Appendix E-1: Stiffness Characterization of Plate Osteosynthesis Constructs

Construct stiffness was characterized by bench testing of three locked plating (LP) and three far cortical locking (FCL) constructs applied to bridge 3-mm-gap osteotomies in six ovine cadaveric tibiae (Fig. E-1, *A*). For axial load application in a materials testing system (DynaMight 8841; Instron, Norwood, Massachusetts), the ends of each tibia were potted with use of bone cement in cylindrical fixtures that were concentrically aligned with the diaphyseal shaft axis. Specimens were axially loaded by the actuator of the test system through a 25-mm-diameter sphere that was centered on the cylindrical fixture to account for rotational freedom at the proximal part of the tibia. Specimens were loaded in 50-N steps up to 1000 N. Construct stiffness was assessed in terms of the amount of osteotomy gap closure in response to each axial load step. Gap closure at the near and the far cortex was measured with use of two miniature digital calipers (KSLR4610; Blitz, Jeffersonville, Indiana) with 0.01-mm accuracy. Locked plating constructs had a stiffness of 3922 ± 474 N/mm. Far cortical locking constructs exhibited a biphasic stiffness profile (Fig. E-1, *B*). Up to an axial load of 400 N, the stiffness of far cortical locking constructs (626 ± 81 N/mm) was 84% lower than the stiffness of locked plating constructs. For loads of >400 N, the stiffness of far cortical locking constructs increased to 2672 ± 594 N/mm because of additional structural support provided by near-cortex contact of far cortical locking screw shafts. A 400-N axial load induced nearly parallel motion at the osteotomy gap of far cortical locking constructs, with similar gap closure at the near cortex (0.56 ± 0.08 mm) and far cortex (0.64 ± 0.06 mm) (Fig. E-1, *C*). In locked plating constructs, the corresponding gap closure

at the near and the far cortex was 0.04 ± 0.01 mm and 0.14 ± 0.02 mm, respectively.

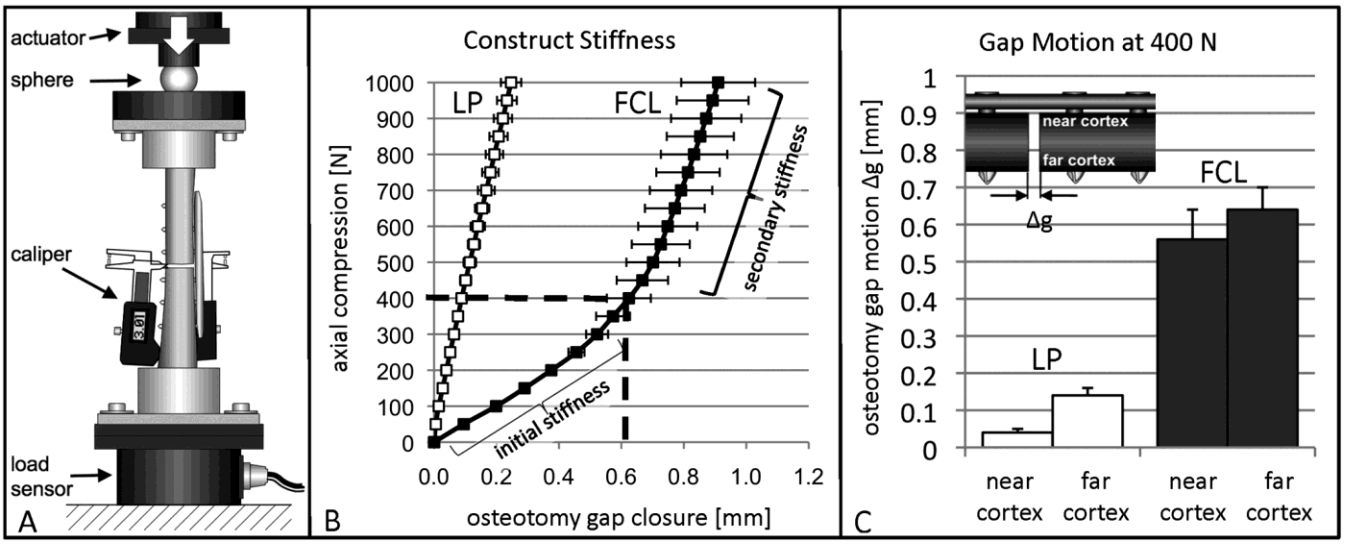

Fig. E-1
Initial axial stiffness of locked plating (LP) and far cortical locking (FCL) constructs (mean and standard deviation). A: Stiffness assessment in axial compression. B: Stiffness of the locked plating construct was over six times higher than the initial stiffness of the far cortical locking construct. At 400-N loading, far cortical locking construct stiffness increased because of near-cortex support. C: At 400-N loading, the far cortical locking construct induced nearly parallel gap motion of approximately 0.6 mm. Gap motion in the locked plating construct was one order of magnitude smaller than in the far cortical locking construct, and motion at the near cortex was 3.5 times smaller than at the far cortex.