The Relationship Between the Distal Nail Target and Alignment of Distal Tibia Fractures

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Background/Purpose: Alignment of metadiaphyseal fractures treated with intramedullary nailing is directly related to the relationship of the nail to the metaphysis. Optimal reaming paths have been well described for the proximal femur, distal femur, and proximal tibia. Malalignment of distal tibia fractures has been anecdotally related to the position of the nail within the distal metaphysis; however, the optimal nail target has not been well described. Our purpose was to assess the relationship between the distal nail target and alignment for distal tibia fractures treated with intramedullary nailing.

Methods: We performed a retrospective review of all distal tibia fractures (within 11 cm of the plafond) treated with intramedullary nailing at a Level I trauma center from 2005 to 2015 (n = 135), after excluding cases with insufficient postoperative imaging or combination of nailing with adjunctive fixation of the tibia. Alignment was assessed in the coronal plane on AP radiographs using the lateral distal tibial angle (LDTA) and in the sagittal plane on lateral radiographs using the anterior distal tibial angle (ADTA). The nail target was defined as the extrapolated intersection between the nail and plafond and was recorded as its relative position from lateral to medial and anterior to posterior. Fractures were grouped for comparison based on the relationship of the nail target to the joint center. Differences in alignment (LDTA and ADTA) were assessed with Student's *t* test analyses. The incidence of deformity was compared by X^2 analysis. Statistical significance was reported for $P < 0.05$.

Results: The population of 135 fractures included 36 cases of malalignment >5° (26.7%). This included 22 fractures in valgus, 9 in procurvatum, and 5 in both valgus and procurvatum. Assessing coronal alignment, nails directed medial to the joint center demonstrated relative valgus (mean LDTA 86.3 vs 89.3°, $P < 0.01$) and were more commonly in valgus >5° (27 of 81, 33.3% vs 0 of 54, 0%; $P < 0.01$). Valgus outliers (>10°) were more common for the far medial quintile of nail targets (4 of 27, 14.8% vs 0 of 108, 0%; $P < 0.01$). Assessing sagittal alignment, nails directed anterior to the joint center demonstrated relative procurvatum (mean ADTA 82.8 vs 81.0°; $P < 0.01$) and were more commonly in procurvatum >5° (16 of 81, 19.8% vs 3 of 54, 5.6%; $P = 0.02$). Procurvatum outliers (>10°) were more common for the far anterior quintile of nails (2 of 27, 7.4% vs 0 of 108, 0%; $P = 0.04$).

Conclusion: Our results quantify the relationship between the distal nail target and malalignment of distal tibia fractures treated with intramedullary nailing. Despite an overall rate of malalignment consistent with previous studies, we found that central as well as slightly posterolateral nail targets were associated with low rates of coronal (0%) and sagittal (5.6%) deformity. The location of the ankle joint center may be miscalculated given tibia-fibula overlap at the posterolateral ankle. We recommend a central nail target, with an emphasis on avoiding medial and anterior deviation. Further prospective research is necessary to determine causality and the degree to which the nail target can be controlled.

See pages 49 - 106 for financial disclosure information.