



Robotic-Assisted Solution



A collaborative effort across DePuy Synthes Joint Reconstruction franchise and the University of Denver

The VELYS™ Robotic-Assisted Solution Demonstrates Improved Accuracy Compared to Computer-Assisted Surgery (CAS)

Background

There are multiple studies that compare the accuracy of robotic-assisted total knee arthroplasty (TKA) to manual instrumentation and likewise there are multiple studies that compare computer-assisted surgery (CAS) to manual instrumentation.¹⁻⁵ However, there is a lack of studies comparing CAS to robotic-assisted TKA. The purpose of this study was to evaluate the accuracy of a contemporary, image-free CAS system for TKA in a cadaveric study using the same methodology as used previously to assess the accuracy of the VELYS™ Robotic-Assisted Solution and conventional instrumentation.¹ Generating this data allowed a direct comparison of the accuracy of conventional instrumentation, CAS and the VELYS Robotic-Assisted Solution (Figure 1).

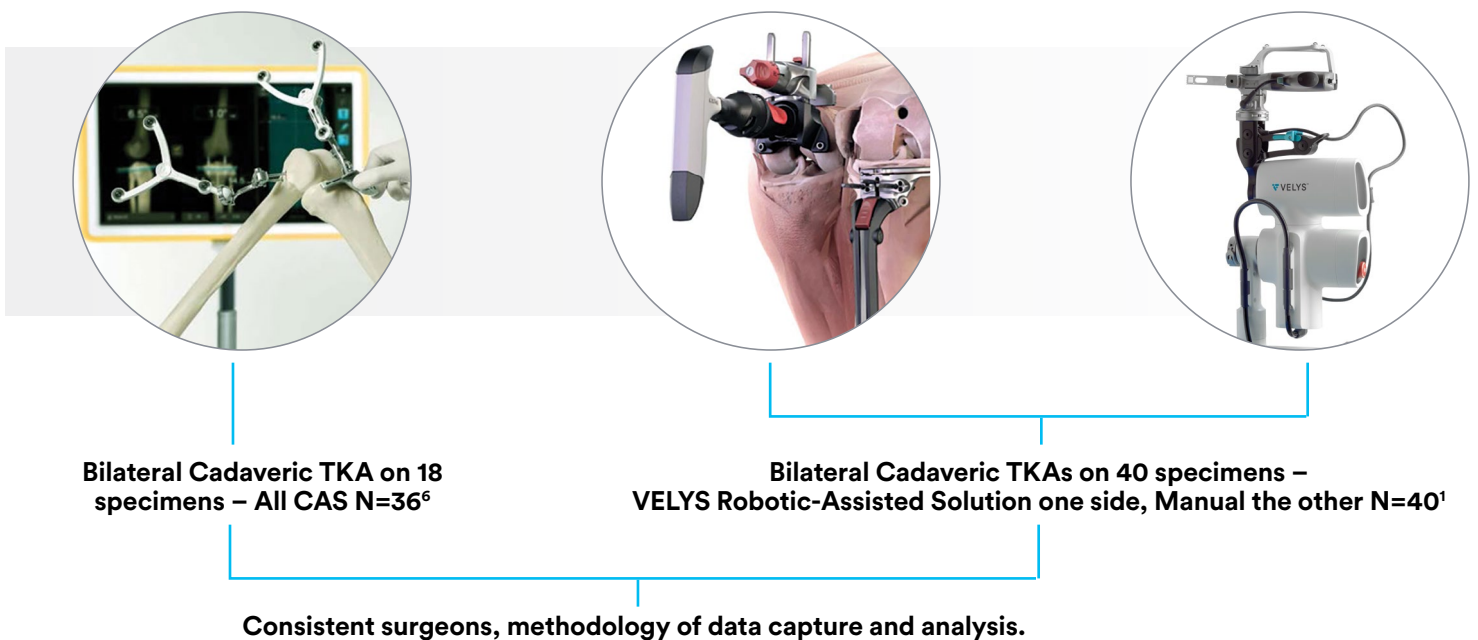


Figure 1. Overview of studies



Materials and Methods

Four experienced orthopaedic surgeons with varying levels of experience with navigation each performed bilateral TKAs on 18 cadaveric specimens without implantation using the BrainLab KNEE3 CAS system (N=36). After trialing, the resected bone surfaces were CT scanned and the accuracy of the angle of the bone resections was compared to the surgeons' pre resection plans on the CAS software (Figure 2). This allowed independent quantification of the system accuracy without relying on the CAS system's established coordinate system and ensured errors from the full system were captured.

