

Defining the Ideal Distal "Exit Point" of a Tibial Intramedullary Nail: A CT Analysis of 860 Tibiae

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Purpose: Fractures of the tibial shaft are routinely managed with intramedullary nailing. It is well known and has been consistently demonstrated that the accuracy of the proximal entry point significantly affects reduction and reduces malunion of proximal tibia fractures. Conversely, the position of the nail in the distal metaphyseal block, the "exit point", can significantly affect reduction and alignment of distal tibia fractures. The aim of this study is to identify the ideal nail position in the distal tibia, the so-called exit point for the nail, using CT analysis.

Methods: 3-dimensional (3D) models of 860 left tibiae were analyzed using the Stryker Orthopaedic Modelling and Analytics software (SOMA, Stryker, Kiel, Germany). This software tool analyzes 3D bone models derived from CT scans using standardized protocols, allowing assessment of population differences in bone morphology. The nail axis was defined by 7 center points at the middle of the the inner cortical boundary. The center point at the isthmus and 3 center points above and 3 center points below were determined using the Stryker Anatomy Analysis Tool (SAAT) software. A best-fit line was calculated through the 7 points. This best-fit line defines the nail axis and thus the exit point in the tibial metaphysis. Where this line fell relative to the center of the tibial plafond in both the anteroposterior and mediolateral planes was calculated. Two techniques were used to define the 3 center points above and below the isthmus: an absolute technique using points 10 mm, 20 mm, and 40 mm above and below the isthmus; and a relative technique using points 2.9%, 5.7%, and 11.5% of the tibial length above and below the isthmus to factor in different length tibiae.

Results: The mean mediolateral offset of the tibial exit point was 4.4 ± 0.2 mm and 4.4 ± 0.2 mm lateral to the center of the tibial plafond using the absolute and relative technique accordingly. The mean anteroposterior offset of the tibial exit point was 0.6 ± 0.1 mm anterior to the center of the tibial plafond for both relative and absolute techniques. 95% confidence intervals were calculated.

Conclusion: We have presented the largest reported series analyzing the ideal nail position using CT scans of 860 tibiae. We have defined the ideal exit point of a tibial nail is lateral with respect to the center of the tibial plafond. This has significant implications for treating distal tibial fractures using intramedullary nailing and preventing malalignment.