more than 15% of patients suffer from clinically significant patellofemoral dysfunction following TKA even when the patella is resurfaced.
- Robotic-assisted TKA was introduced to enhance the precision of bone preparation and component alignment with the goal of improving the clinical results and survivorship of TKA.
- This improvement in the positioning of the femoral and tibial components could also translate into improved patellar alignment.
- Robotic-assisted TKA does not directly assist patellar positioning.
- Objective: Evaluate patellar alignment in robotic-assisted TKA

Materials and Methods

- Descriptive study. 60 patients (64 knees)
- Robotic-assisted TKA (MAKO, Stryker Corporation, Mahwah, NJ, USA)
- Standardized pre op Xrays – 3 months post op Xrays
- Measurements by 2 musculoskeletal radiologists:
  - Patellar Tilt
  - Patellar Displacement
  - Patellar Height: Modified Insall-Salvati and Caton-Deschamps
  - Distance to Joint Line, Epincondylar ratio
  - Anterior condylar offset (ACO), Posterior condylar offset (PCO)
- Descriptive analysis: mean, standard deviation (SD), difference pre op – post op

Patellar Height

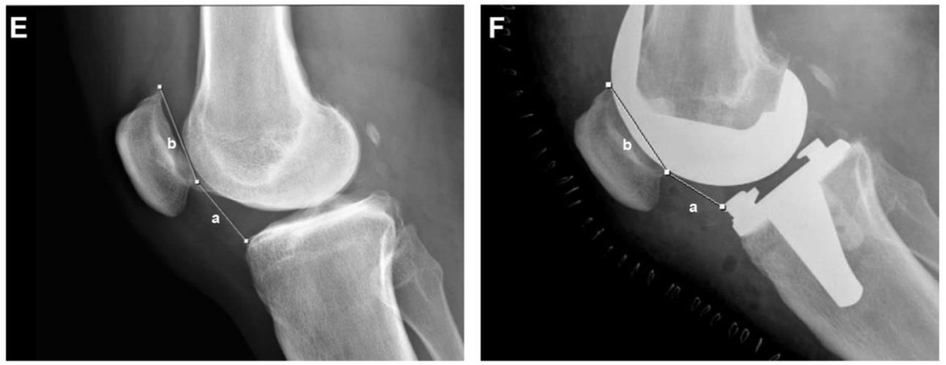
Modified Insall Salvati Ratio



Normal value	1.2 – 2.1

IS pre op	1.67 (SD 0.17)
IS post op	1.51 (SD 0.21)
Difference pre – post	0.16mm

Caton Deschamps Ratio



Normal value	0.6 – 1.3

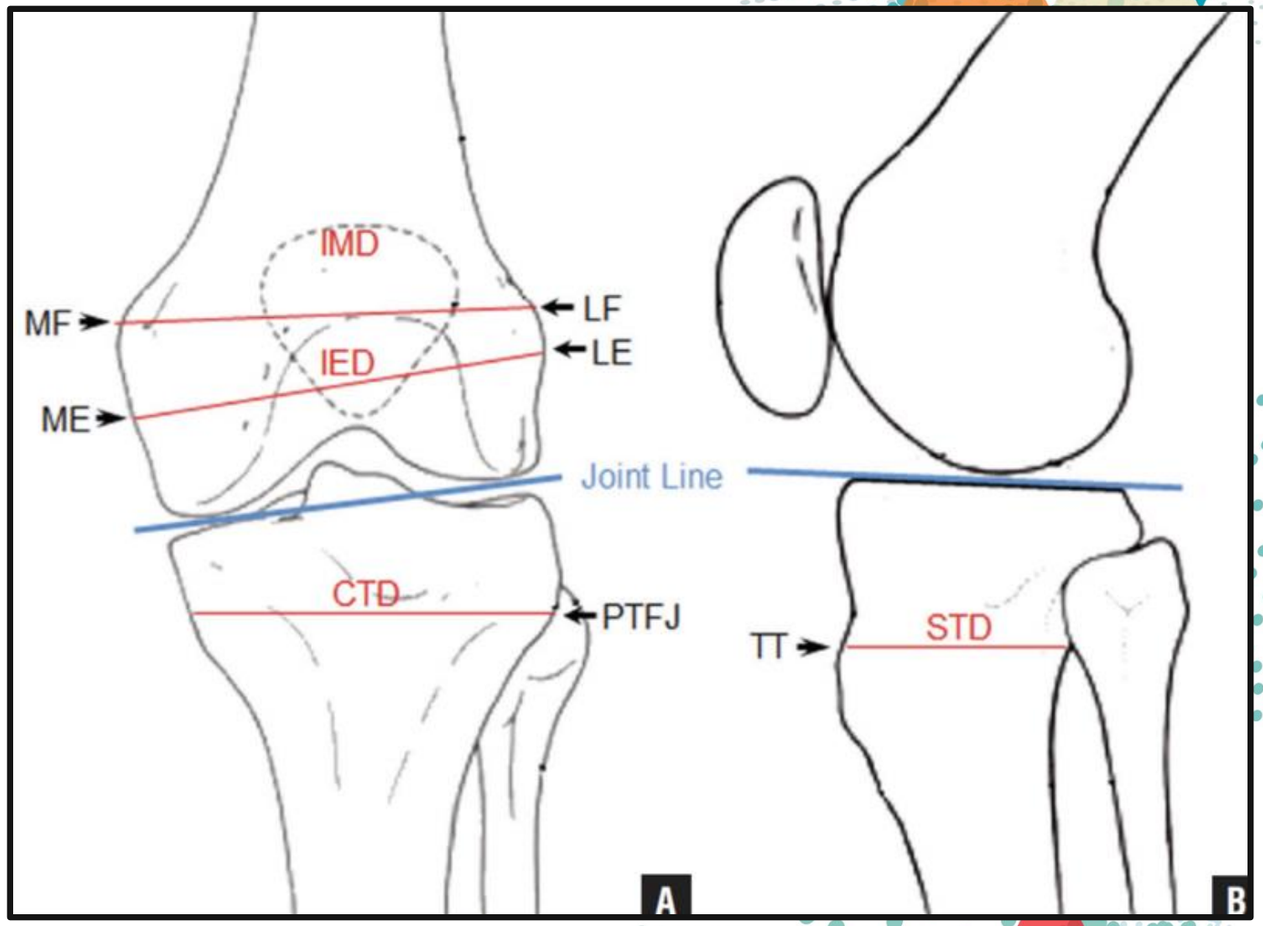
CD pre op	0.88 (SD 0.26)
CD post op	0.86 (SD 0.18)
Difference pre – post	0.25mm

Difference in Distance pre and post op to Joint Line

Joint Line to Medial Epicondyle	
Difference pre – post	–1.0mm

Joint Line to Tibial Tuberosity	
Difference pre – post	0.46mm

Joint Line to Adductor Tubercle	
Difference pre – post	–0.67mm

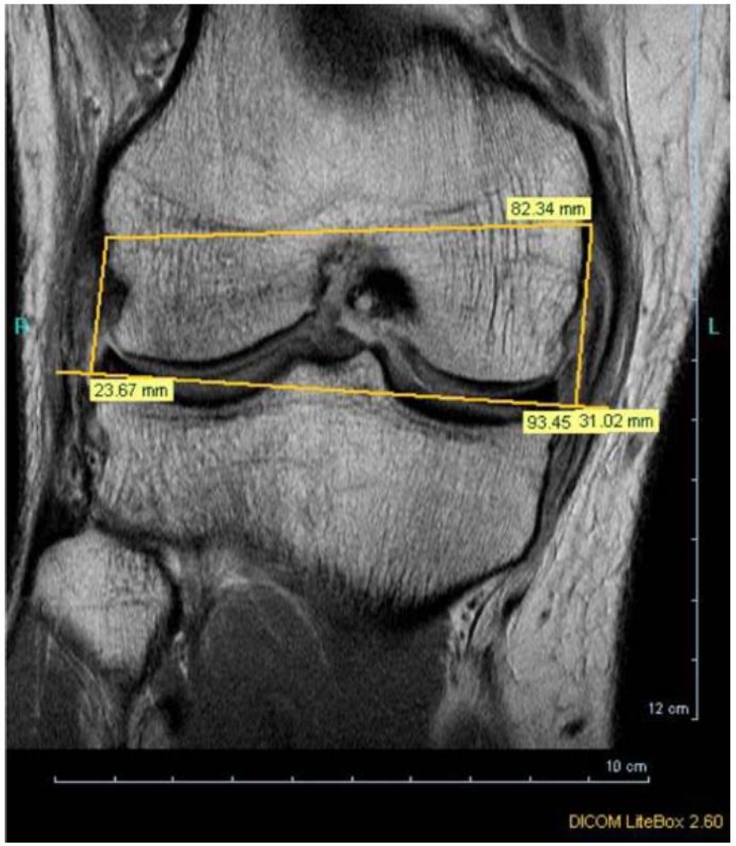


Epicondylar ratio

(Distance from the lateral epicondyle to the joint line (LED) related to the femoral width (FW))