The results of the study were compared to the results of the previous study on the VELYS Robotic-Assisted Solution and conventional instrumentation executed using the same methodology and surgeons. Statistical differences between the three groups were assessed via a T-test with a p-value of 0.05 set as the threshold for significance.

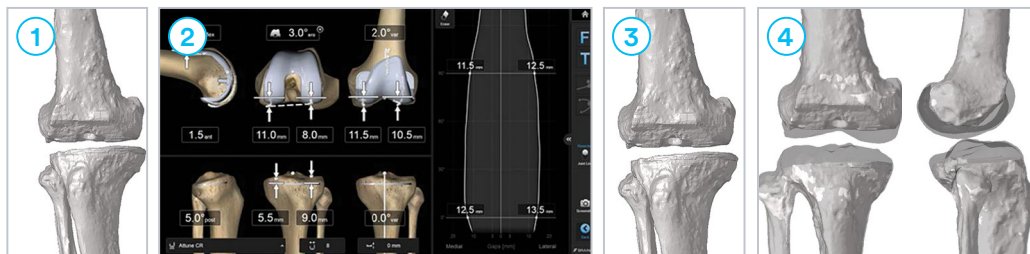


Figure 2. Methodology overview: 1. Pre-operative CT scan; 2. Example plan on the CAS system; 3. Post-operative CT scan; 4. Overlay of pre-operative and post-operative CT scans

Results

The CAS system was found to have a high level of accuracy with the mean absolute error ranging from 1.08 degrees (femoral coronal angle) to 2.13 degrees (femoral sagittal angle).⁶ When compared to the other methodologies, the mean absolute errors for the femoral coronal, femoral sagittal and tibial coronal alignment of the CAS system were lower than for conventional instruments but higher than for the VELYS Robotic-Assisted Solution. The difference between CAS and conventional was statistically significant for the femoral sagittal angle only. The difference between CAS and the VELYS Robotic-Assisted Solution was statistically significant for the femoral coronal and femoral sagittal angle. The mean absolute errors for the femoral rotation and tibial slope were similar between the 3 methodologies (Figure 3).

