Distal Targeting Arm for Insertion of Distal Interlocking Screws Reduces Radiation Exposure: Results of a Prospective Randomized Controlled Trial

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INTRODUCTION: Placing distal interlocking screws during surgical placement of intramedullary femur and tibia nails can involve considerable radiation exposure for both the patient and the operating team. The traditional freehand technique involves taking a sequence of images before placing each screw to confirm proper alignment and position. Numerous other techniques have been proposed to solve the problem, with variable results. In this study we investigated the use of a distal targeting arm. We propose to study the use of the distal targeting arm in a clinical setting and determine whether there is a difference in the number of images taken and time elapsed as compared to the freehand technique.

METHODS: This study took place at a large, urban, level 1 trauma center. IRB approval was obtained. All devices and techniques have been approved by the FDA. Inclusion criteria included adults with either a femur or tibia shaft fracture treated with an intramedullary nail. Patients were randomized to either freehand or distal targeting arm. Data on elapsed time, amount of radiation exposure, and number of radiographic shots for each screw was collected during the surgery by an in-person observer. Data for each screw placement was recorded from the first fluoroscopic image used to determine screw placement till the last confirmation image. T-tests were used to compare the average time duration and average number of shots between the freehand and distal targeting arm techniques.

RESULTS SECTION: We collected data from 61 patients. There were 37 in the freehand group (24 femurs, 13 tibias) and 24 in the distal targeting arm group (11 femurs, 13 tibias). Median time elapsed for placement of the first screw in the distal targeting arm group was 6.3 minutes (range, 2.0 – 15.2; Q_1 - Q_3, 4.8 - 8.1) vs for the freehand group was 7.3 minutes (range, 2.9 – 20.9; Q_1 - Q_3, 5.1 - 10.5). Median number of fluoroscopy images for the placement of the first screw in the distal targeting arm group was 12.5 images (range, 6.0 – 30.0; Q_1 - Q_3, 10.3 - 19.0) vs for the freehand group was 20.0 images (range, 6.0 – 68.0; Q_1, Q_3, 14.0 - 26.0). The mean number of fluoroscopy shots was significantly less in the distal targeting arm group vs the freehand group for both screw 1 and screw 2 ($p = 0.009$, $p = 0.0004$). The mean duration of time for screw 1 was not significantly different between the distal targeting arm and freehand groups ($p = 0.27$). However, the mean duration of time for screw 2 was significantly reduced in the distal targeting arm group ($p=0.019$).

DISCUSSION: In this randomized controlled trial, the distal targeting arm reduced the amount of radiation exposure with no significant difference in operation time. Interestingly, we found a significant decrease in time to place the second screw in the distal targeting arm vs freehand groups. Furthermore, the difference in number of fluoroscopy shots was more significant in the placement of the second screw vs the first screw. These results suggest that the benefit of the distal targeting arm increases with placement of a second screw. There were not enough patients in which a third screw was placed to compare those results and determine whether the observed benefit remains with the addition of further screws.

SIGNIFICANCE/CLINICAL RELEVANCE: This study suggests an alternative method for inserting distal interlocking screws that may help reduce the radiation load for orthopaedic surgery teams and patients without lengthening the duration of surgery.

REFERENCES: N/A

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IMAGES AND TABLES:

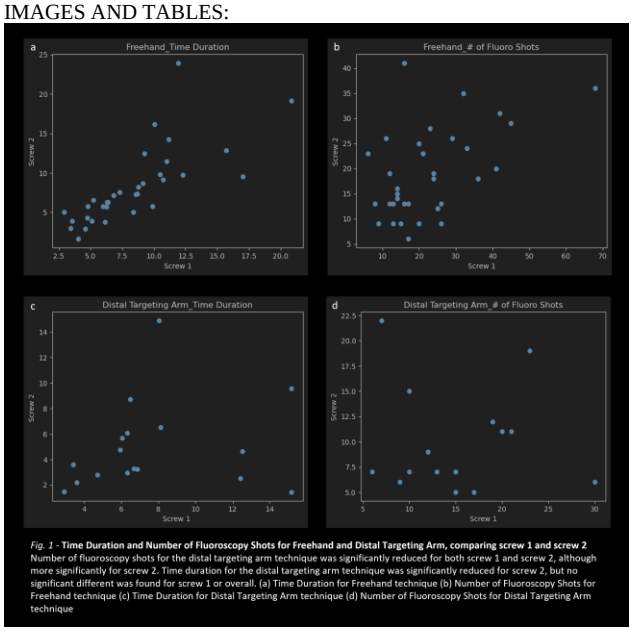

Fig. 1 - **Time Duration and Number of Fluoroscopy Shots for Freehand and Distal Targeting Arm, comparing screw 1 and screw 2**
Number of fluoroscopy shots for the distal targeting arm technique was significantly reduced for both screw 1 and screw 2, although more significantly for screw 2. Time duration for the distal targeting arm technique was significantly reduced for screw 2, but no significant different was found for screw 1 or overall. (a) Time Duration for Freehand technique (b) Number of Fluoroscopy Shots for Freehand technique (c) Time Duration for Distal Targeting Arm technique (d) Number of Fluoroscopy Shots for Distal Targeting Arm technique