

# Navigation controlled medial opening wedge high tibial osteotomy with minimal use of fluoroscopy

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**Background:** High tibial osteotomy (HTO) can be a good option for young patients with medial compartmental osteoarthritis and varus malalignment in pain relief, functional restoration, and prevention of osteoarthritis progression. Traditionally lateral closing wedge osteotomy was done more frequently, but lately medial opening wedge osteotomy is regaining popularity with the advent of new surgical techniques and fixation devices. Achievement of correct alignment is the key to the successful outcomes of the procedures. The use of navigation can be an excellent armamentarium to achieve correct alignment in HTO, and multiple authors reported better results with navigation than with standard technique in terms of achieving aimed alignment. In addition, TomoFix, a locked screw plate has been reported to provide sufficient fixation strengths allowing early weight bearing after surgery. However, the need for frequent use of fluoroscopy is not only a hassle to surgical teams but also present radiation hazards both for surgeons and patients.

**Study Purpose:** We wanted to establish a simple algorithm to predict proper screw lengths for proximal holes of a TomoFix HTO plate from plain radiographs and to report the clinical outcomes of the initial 25 knees performed with the developed algorithm.

**Methods:** A proximal tibia model was manufactured from computed tomography images using the rapid prototype technology for 30 patients undergoing medial opening wedge HTO for medial compartmental osteoarthritis with varus deformity. Experimental HTO surgery was done for these 30 models, and the longest screw length was measured for 4 proximal holes of the TomoFix plate. Two simple equations that predict a proper length from mediolateral (ML) and anteroposterior (AP) radiographic dimensions of a proximal tibia on plain radiographs were created for each of 4 proximal screws by investigating the relationships between measured screw lengths and radiographic dimensions. These equations were used for navigation (Orthopilot) controlled medial opening wedge HTO in 25 five knees with medial compartment osteoarthritis and varus deformity. A TomoFix HTO plate was used in all cases. All procedures were controlled with the information given by the navigation system, and no further fluoroscopy was used once osteotomy was done. These 25 knees were reviewed for operation time, whether proper lengths were chosen for 4 proximal screws, and whether targeted alignment was achieved.

**Results:** The average measured length of 4 proximal screws screw was 66 mm (range, 51-79) for screw A, 61 mm (43-80) for screw B, 53 mm (40-71) for screw C, and 49 mm (35-75). The average radiographic ML and AP dimensions of proximal tibia were 85 mm (73-103) and 56 mm (50-66), respectively. Eight equations created from these values were; ML width – 20 mm and AP length + 10 mm for screw A, ML width – 25 mm and AP length + 5 mm for screw B, ML width – 35 mm and AP length – 5 mm for screw C, and ML width – 40 mm and AP length – 10 mm for screw D. All 25 surgeries were finished without adverse events during surgery. The mean operation time (tourniquet time) was 48 minutes (37-70), and far cortex perforation by any of 4 proximal screws was observed in no cases. The mean mechanical tibiofemoral angle and the coordinate of weight loading line on knee joint were valgus 2° and 57% (medial end = 0% and lateral end = 100%), respectively. Targeted alignment was achieved in 65% by the criterion of mechanical tibiofemoral angle between valgus 1° and 3° and in 87% by the criterion of weight load line coordinate between 50% and 70%.

**Conclusion:** This study demonstrates that the use of the navigation system and the simple equations to predict proper screw lengths could facilitate surgical procedures and minimize the use of fluoroscopy. We propose the combined use of navigation technology and simple equations in medial opening wedge HTO with TomoFix plate.