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The Femoral Cuts Correlation Between Robotic And Conventional Surgery In Total Knee Arthroplasty:

A Cadaveric Study

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- **My disclousures are**

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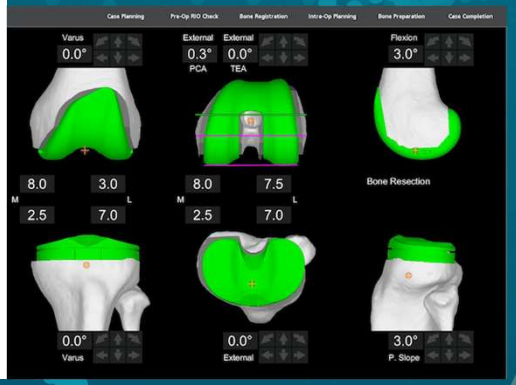
- **Introduction**

Precision in Total Knee Arthroplasty (TKA) is crucial for accurate implant positioning, restoration of joint balance, and leg alignment, all of which ultimately enhance prosthesis longevity and patient functionality.

Advances in technology have led to the development of robotic systems that improve accuracy in TKA surgery.

- **Objective**

To assess the correlation of planned distal and rotational femoral cuts between a surgeon using the MAKO® robotic system (Stryker, *Kalamazoo, MI*) and those employing manual-conventional technique (MCT).



Material and Methods

- 29 knee replacements were performed on 15 frozen cadaveric hemibodies. (1 rejected)
- Preoperative computed tomography (CT) scans were conducted to facilitate surgical planning using MAKO®.
- The medial parapatellar approach was performed in all knees.

• Material and Methods

Flowchart of the procedure

29 approached cadaveric knees

↓

A senior surgeon mapped the bone surface and planned the cuts depending on medial and lateral laxities in extension and 90º of flexion (MAKO®)

↓

90º tibial cut with 3º PTS was performed (MAKO®)

↓

Blinded MCT senior surgeon | Blinded MCT junior surgeon

↓

Evaluated medial and lateral laxities in extension and at 90º flexion

↓

Planned the distal and rotational femoral cuts following functional alignment and PCA reference

↓

MAKO® Senior surgeon performed the femoral cuts and applied Triathlon TKR test components (Stryker®)

↓

Final alignment and knee stability were measured using MAKO®

*Note: Abbreviations: PTS posterior tibial slope, PCA Posterior condylar angle

- **Results**

  - Sociodemographic variables description

Variable	n (%)
Gender, n (%)	
Men	10 (66.7%)
Woman	5 (33.3%)
Age (mean(SD))	77.2 (13.1)
Laterality:	
Right	15 (51.7%)
Left	14 (48.3%)

- In the distal femoral cuts

We found a moderate correlation between measurement of MAKO® vs. MCT surgeons. However, considering the experience of the surgeon separately, we found higher correlation between MAKO® and MCT senior surgeon than with MCT junior surgeon. The correlation between MCT senior and junior surgeons was low.

	MAKO®		Senior MCT		Junior MCT		Mean MCT surgeons		MAKO® vs. Mean MCT surgeons
	n	mean (SD*)	n	mean (SD)	n	mean (SD)	n	mean (SD)	
Distal femoral cut:									
Neutral	3	0	5	0	9	0	4	0	
Valgus	12	1,92 (1,48)	3	1 (0)	5	1,6 (0,89)	3	1 (0,5)	
Varus	14	1,89 (1,62)	21	1,81 (0,93)	15	1,13 (0,35)	22	1,14 (0,58)	
			Correlation between Senior MCT vs MAKO®		Correlation between Junior MCT vs MAKO®		Correlation between MCT surgeons		Correlation between MAKO® vs MCT surgeons
Pearson r				**0,425[a]**		**0,249[b]**		**0,104[c]**	**0,461[d]**
p-value				0,022		0,194		0,593	0,012

- In the femoral rotation cuts

There was a moderate correlation between MAKO vs. MCT surgeons and similar moderate correlation between MCT surgeons

	MAKO®		Senior MCT		Junior MCT		Mean MCT surgeons		MAKO® vs. Mean MCT surgeons
	n	mean (SD*)	n	mean (SD)	n	mean (SD)	n	mean (SD)	
Femoral rotational cut:									
Neutral	3	0	2	0	1	0	1	0	
ER	24	4,84 (2,06)	27	2,67 (1,33)	28	2,07 (0,94)	28	2,32 (1,01)	
IR	2	1,75 (1,06)	0	-	-	-	-	-	
Pearson r				**0,577[a]**		**0,407[b]**		**0,540[c]**	**0,576**
p-value				0,001		0,028		0,003	0,001

