

Title

Defining the ideal distal 'exit point' of a tibial intramedullary nail – a computed tomography analysis of 860 tibiae

Authors

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Abstract**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 mal union 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 computed tomography (CT) analysis.

Methods

3D models of 860 left tibiae were analysed using the Stryker Orthopaedic Modelling and Analytics software (SOMA, Stryker, Kiel, Germany). This software tool analyses 3D bone models derived from CT scans using standardised protocols, allowing assessment of population differences in bone morphology. The nail axis was defined by seven centre points at the middle of the the inner cortical boundary. The centre point at the isthmus and three centre points above and three centre points below were determined using the Stryker Anatomy Analysis Tool (SAAT) software. A best fit line was calculated through the seven 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 centre of the tibial plafond in both the anteroposterior and mediolateral planes were calculated. Two techniques were used to define the three centre points above and below the isthmus; an absolute technique using points 10mm, 20mm and 40mm 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 $4.4 \pm 0.2\text{mm}$ and $4.4 \pm 0.2\text{mm}$ lateral to the centre of the tibial plafond using the absolute and relative technique accordingly. The mean anteroposterior offset of the tibial exit point was $0.6 \pm 0.1\text{mm}$ anterior to the centre of the tibial plafond for both relative and absolute techniques. 95% confidence intervals were calculated.

Conclusions

We have presented the largest reported series analysing 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 centre of the tibial plafond. This has significant implications for treating distal tibial fractures using intramedullary nailing and preventing mal alignment.