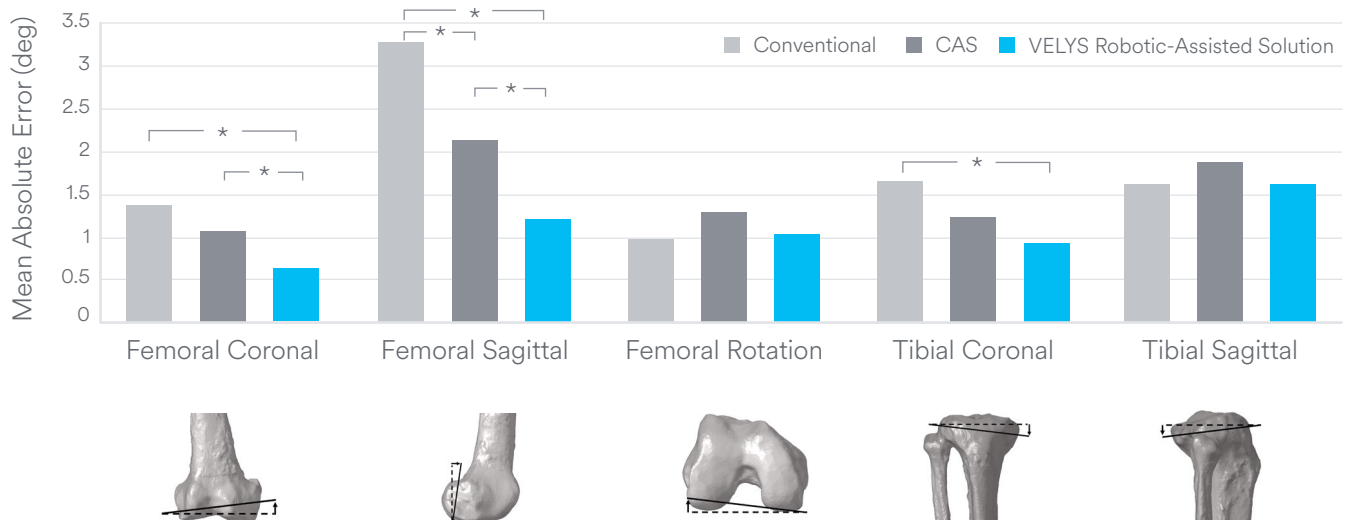


Figure 3. Mean differences between target and measured resection angles (mean absolute error) for the conventional instruments, CAS and VELYS Robotic-Assisted Solution cohorts. Statistically significant ($P > 0.05$) differences are identified with '*'



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Discussion

The use of CAS systems has previously been shown to improve the accuracy of bone resections and implant positioning compared to conventional instrumentation in clinical studies.^{3,5,6} The VELYS Robotic-Assisted Solution has been able to demonstrate further improvements in accuracy compared to CAS in some of the metrics assessed. The relative accuracy of the conventional instruments, CAS and the VELYS Robotic-Assisted Solution follow a logical progression. The use of the CAS coordinate system to guide the position of the cutting blocks results in a favorable trend in accuracy for CAS vs. conventional. Additionally, the VELYS Robotic-Assisted Solution allows a more precise execution of the plan vs. CAS. This difference in precision of execution of the plan between the VELYS Robotic-Assisted Solution and CAS can potentially be explained by two contributing factors:

1. With CAS the surgeon is required to position and pin the cutting blocks to the bone according to the guidance on screen; this can be challenging to achieve precisely in all planes with the surgeon often accepting a small amount of error in one or both planes (e.g. +/- 1 degree)
2. The bone resections are executed through the cutting block slot where play between the saw blade and slot can introduce further errors

With the VELYS Robotic-Assisted Solution, both potential sources of error are removed, as the system is directly connected to the oscillating saw, which is driven to the angle and position as defined by the surgical plan and maintained within the cutting plane during the cut execution.

Visit VELYSDigitalSurgery.com to learn more.

References: 1. Doan GW, Courtis RP, Wyss JG, Green EW, Clary CW. Image-free robotic-assisted total knee arthroplasty improves implant alignment accuracy: a cadaveric study [published online ahead of print, December 31, 2021]. *J Arthroplasty*. 2021;S0883-5403(21)00970-0. doi:10.1016/j.arth.2021.12.035. 2. Agarwal N, To K, McDonnell S, Khan W. Clinical and radiological outcomes in robotic-assisted total knee arthroplasty: a systematic review and meta-analysis. *J Arthroplasty*. 2020;35(11):3393-3409. 3. Hetaimish BM, Khan MM, Simunovic N, Al-Harbi HH, Bhandari M, Zalzal PK. Meta-analysis of navigation vs conventional total knee arthroplasty. *J Arthroplasty*. 2012;27(6):1177-1182. 4. Blakeney WG, Khan RJK, Wall SJ. Computer-assisted techniques versus conventional guides for component alignment in total knee arthroplasty: a randomized controlled trial. *J Bone Joint Surg Am*. 2011;93(15):1377-1384. 5. Brin YS, Nikolaou VS, Joseph L, Zukor DJ, Antoniou J. Imageless computer assisted versus conventional total knee replacement. A Bayesian meta-analysis of 23 comparative studies. *Int Orthop*. 2011;35(3):331-339. 6. Doan G, Courtis P, Van Avery A, Green E, Clary C. Cadaveric BrainLab KNEE3 accuracy study. Internal report 103836724.