

3.5 mm Lag Screws as Compared With 6.5 mm Lag Screws for Fixation of the Distal Femur: Implications for Reconstruction of Complex Joint Injuries

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INTRODUCTION

Distal femur fractures result from high energy impacts such as vehicular trauma in the younger population, but are also common in osteoporotic patients.

Approximately 85% of the distal femoral fractures occur in the over 50's age group (Forster, 2006). These fractures generally include an intra-articular line, which make it necessary to achieve anatomical reduction permitting a faster healing process and enabling early range of motion.

The fixation of complex distal femur fractures has evolved over the past 5 years to be dominated by locked plating as opposed to DCS or blade plate fixation. These plates fill a greater area of the lateral portion of the lateral condyle, leaving less room for lag screws outside of the implants. Many surgeons have moved away from 6.5mm screws in favor of smaller lag screws that can be placed around the plate. The purpose of this study was to evaluate the stiffness and strength of 3.5mm vs. 6.5 mm screws for the fixation of a unicondylar fracture of the distal femur in osteopenic human bone (mimicking the intercondylar component of more complex injuries).

METHODS

Seven unembalmed, matched pairs of human femurs (average age 82 ± 7 yrs.) underwent biomechanical testing. Fresh specimens

were stored, frozen vacuum sealed and wrapped in saline then thawed to room temperature prior to testing. The pairs were tested with (DEXA) scanning to confirm correlation within matched pairs. Lateral condyle fractures were created at a 25° angle from the intercondylar notch. One of each pair was fixed with three 3.5mm lag screws placed in the periphery of the joint and the other with two 6.5mm lag screws (Smith & Nephew, Memphis, TN) anteriorly and posteriorly, simulating fixation that would be placed around a plate (Figure 1). After pilot testing, axial loading tests were conducted using a uniaxial servo-hydraulic load frame (Dynamic Testing Systems, Phoenix, Arizona) with a digitally-monitored analog controller (Lynx, Michigan) and a closed-loop, vector drive hydraulic pump (LeBlond & Associates, Phoenix, Arizona). Specimens were potted in a vertical position .



Figure 1: 3.5mm and 6.5mm screws

A lateral tibial plateau component of a total knee prosthesis was used for loading purposes. An axial preload of 50N was applied to the femur to stabilize the construct. After preloading for ten seconds

a ramped load increasing at 25N/s was applied to the lateral condyle until clinical failure of the bone, defined as a displacement greater than 3mm. Data were recorded at 500 Hz.

RESULTS AND DISCUSSION

The load at failure (3mm of displacement) was 919 ± 368 N for the 3.5mm and 1041 ± 339 N for the 6.5mm screws ($p=0.5$, 95% CI difference -544 - +300). See Figure 2 for incremental load-displacement curves. The stiffness of the constructs (slope of the curve between 0.2 and 1.2 mm displacement) was 289 ± 150 N/mm for the 3.5 screws and 371 ± 170 N/mm for the 6.5 screws ($p=0.29$). The low number of pairs likely contributed to the variability in the study.

The smaller diameter screws are preferred for ease of placement in distal femur fractures especially when plating is required for further reduction of a fracture. Additional studies are recommended to include additional pairs and fatigue testing to further compare the screw sizes.

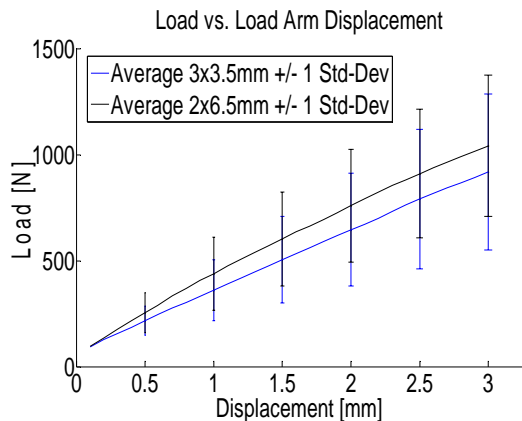


Figure 2: Load vs. displacement for 3x3.5mm and 2x6.5mm screws showing \pm one standard deviation

SUMMARY/CONCLUSIONS

There was no difference seen in the ability of the 3.5mm screws to resist vertical displacement in a model of a shearing lateral condyle fracture. This study, done in osteoporotic fresh human cadaveric distal femur pairs supports the use of smaller lag screws that are more easily placed around the current distal femoral plates with a larger footprint than traditional DCS or blade plates, which had room for 6.5mm lag screws.

REFERENCES

Forster, M.C. et al. (2006). *Injury*, **37(2)**, 97-108.