Role of Computer Navigation in Total Knee Replacement

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The number of total knee replacements is going to increase in coming decades. Hence there is a need for proper and accurate method of surgical techniques to avoid the complications such as instability and malalignment which leads to a secondary procedure. Use of Computer Navigation provides a more reliable source of intra operative measurement and corrections of deformity. Robotic and hand held computer navigation systems, computer-guided cutting instruments, and patient-specific cutting blocks are the rapid advancements seen recently into the field of knee replacements.

Few of the advantages we see with computer assisted knee replacements are incisions can be made smaller and the soft tissue dissection can be kept less invasive with computer navigation guidance which results is greater protection of the muscle and tendon during surgery. Also bone cuts can be made more accurately and more reproducibly when guided by computer navigation versus other systems. There is no need for an intramedullary rod to be placed inside this decrease the chances of fat embolism.

With computer navigation, ligament balancing can potentially be quantified the surgeon will be able to more precisely balance the ligaments of the knee. In TKR surgery if there is significant deformity in the femur above the knee or in the tibia below the knee, conventional alignment systems can be difficult or impossible to use. Thus, patients with bony deformity or hardware above or below the knee are ideal candidates for utilizing computer navigation guidance systems.

Studies have shown that computer navigation eliminates alignment "outliers". Experienced surgeons using alignment systems can accurately align the knee replacement in over 90 - 95% of cases. However, studies show that in as much as 5 to 10% of surgeries, postoperative knee alignment will be less than ideal. These patients in this 5 to 10% group are considered "outliers". Computer navigation's accuracy can help the surgeon shrink this percentage of postoperative alignment outliers.

The clinical practice guidelines put forth by the American Academy of Orthopaedic Surgeons recommend against navigation on the basis that at follow-up greater than 90 days, there were no differences in patient-reported quality of life outcomes defined by the EQ-5D and SF-36 Mental Component Summary, patient-reported knee function defined by the Oxford Knee Score, Knee Society Score, and WOMAC, and pain defined by the WOMAC score [1].

One study done provides evidence that the implant alignment with computer-assisted total knee arthroplasty, as measured with radiography and computed tomography, is significantly improved compared with that associated with conventional surgery with intramedullary or extramedullary guides. This finding adds to the body of evidence showing an improved radiographic outcome with computer-assisted surgery compared with that following conventional total knee arthroplasty [2]. A meta-analysis on infection found no difference in infection risk comparing surgical navigation to conventional instrumentation for total knee arthroplasty.

Another study shows that there were fewer differences in the biomechanics of computer-assisted navigation TKA patients compared to controls than for patients with conventional TKA. Computer-assisted navigation TKA may restore biomechanics during walking that are closer to normal than conventional TKA [3].
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One study used radiostereometric analysis (RSA) in a randomized controlled trial (RCT) to determine whether there are any differences in migration of the tibial component between CAS and conventionally (CONV-) operated TKA. Both groups had most migration within the first 3 months, but there was no statistically significant difference in the magnitude of the migration between the CAS group and the CONV group. From 3 to 24 months, the MTPM (in mm) was 0.058 and 0.103 (p = 0.1) for the CAS and CON groups, respectively, and the subsidence (in mm) was 0.005 and 0.011 (p = 0.3). Finally Interpretation was Mean MTPM, subsidence, lift-off, and rotational movement of tibial trays were similar in CAS- and CONV operated knees [4].

Another study showed Tranexamic acid decreases blood loss in patients undergoing TKA is independent of whether it was a conventional or computer assisted surgery the other blood conserving procedures [5].

There has been several studies that compared the joint line changes or ligament balance between navigated and conventional total knee arthroplasty, but the results showed that there is no substantial differences in the maintenance of the joint line, quality of life, and functional outcomes. Although few claimed as good midterm results compared to the conventional TKA. To conclude at a longer period of follow up there is no difference in the functional score results, patient reported outcomes or even the alignment and implant survival years. Hence unless there are gross deformities there is not much advantage of navigation over the conventionally done total knee arthroplasty.

Bibliography


