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Improving surgical precision when targeting the wrong goal should not produce better results

Pascal-André Vendittoli

Professor of surgery

Montreal University, Maisonneuve-Rosemont Hospital

Other Contributors:

Lazaros Kostretzis

Fellow in lower limb arthroplasty

Montreal University, Maisonneuve-Rosemont Hospital

Charles Rivière

Orthopedic surgeon

Imperial College London – MSK Lab

Dear Chief Editor,

You recently published an article by Roberts et al.: Outcomes of Computer-Assisted Surgery Compared with Conventional Instrumentation in 19,221 Total Knee Arthroplasties (1). Roberts et al. analyzed the revision rates and functional data in 19,221 TKAs from the New Zealand Joint Registry by comparing 2 cohorts of patients: those performed by routine CAS surgeons and those performed by routine conventional surgeons. The study proved no difference in survivorship or functional outcome scores to support any benefit for using CAS for TKA. A note by Stefano A. Bini was also released by your journal: Rethinking the Value of Computer-Assisted Surgery (2). In this commentary, the author wrote: “there is a general agreement that CAS (1) increases alignment accuracy and (2) does not produce worse outcomes. One reason may be that there simply is not much room for improvement when the reported results associated with traditional instrumentation are already excellent.”

First, we disagree that TKA functional results are excellent. To match hip replacement’s clinical results and patients’ expectations, there is still a major room for improvement. Rates of dissatisfaction and residual symptoms (e.g. pain, instability, stiffness) following mechanically aligned (MA) TKA have been reported to be approximately 15% and 50%, respectively. Patient dissatisfaction following total knee replacement is a growing concern (3). In addition, patients’ perception of their prosthetic knees is rarely

“natural” and forgotten joint scores are disappointing (4). Last, MA TKA fails to restore the individual native knee joint kinematics, viewed as an important factor of knee function and perception, and patient satisfaction after surgery (5, 6).

As reported by Robert et al. in their study and confirmed by Bini, the use of technological assistance (to aid precision of implantation) did not solve these issues (7). Although, Robert et al. did not report the targeted alignment, we are assuming that it was MA for the vast majority of cases. In that event, we feel there was a misuse by Robert et al. and Bini, between ‘accuracy’ and ‘precision’ (8). When targeting for a neutral lower limb alignment (MA TKA) with CAS, you may be more precise than with standard instruments but away from the real alignment goal and not accurate at all (Figure 1). Increasing precision when targeting the wrong goal cannot produce better results.

Figure 1 (to be added)

Our understanding of knee anatomy and biomechanics has changed over the past years and we now have a better view of what should be the targeted goal (9). In a population of 4884 pre-operative lower limb CT scans of patients undergoing TKA, we demonstrated that only 4% had a neutral tibia (0 degrees), and 5% a neutral femur. Only 0.1% of the cases patients had neutral tibia and femur mechanical axes (the goal of MA TKA) (10). Systematically aiming for MA in all patients creates significant anatomical alterations responsible of frequent soft tissue imbalances, unphysiological joint line orientation, and poor tibio-femoral and patella-femoral joints kinematics (6, 11). These changes have been linked to residual symptoms, reduced clinical scores and patient dissatisfaction (12). This highlights the technical limitations that are inherent to the MA technique, in that it produces a non-physiological prosthetic knee (11, 13, 14, 15).

Obviously, improving surgical precision will never be a downside (16) and instead of “Rethinking the Value of Computer-Assisted Surgery”, we should question ourselves; what should be the optimal target to improve our TKA results (9,17)? It was shown that a personalized surgical technique as the kinematic alignment (KA) technique, replicating native knee anatomy and soft tissues laxities, can improve clinical outcomes (18, 19, 20) and in-vivo biomechanics (6, 21, 22), while offering good mid-term implant survivorship (23) and favorable 2-year radio-stereometric implant migration (24). This is where more precise surgical tools as CAS or robot can provide several advantages in TKA including real time information in millimeters to obtain accurate bone cuts, reduced soft tissue injury, and achieve the target joint reconstruction which may lead to improved patient satisfaction (6, 25).

There is no doubt that greater accuracy in TKA surgery is desirable (16). Perhaps the reason why this

greater precision has not resulted in better TKA clinical outcomes is that we are aiming for the wrong target (Figure 1). We need to step up from the systematic goal of achieving a neutral HKA and use all the tools available to accurately reproduce patients’ knee anatomy and kinematics. With a new target in mind, a personalized alignment goal for each patient, improved precision provided by CAS may reveal its value.

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