

Can navigation help avoid early arthroplasty complications?

B. Stuyts, M.D.
A. Van Assche, M.D.
Sint-Augustinus, Wilrijk
Sint-Jozef, Malle
Belgium



What does a Surgeon want ?

- Fast / Efficient
- Accurate
- Reproducible
- Cheap / Cost effective
- Improved outcome / Survival




Postoperative morbidity and mortality following total knee arthroplasty with computer navigation

James A. Browne^{1,2*}, Chad Cook³, Aaron A. Hofmann⁴, Michael P. Bolognesi⁴



- 101,596 patients, 1156 computer assisted
- **No differences in mortality**
- **No differences in majority of early complications**
- **Some subset analysis significant** (clinically relevant vs statistically significant?)
 - Lower rate of cardiac events
 - Shorter hospital stay
 - Less hematoma



Thirty-Day Complications of Conventional and Computer-Assisted Total Knee and Total Hip Arthroplasty: Analysis of 103,855 Patients in the American College of Surgeons National Surgical Quality Improvement Program Database.

Aoude AA¹, Alkheykan SA¹, Noubi A¹, Weber MJ¹, Tanszer M¹



- **Advantages navigation**
 - Decrease in number of minor complications in TKA en THA (DVT, UTI, and pneumonia)
 - Decrease in blood transfusions
- **Disadvantages navigation**
 - Higher 30-day revision rate (TKA)
 - Increased risk superficial wound infection (prolonged surgery? Additional instruments?)
 - Increased surgery time



18.Orthop. 2011 Oct;41(10):2037-2044. doi: 10.1007/s00264-011-2009-z. Epub 2011 May 26.

Clinical, radiological and survivorship results after ten years comparing navigated and conventional total knee arthroplasty: a matched-pair analysis.

Barni C¹, Wolfsteiner J¹, Citak F¹, Zeman F¹, Reckhowitz T¹, Springerum LS², Mischkebacher SP, Girthner J¹



- **350 patients** (350 knees) treated with navigated (n = 157) or conventional (n = 188) TKA
- The mean clinical follow-up was **ten years**
- There were **no clinically relevant differences with respect to any clinical outcome, patient satisfaction or pain** between the two groups
- **Coronal leg alignment was closer (1.7-3.1°) to the neutral mechanical axis** in the navigated group compared with the conventional group (2.6-4.7°)
- A total of 12 knees (6.4%) in the conventional group and three (1.9%) in the navigated group underwent revision surgery (p = 0.04), resulting in an **absolute risk reduction of 4.5% for revision surgery by using navigation**
- **Navigated TKA improves implant survivorship compared with conventional TKA**



2017 Chitranjan S. Ranawat Award: Does Computer Navigation in Knee Arthroplasty Improve Functional Outcomes in Young Patients? A Randomized Study

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Young-Hoo Kim MD, Jang-Won Park MD, Jun-Shik Kim MD

- 296 bilateral TKAs (conv vs nav)
- Evaluation of clinical results / radiographic and CT scan results / survival rate
- **No benefit to computer navigation in TKA** in terms of **pain, function, or survivorship**
- The **frequency of aseptic loosening was not different** between the two groups ($p = 0.918$)
- **The authors do not recommend the widespread use of computer navigation in TKA because of its risks** (femoral notching and pin site problems)



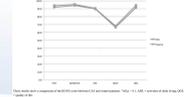
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No Benefit of Computer-assisted TKA: 10-year Results of a Prospective Randomized Study

Clinical Orthopaedics and Related Research®
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Mathieu Olivier MD, PhD, Sébastien Parratte MD, PhD, Ludovic Lino MD, Xavier Flecher MD, PhD, Sébastien Pésenti MD, Jean-Noël Argenson MD, PhD

- 80 TKAs (conv vs nav)
- No difference between the CAS group and the conventional TKA group in terms of survivorship **free from aseptic loosening** 10 years after TKA
- No difference in SF-12, KOOS, KSS and FJS
- **No substantial advantage in survivorship, function, or quality of life at 10 years after TKA**



