

Discrepancies between image-free navigation and radiological limb alignment measurements in open wedge high tibial osteotomy

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Background: A good high tibial osteotomy (HTO) long-term outcome is dependent on a proper correction of the varus deformity, and therefore it is critical to accurately correct the mechanical axis (MA) of the lower extremity during the procedure.

Computer-assisted navigation appears to be a useful intraoperative tool for determining the degree of correction required during HTO due to its real-time assessment of the limb. However, it is yet to be established whether the lower limb alignment achieved using intraoperative navigation agrees with the actual alignment determined pre- and postoperatively using radiography. To determine whether intraoperative navigation-assisted limb axis alignment in open wedge HTO correlates with pre- and postoperative lower limb alignment. It was hypothesized that, in computer-assisted open wedge HTO, intraoperative navigation data regarding lower limb alignment are correlated with and pre- and postoperative radiographic results.

Methods: This prospective study involved 35 patients (39 knees) who underwent navigation HTO for primary medial osteoarthritis. Hospital for Special Surgery (HSS) scores were used to evaluate the degree of osteoarthritis, and the Lysholm knee score was used to evaluate the knee ligament condition preoperatively and at 6 months postoperatively by a dedicated study nurse. Mechanical axis (MA) and weight-bearing line (WBL) ratios were calculated from preoperative radiographs, intraoperative navigation, and postoperative (6 months) radiographs. Radiographs were of the full-length standing leg type. The surgical target for MA was a final valgus overcorrection of 2-8°, and the WBL ratio target was between 50% and 70%. Outliers were measurements that were $> \pm 3^\circ$ for MA and $> \pm 10\%$ for WBL ratio in terms of postoperative difference from that preoperatively planned.

Results: The mean final postoperative follow-up time was 6.5 months (range, 6 to 9.5 months). HSS scores improved from a preoperative mean value of 60.6 (range, 48-72) to a final mean value of 80.5 (range, 64-94) ($P = .015$). The Lysholm score also improved from a preoperative mean of 73 (range, 62 to 84) preoperatively to a final postoperative mean of 88 (range, 78 to 96, $P = 0.032$). The MA target was achieved in 33 of 39 knees (84.6%), and the WBL ratio target was achieved in 30 of 39 knees (74.4%). The intraclass correlation coefficients (ICCs) between navigation and radiographical data were lowest for postoperative MA and postoperative WBL ratio when compared with ICCs for preoperative MA and WBL ratio and ICCs for change in MA (D MA) and change in WBL ratio (D WBL). The ICCs for MA were better than those for the WBL ratio for both pre- and postoperative measurements. The differences between the number of outliers between navigation and radiographical MA and WBL were greater postoperatively than preoperatively. Additionally, the postoperative differences in the extent of the outliers between navigation and radiographic were greater for WBL ratios than MA ($P = .023$).

Conclusion: Use of the navigation system during open wedge HTO resulted in the MA lower limb correction target value being achieved in over 80% of cases. However, navigation-assisted alignment was not found to correlate with postoperative alignment determined radiographically. Navigation-assisted alignment was found to be more accurate in terms of MA than WBL ratio according to radiographical measurement comparison.