



# Current role of handheld navigation system in total knee arthroplasty: where we are?

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The goal of successful total knee arthroplasty (TKA) has been to restore the mechanical alignment of the lower limb, because incorrect alignment can lead to abnormal prosthesis wear, and premature mechanical loosening (1-3). Many previous studies reported that postoperative malalignment of  $>3^\circ$  from the mechanical axis, particularly into varus angulation, can lead to early failure in TKA (1,2,4,5), although this topic has become a debated topic recently (6).

Despite a lack of conclusive evidence for the appropriate postoperative alignment, the computer-assisted surgical (CAS) navigation system was designed to obtain more reliable and reproducible intraoperative alignment than conventional TKA (7-12). In general, CAS navigation can be categorized into three groups: image-based or imageless large-console navigation and handheld navigation. The disadvantages of large-console navigation systems are that they require transosseous tracker pins in the femur and tibia, appropriate optical tracking in a complicated surgical setting, and prolonged operative time with long learning curve periods (13,14). To address these limitations, the handheld navigation systems were introduced with the advantages of shorter learning curve periods, no transosseous tracker pins, no need to ream the femoral/tibial canal, no optical tracking which might be affected by conditions in the operating room, and similar instrumentation to conventional TKAs. Xu *et al.* (15) reported the results of TKA using a novel handheld

accelerometer-based navigation system called i-JOIN. Alike the results of previous different kind of handheld navigation systems (16-20), the coronal femur alignments in this handheld navigation were not significantly different compared to that of a conventional system, although the postoperative mechanical axis seemed to be close to neutral alignment and the number of outliers more than  $3^\circ$  were found less frequently in the handheld navigation group. However, the surgical time in a study by Xu *et al.* (15) was still longer in a handheld navigation group than a conventional group, and it was similar to the results of a recent meta-analysis (16). Hence, there are still limitations including increased surgical time, lack of information for soft tissue balancing and rotational alignment, and lack of cost-effectiveness in terms of clinical outcomes when using a handheld navigation system (16). However, the surgical time might be shorter than that of the TKA using large-console navigation system, which needs transosseous tracker pins, it would be interesting to compare the clinical results between large-console navigation and hand held navigation system in further study. Finally, further studies are also warranted because it is likely that technology will continue to improve, including introducing handheld robot assisted TKA (21-23).

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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