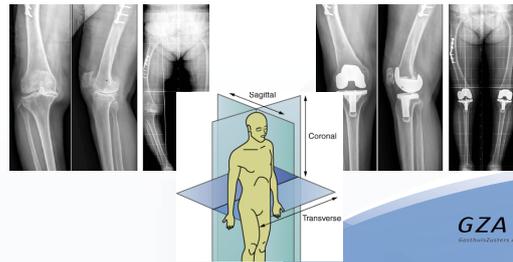
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Studies	Series	Level of evidence or rating	Mean age (years ± SD)	Mean follow-up (months)	Main clinical outcome CAS versus conventional	Survivorship or aseptic loosening CAS versus conventional
Lötters et al (2010) [15]	33 CAS TKA	I	68 (63-74)	70 (median)	KSS knee score versus SF-12	No differences
Idkha et al (2011) [16]	27 CAS TKA	I	62 (56-68)	72	KSS knee SF-12 versus SF-12	No differences
Idkha et al (2011) [16]	27 conventional TKA	I	62 (51-67)	72	KSS knee SF-12 versus SF-12	No differences
Homandop et al (2011) [17]	50 CAS TKA	II	70.4 (SD 6.9)	99	Global KSS SF-12 versus SF-12	94.7 versus 81% survivorship (no differences p = 0.08)
Kim et al (2012) [18]	520 CAS	I	67.4 (69-66)	129	KSS knee SF-12 versus SF-12	No differences
Kim et al (2012) [18]	520 conventional	I	68.7 (59-80)	129	KSS knee SF-12 versus SF-12	No differences
Harvie et al (2012) [19]	22 CAS	I	70 (NA)	60	Global KSS SF-12 versus SF-12	—
Harvie et al (2012) [19]	20 conventional	I	70 (NA)	60	Global KSS SF-12 versus SF-12	—
Lötters et al (2013) [10]	34 CAS TKA	I	NA	60	KSS knee SF-12 versus SF-12	No differences
Lötters et al (2013) [10]	33 conventional TKA	I	NA	60	KSS knee SF-12 versus SF-12	No differences
Chen et al (2014) [21]	100 CAS TKA	I	74.9 (53.1-91.8)	60	KSS knee SF-12 versus SF-12	No differences
Chen et al (2014) [21]	100 conventional TKA	I	76 (54.7-89.6)	60	KSS knee SF-12 versus SF-12	No differences
Banfield et al (2016) [22]	50 CAS	II	73.6 (SD 6.6)	120	Global KSS SF-12 versus SF-12	88 versus 87% survivorship (p = 0.5)
Banfield et al (2016) [22]	46 conventional	II	68.8 (SD 7)	120	Global KSS SF-12 versus SF-12	88 versus 87% survivorship (p = 0.5)
Our study (2018)	40 CAS TKA	I	64.4 (18-77)	132	SF-12 physical SF-12 mental SF-12 mental SF-12 mental	No differences
Our study (2018)	40 conventional TKA	I	64.4 (18-77)	132	SF-12 physical SF-12 mental SF-12 mental SF-12 mental	No differences

CAS = computer assisted surgery; KSS = Knee Society Score; NA = nonapplicable; SF-12 = International Knee Society score

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Alignment



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Knee Surg Sports Traumatol Arthrosc. 2012 Jun;20(6):1075-82. doi: 10.1007/s00167-011-1695-6. Epub 2011 Oct 15.

Alignment outcomes in navigated total knee arthroplasty: a meta-analysis.

Fu Y, Wang M, Liu Y, Fu Q



- Twenty-one randomized controlled trials / 2,414 patients
- Navigated group had a **lower risk of malalignment** for both **coronal femoral component and coronal tibial component** of $>3^\circ$ and $>2^\circ$
- **Sagittal femoral component alignment and tibial slope** showed statistical significance in favor of navigated arthroplasty at $>2^\circ$ and 3° malalignment.
- **CONCLUSION:** Meta-analysis indicates **significant improvement in alignment of the limb and the component position** with use of computer navigation system.