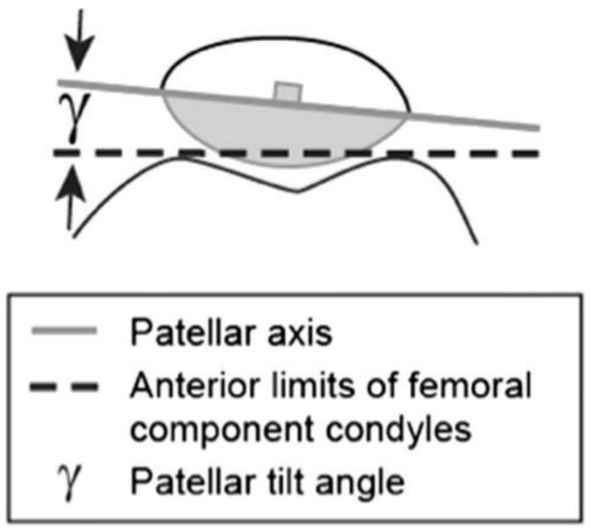
Distance to Lateral Epicondyle	
Difference pre – post	–3.06mm

Epicondylar ratio (LED/FW)	
Pre op	0.34 (SD 0.03)
Post op	0.37 (SD 0.04)
Difference pre – post	–0.03



** Servien E, Viskontas D, Giuffrè BM, Coolican MR, Parker DA. Reliability of bony landmarks for restoration of the joint line in revision knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2008*

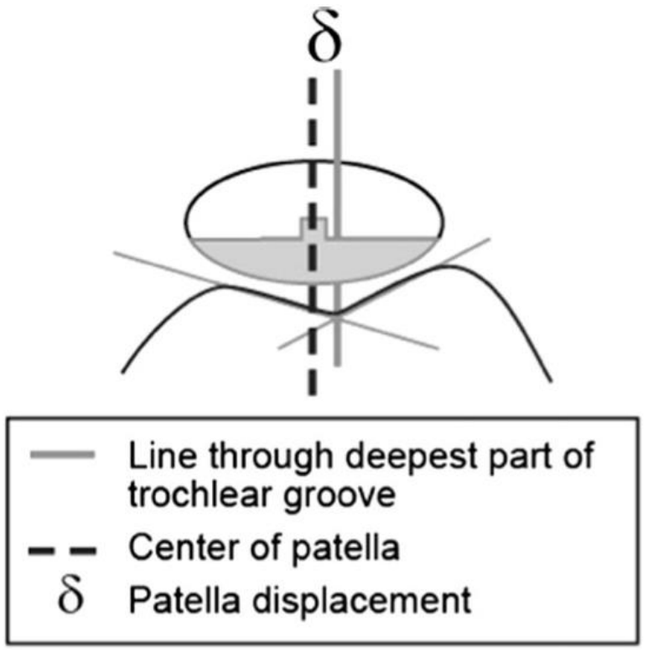
Patellar Tilt



Normal value <5º

Tilt pre op	6.09 (SD 4.12)
Tilt post op	3.98 (SD 5.89)
Difference pre - post	2.11mm

Patellar Displacement



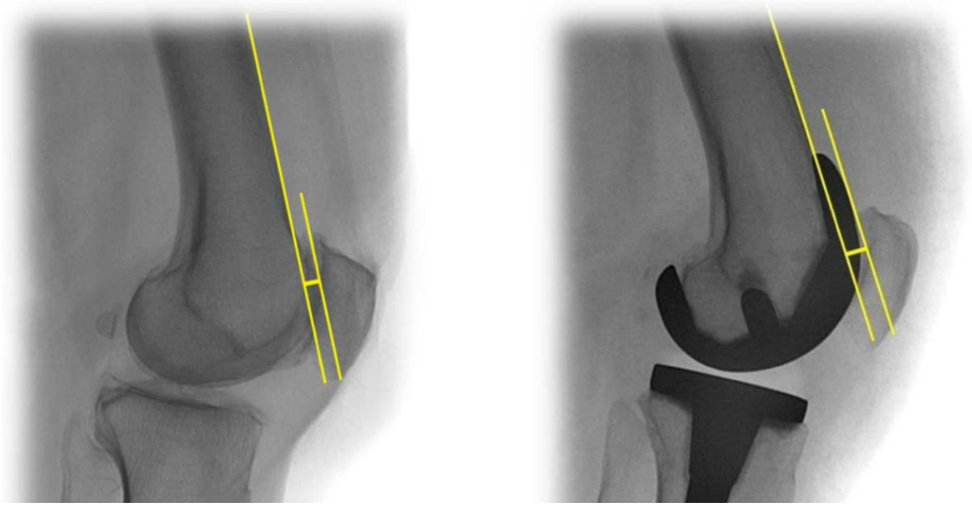
Normal value <5mm

Displacement pre op	5.48 (SD 6.46)
Displacement post op	3.89 (SD 3.18)
Difference pre - post	1.59mm