Note: [a]= Pearson correlation MAKO® vs. Senior MCT; [b]=Pearson correlation MAKO® vs. Junior MCT; [c]=Pearson correlation Senior MCT vs. Junior MCT; [d]= Correlation between MAKO® vs. mean MCT surgeons; Abbreviations: SD standard deviation, MCT manual-conventional technique, ER external rotation, IR internal rotation

- Evaluating the grades difference between techniques we found:

N=29	Mean ± SD* (grades)
Femoral distal cut:	
Between MCT surgeons	1.17±1.42
Between MAKO® vs mean of MCT surgeons	1.67±1.35
Between MAKO® vs MCT senior surgeon	1.98±1.29
Between MAKO® vs MCT junior surgeon	1.84±1.37
Femoral rotational cut:	
Between MCT surgeons	0.86±0.95
Between MAKO® vs mean of MCT surgeons	2.14±1.58
Between MAKO® vs MCT senior surgeon	2.03±1.76
Between MAKO® vs MCT junior surgeon	2.38±1.76

*Note: Abbreviations: SD standard deviation, MCT manual-conventional technique

• Discussion

- The results of our study showed a clear difference between the planned femoral distal cuts using MAKO® vs manual-conventional technique. We did not find any other study evaluating accuracy during intervention.

- The mild to moderate correlations between robotic and conventional surgery could be explained because of a less accurate conventional technique when evaluating laxities and planning cuts to perform.

- In the literature, robotic TKA technique has shown better accuracy in alignment and implant position than conventional technique:

Comparative Study > Int Orthop. 2024 Sep;48(9):2351-2358. doi: 10.1007/s00264-024-06234-0. Epub 2024 Jun 14.

Comparison of the efficacy and safety of MAKO robot-assisted total knee arthroplasty versus conventional manual total knee arthroplasty in uncomplicated unilateral total knee arthroplasty a single-centre retrospective analysis

Nanshan Ma [1 2], Pengfei Sun [1 2], Pengfei Xin [1 2], Sheng Zhong [2], Jun Xie [2], Lianbo Xiao [3]

Randomized Controlled Trial > Knee Surg Sports Traumatol Arthrosc. 2022 Feb;30(2):621-626. doi: 10.1007/s00167-020-06353-2. Epub 2020 Nov 9.

Robotic-assisted TKA leads to a better prosthesis alignment and a better joint line restoration as compared to conventional TKA: a prospective randomized controlled trial

Narendra V Vaidya [1], Ajinkya N Deshpande [2], Taufiq Panjwani [1], Rakesh Patil [1], Tanmay Jaysingani [1], Pratik Patil [1]

Review > Knee Surg Sports Traumatol Arthrosc. 2022 Aug;30(8):2677-2695. doi: 10.1007/s00167-021-06464-4. Epub 2021 Feb 6.

Robotic-arm assisted total knee arthroplasty is associated with improved accuracy and patient reported outcomes: a systematic review and meta-analysis

Junren Zhang [1], Wofhatwa Solomon Ndou [2], Nathan Ng [2], Paul Gaston [2], Philip M Simpson [2], Gavin J Macpherson [2], James T Patton [2], Nicholas D Clement [2]

Meta-Analysis > Eur J Orthop Surg Traumatol. 2024 Apr;34(3):1333-1343. doi: 10.1007/s00590-023-03798-2. Epub 2023 Dec 22.

Robotic-assisted versus conventional total knee arthroplasty: a systematic review and meta-analysis of randomized controlled trials

Reda Alrajeb [1], Mohammed Zarti [1], Zakaria Shuia [1], Osama Alzobi [2], Ghalib Ahmed [3], Aissam Elmhiregh [1]

• Discussion

- The use of a preoperative CT scan with MAKO® allows to know the TEA and PCA patient's values.
- Femoral rotational cutting can be controlled following the anatomy and ligament laxities recorded intraoperatively with MAKO®.
- Mahoney O. et al, 2022 showed a better femoral component rotation and other parameters accuracy in a postoperative CT scan using MAKO® compared with conventional technique.

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