

Results of navigated open wedge high tibial osteotomy compared with conventional cable technique

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Introduction: Long-term results of HTO strongly depend on the amount of correction, and inadequate intraoperative measurements of the leg axis can lead to under or over correction. Until now surgeons have to solve these problems based on personal experience. Over the last few years, navigation systems have been widely used for orthopaedic surgeries, and it has been proven that navigation systems allows more precise evaluation of deformities and more precise intra-operative real-time control of the axes obtained by correction. The advantages of navigation systems that allow limb alignment in HTO to be continuously visualized have been previously reported. Nevertheless, HTO is a technically demanding procedure and can result in changes in the slopes of coronal and sagittal planes. This study was undertaken to investigate and compare the clinical and radiological results of navigation assisted open wedge high tibial osteotomy (HTO) versus conventional HTO at 12 months after surgery, for unicompartmental gonarthrosis.

Materials & Methods: Between October 2005 and Jan 2011, fifty-five navigated open HTOs were included for this study and compared them with forty open HTOs performed using the conventional cable technique in terms of intraoperative leg axis assess. The Orthopilot navigation system (HTO version 1.3, B. Braun Aesculap, Tuttlingen, Germany) was used throughout. All procedures were performed in a standard incomplete valgus open-wedge manner. The osteotomy begins 5 cm distal to the medial joint line at the medial cortex of the proximal tibia, and is directed to the proximal one third of the fibular head leaving the lateral 5 mm of the cortex intact. Careful valgization by the stepwise insertion of three coupled chisels was performed to avoid intra-articular fractures. The mechanical axis was visualized continuously throughout the procedure on the navigation screen, and the aim of the correction was to achieve of 3° of valgus (2-4°). When the required correction is achieved, the osteotomy is stabilized with two Aescula open wedge plates (B. Braun Aesculap, Korea). The control group was composed of 40 patients with similar ages, genders, BMIs, ROMs, degrees of varus deformity, and HHS scores and control group data was analyzed retrospectively. The procedure used was exactly the same as that used for navigated open wedge HTO except the cable method was used to evaluate the mechanical axis intra-operatively by fluoroscopy instead of use of navigation system. For the radiological evaluation, postoperative leg axes were examined using weight bearing full-leg radiography obtained at 1 year after surgery. To assess correction accuracies, we compared mechanical tibiofemoral angles and intersections of the mechanical axis of the tibial plateau (%) in the conventional and navigated HTO groups. Outliers were defined as under-corrections of < 2° of valgus and as over-corrections of > 5° of valgus. The posterior slope of the proximal tibia was measured using the proximal tibial anatomical axis (PTAA) method. HSS scores and ROMs (ranges of motion) were evaluated clinically at postoperative 1 year, and all complications were recorded. Surgical and radiation times were measured.

Results: Navigated HTOs corrected mechanical axes to 2.5° valgus (range -3.1- 5.3) with few outliers (12.5%), and maintained posterior slopes (8.7±2.3° preoperatively and 10.5±2.8° postoperatively) (P>0.05). In the conventional group, the mean valgus correction was satisfying (valgus 2.1°), but only 63% were within the required range (2-5° valgus), and 30% of cases were under-corrected and 7% of cases were over-corrected. Posterior slope increased from 8.0 to 10.6° on average without significant change after surgery. Total fluoroscopic radiation time during navigated HTO was 8.25 seconds (5-12 s) as compared with 48.4 seconds (31-64 s) during conventional HTO (p<0.05). The surgery time for

navigated HTO was 11 minutes longer than for conventional HTO (56 minutes). No specific complications related to the navigation were encountered. One case of tibial plateau fracture requiring screw fixation occurred in the navigation and, 1 case of gradual correction loss occurred in conventional group, which were treated with cast immobilization. At clinical follow up at 1 year after surgery, mean HSS scores of the navigated HTO and conventional groups improved to 89.3 and 88.7 from preoperative values of 56.2 and 54.7, respectively ($p>0.05$), and all patients achieved full range of knee motion.

Conclusion: Navigation for HTO significantly improved the accuracy of postoperative leg axis, and decreased the variability of correction with fewer outliers, and without any complications. Moreover, it allows multi-plane measurements to be made, in the sagittal and transverse planes as well as the frontal plane intra-operatively in real time, compensates to some extent for preoperative planning shortcomings based on radiography, and significantly reduces radiation time.

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