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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.

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