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Michaël Verset, Sophie Palierne, Didier Mathon, André Autefage, Pascal Swider

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## **Comparison of the effect of locking versus standard screws on the mechanical properties of bone-plate constructs in a comminuted diaphyseal fracture model.**

*M. Verset, S. Palierne, D. Mathon, A. Autefage (Ecole Nationale Vétérinaire de Toulouse, France)*

*P. Swider (Laboratoire de Biomécanique, CHU Purpan, Toulouse, France)*

### **Introduction**

The purpose of this study was to compare the mechanical properties of bone-plate constructs with LCP plates used with either standard screws or with locking screws on an experimental model of comminuted fracture.

### **Materials and Methods**

A model of comminuted fracture (mid-diaphyseal 5-mm gap) was created in ovine tibiae and treated with an 8-hole, 4.5-mm, broad stainless LCP plate with 3 bicortical self-tapping screws in each fragment.

In group 1 (n = 6), 4.5 mm cortical screws were placed in a slightly inner eccentric position and in group 2 (n = 6), 5.0-mm locking screws were used. Quasistatic nondestructive tests were performed in 4-point bending, torsion, and axial compression. A laser scan micrometer continuously measured the width of the osteotomy gap. Extrinsic stiffness of bone-plate constructs (K) was calculated, as well as stiffness loss (Kr) compared with the contralateral tibia. The slope of the load-gap displacement curve (S) was calculated. Results were statistically compared between the 2 groups by a 2-way ANOVA and Tukey's post hoc tests with significance set at  $P < .05$ .

### **Results**

In 4-point bending, there were no significant differences between group 2 (G2) and group 1 (G1) for K (G2:  $321.9 \pm 65.2$  kN/m, G1:  $286.0 \pm 36.6$  kN/m), for Kr (G2:  $55.4 \pm 10.4\%$ , G1:  $64.5 \pm 3.9\%$ ), and for S (G2:  $292.0 \pm 84.3$  N/mm, G1:  $271.4 \pm 36.2$  N/mm). In torsion, there were no significant differences between the 2 groups for K (G2:  $122.1 \pm 17.1$  Nm/rad, G1:  $107.3 \pm 16.5$  Nm/rad) and for Kr (G2:  $44.0 \pm 10.3\%$ , G1:  $55.0 \pm 10.6\%$ ). In compression, group 2 showed significantly lower K ( $611.1 \pm 104.0$  kN/m) and higher Kr ( $66.5 \pm 10.3\%$ ) than group 1 ( $1019.2 \pm 249.5$  kN/m;  $47.7 \pm 10.8\%$ ). There was no significant difference between the 2 groups for S (G2:  $254.6 \pm 72.6$  N/mm, G1:  $438.2 \pm 228.4$  N/mm).

**Conclusion:** Locking screws had no statistically significant effect on the mechanical properties of LCP-plated bones in 4-point bending and torsion compared to standard screws. In axial compression, locking screws induced a significant decrease in global mechanical properties without significant decrease in local mechanical properties of the osteotomy gap.