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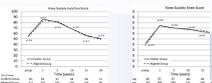
J Bone Joint Surg Am. 2018 Mar 21;100(6):472-478. doi: 10.2196/JBJS.16.01587

Effect of Postoperative Mechanical Axis Alignment on Survival and Functional Outcomes of Modern Total Knee Arthroplasties with Cement: A Concise Follow-up at 20 Years.

Abdel MP, Olivier M, Parratte S, Trousdale RT, Berry DJ, Pagnano MW



- At 20 years, 57 (19.5%) of the 292 knees in the **mechanically aligned group** had been revised compared with 16 (15.1%) of the 106 knees in the **outlier group** ($p = 0.97$).
- Postoperative alignment within $0^\circ \pm 3^\circ$ of the mechanical axis did not provide a functional advantage at 1, 5, 10, 15, and/or 20 years postoperatively as demonstrated by the **Knee Society scores being similar between the groups** ($p \geq 0.2$ at all intervals)
- **At 20 years, they once again did not find that neutral mechanical alignment provided better implant survivorship than that found in the outlier group**

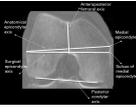


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Review Article
<https://doi.org/10.1155/2012/2012029> • <http://dx.doi.org/10.4236/2012.412029>

Computer Assisted Navigation in Knee Arthroplasty

The Kyung Ilan, MD, Sang In Song, MD
 Department of Orthopedic Surgery, Sungkyunkwan University School of Medicine, Seoul, Korea



- **Coronal and sagittal alignment of the individual components can be improved with navigation**
- Debate still exists as to whether a navigation does (Stocki et al., CORR, 2004 / Chauhan et al., JBJS Br, 2004) or does not (Cheng et al., JSR, 2011 / Siston et al., JBJS Am, 2005) improve the rotational alignment
- The assessment of the transepicondylar axis or the AP axis seems to be inconsistent compared to mechanical axis alignment
- **Positioning of the medial epicondylar sulcus may be incorrect**
- **discrimination between the surgical and anatomical transepicondylar axis may be difficult**
- Errors in judgement for femoral rotation can occur (Yau et al, J arthroplasty, 2005)

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THA



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No Benefit After THA Performed With Computer-assisted Cup Placement: 10-year Results of a Randomized Controlled Study

Sebastien Parratte MD, PhD, Matthieu Olivier MD, Alexandre Lunebourg MD, Xavier Flecher MD, PhD, Jean-Noel A. Argenson MD, PhD

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- **CAS used for cup placement:**
 - **No substantial advantage in function, wear rate, or survivorship** at 10 years after THA
 - Because CAS is associated with **added costs and surgical time**, future studies need to identify what clinically relevant advantages it offers, if any, to justify its continued use in THA



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Current Role of Computer Navigation in Total Knee Arthroplasty

Christopher W. Jones, FRCR, FRCS, PhD, MBBS(Hons), BEng(Hons), BCom Ed Sethi, A. Jaisankar, MD, FRACS
 Complex Joint Reconstruction Center, Hospital for Special Surgery, New York City, NY



- **CAS improves the accuracy and precision** of component alignment in TKA
- **No clinical superiority** in terms of improved patient-reported outcome measures and/or decreased cumulative revision rates in the long term
- Few authors would argue that **accuracy of alignment is a goal to ignore**
- therefore, in the absence of clinical evidence, many of the arguments against the use of large-console CAS navigation center on the prohibitive cost of the systems. **The utilization of low-cost, handheld CAS navigation systems may therefore bridge this important gap**, and over time, further clinical evidence may emerge.



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Cost

Review Article
A Systematic Literature Review of Three Modalities in Technologically Assisted TKA

William A. Leone,¹ Leah C. Elson,² and Christopher R. Anderson³



- **The price of a typical system:**
 - Cost of the computer
 - Cost of the software
 - Cost of an annual service contract from the manufacturer.
- In total, the dues of navigation equipment, per year, can reach upwards of **\$45,000 dollars**
Gethesen, BMC Musculoskeletal Disorders, 2013
- **\$1,500 per procedure**
Novak, JBJS Am, 2007

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Conclusion

- **NOT** Fast / Efficient
- **It is** accurate
- **It is** reproducible
- **NOT** Cheap / Cost effective
- **NO** Improved outcome / Survival



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