Results

Anterior Condylar Offset (ACO)

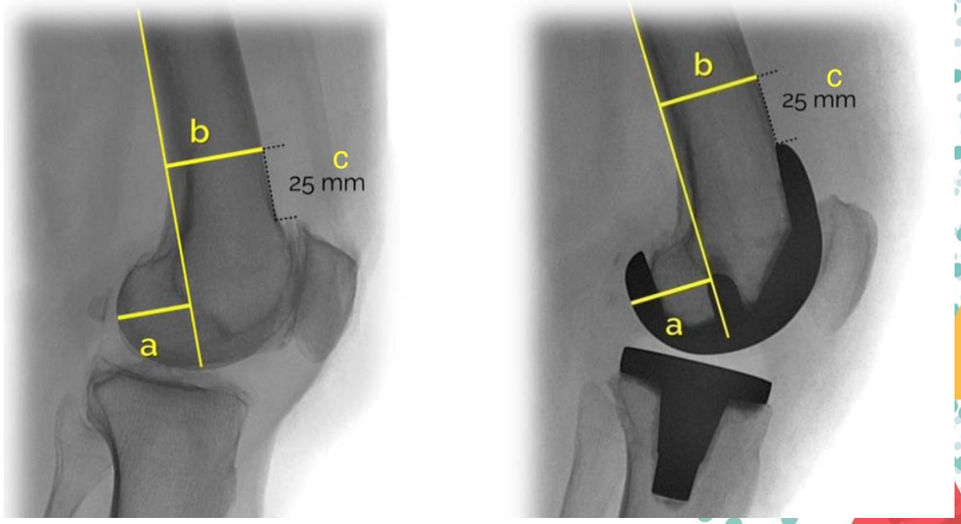
ACO pre op	7.72 (SD 2.72)
ACO post op	6.45 (SD 2.18)
Difference pre - post	1.29mm



Avoid ACO variation*

Posterior Condylar Offset PCO)

PCO pre op	27.89 (SD 4.19)
PCO post op	29.46 (SD 4.33)
Difference pre - post	- 1.57mm



Optimal variation** <2.85mm

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*Matz J, Lanting BA, Howard JL. Understanding the patellofemoral joint in total knee arthroplasty. Can J Surg. 2019

**Zhong Y, Deng Z, Gu C, Li M, Kang Y, Liao W, Zhang Z. The Optimal Variation Range of Posterior Condylar Offset Associated with Positive Clinical Outcomes of Primary Total Knee Arthroplasty: A Retrospective Analysis. Orthop Surg. 2024

Discussion

- Patellar Height pre and post op within normal values
  - Modified Insall-Salvati ratio 1.2– 2.1
  - Caton-Deschamps ratio 0.6 – 1.3
- Patellar Tilt and displacement → change from abnormal values pre op to within normal values post op
  - Tilt <5º
  - Displacement <5mm
- Variation in joint line pre and post op <5mm in all references
  - Slightly higher difference in distance to lateral epicondyle (-3 mm), but no significant difference in epicondylar ratio.
- Anterior – Posterior condylar offset with minimal differences pre and post op

Discussion

- Patellar alignment is influenced by the size, rotation, translation and balance of the other prosthetic components.

- Several authors have described patellar alignment after conventional TKA, but scarce literature with robotic-assistance
  - Batailler et al* → description of a new technique for intraoperative measurement of patellar tracking evolution during robotic-assisted total knee arthroplasty.
  - Shatrov et al** → effect of alignment choice in TKA on the ability to restore the native trochlear groove.

*Batailler C, Greiner S, Rekik HL, Olivier F, Servien E, Lustig S. Intraoperative patellar tracking assessment during image-based robotic-assisted total knee arthroplasty: technical note and reliability study. SICOT J. 2024

**Shatrov J, Coulin B, Batailler C, Servien E, Walter B, Lustig S. Alignment philosophy influences trochlea recreation in total knee arthroplasty: a comparative study using image-based robotic technology. Int Orthop. 2023.

Conclusion

Robotic-assisted TKAs obtained adequate patellar alignment, with patellar height, tilt and displacement within the values established in the literature, and no mayor difference in joint line height, anterior condylar offset and posterior condylar offset from pre and post op X-rays.

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