

LOWDFO Demonstrates Greater Effect on TT-TG Distance Compared to MCWHTO in Patients with Valgus Malalignment

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INTRODUCTION:

Genu valgum is a known risk factor for recurrent patellar instability, with management often addressing the bony deformity to obtain an optimal result. Tibial tuberosity-trochlear groove (TT-TG) distance is a widely used objective measurement of the lateral quadriceps vector in patients with patellar instability. The evidence documenting the effect of LOWDFO and MCWHTO on TT-TG is limited, with minimal data directly comparing the biomechanical implications of one versus the other. The purpose of this study was to directly compare LOWDFO and MCWHTO using a computer model to determine the effect of each osteotomy on TT-TG distance. It was hypothesized that LOWDFO will have a greater effect on TT-TG distance, given the position farther away from the tibial tubercle.

METHODS:

Eighteen knees from seventeen CT scans of patients with patellar instability and valgus malalignment were processed using 3D Slicer (v5.4.0) to generate .stl models, which were imported into Fusion (Autodesk v2601.1.37) for 3D analysis. Meshes were segmented into femur, tibia, patella, and fibula. The tibial tuberosity (TT) and trochlear groove (TG) were tracked across a variety of simulations.

A posterior plane was constructed between the most posterior points of the femoral and lateral tibial condyles. For the distal femoral osteotomies, the hinge point was placed 10-mm lateral from the medial cortex. The distal section of the femur was then rotated from 0 - 12° in 2° increments. For the HTO group, the tibial pivot point was defined on the posterior plane, 15-mm distal from the point of contact between the femur and tibia and 10-mm medial from the lateral cortex. A fixed horizontal line was placed colinear to the pivot point, with a second line used to make the closing wedge cut through the tibia, ranging from 0 - 12° with the horizontal line in 2° increments. To track the positions of the TG and TT, a perpendicular transverse plane was constructed on the line between the posterior femoral condylar points. A final projection of the perpendicular transverse plane was used to track the movements of the TG and TT lines in the same plane and measure the horizontal distance between them using Fusion's in-built ruler function.

RESULTS:

Eighteen knees from seventeen subjects were included in the final analysis. The average native TT-TG for patients included in this cohort was 15.83 mm. LOWDFO and MCWHTO were sequentially performed in 2° increments from 2° to 12° of varus-producing osteotomies. Ultimately, the TT-TG distance decreased by an average of 1.81 mm for every 2° in the LOWDFO and 0.45 mm for every 2 degrees for MCWHTO, with all comparisons meeting statistical significance ($p < 0.001$).

LOWDFO demonstrated the following differences for 2°-12°: 1.79, 3.60, 5.42, 7.26, 9.11, and 10.86. MCWHTO demonstrated the following differences for 2°-12°: 0.51, 1.0, 1.48, 1.94, 2.38 and 2.76. ($p < 0.001$) The difference in magnitude of change of TT-TG at each increment was greater for LOWDFO compared to MCWHTO by the following amounts 2°-12°: 1.28, 2.60, 3.94, 5.32, 6.73, 8.10. **(Table 1)**

DISCUSSION AND CONCLUSION:

LOWDFO results in a significantly larger magnitude of change in the TT-TG compared to MCWHTO, with DFO at almost a 1:1 change with TT-TG compared the correction angle, and HTO about 1:4. Consequently, the LOWDFO may be a more effective procedure in reducing the TT-TG distance, which is important when addressing patellar instability in patients with valgus malalignment.

