**Introduction:** To determine the stiffness characteristics of a new proposed hybrid fixator in comparison with more commonly used commercialized hybrid external fixators and idealized hybrid fixator.

**Materials and Methods:** A prospective laboratory investigation was used to test the mechanical stiffness between the new proposed hybrid fixator (Figure 1) and the more commonly used hybrid external fixators: Ace-Fischer, DePuyACE, Warsaw, IN; Hoffmann II, Stryker Howmedica Osteonics, Rutherford, NJ; Synthes Hybrid, Synthes USA, Paoli, PA; EBI DynaFix®, EBI, Parsippany, NJ; and a custom built “rigid” frame (Figure 2). The test model was a fiberglass composite tibia (Pacific Research Laboratories, Vashon Island, WA, USA) with a 2 cm proximal metaphyseal gap osteotomy simulating the fracture pattern described by OTA classification 41-A3.3. The “rigid” frame consisted of five 15 cm diameter aluminum rings having 2.0 cm square cross-sections and four stainless steel longitudinal connecting rods 1.25 cm diameter. A standardized pin and wire configuration was created by using the “rigid” frame as a guide for drilling holes in each test tibia for placement of wires and pins. Proximal loading was through a custom load plate mounted on the tibial plateau and distal loading was through a universal joint mounted at the level of the ankle. Direct compression and torsion loads were applied using a biaxial servohydraulic load frame (Model 858 Bionix, MTS, Eden Prairie, MN). Five loading regimes were used; central compression, medial compression, posterior compression, posteromedial compression, and torsion. The compression load was 100 N in each case. The proximal load plate offset the medial and posterior loading by 4 cm resulting in 4 N-m of bending in those loading modes. The posteromedial loading resulted in 5.66 N-m of bending. The torsional loading was 5 N-m. The amount of displacement (mm or deg) of the MTS actuator was recorded for each test. Each of the five fixation types were applied to three separate tibiae. Each tibia construct was loaded and data recorded for three test runs with wires re tensioned between each run. The multiple runs were used to confirm that the testing procedure was consistent. Analysis of Variance (ANOVA) followed by post-hoc t-tests was used to compare the amount of displacement allowed by the four configurations for each loading mode (p<0.05). Separate validation tests were performed on the “rigid” frame to determine its stiffness. A 0.75 cm thick plate was mounted on the top ring of a five ring configuration of the “rigid” frame. The custom load plate was then mounted to the thick plate and loaded as described previously. The load developed for very small motions was recorded and the stiffness of the “rigid” frame was calculated.

**Results:** The new proposed hybrid external fixator was stiffer than all the other fixators tested in all modes of testing (P<0.05), except for torsion. The Hoffmann II, DePuyACE, EBI, and Synthes fixators were essentially equivalent in stiffness in all five modes of testing (P>0.05).

**Discussion:** The hybrid fixators, or the fixators that use the thin wire fixation in the periarticular fragment combined with the half-pin fixation in the diaphysis, have made the multiplanar external fixation easier to use and thus growing in popularity (1). However, the configuration of the ideal hybrid has not been elucidated yet. Decreasing the distance of the side bar to the center of the bone effectively shortens the length of the half-pins, which decreases their deflection during bending, and thus increases stiffness (2). We measured the distance between the bone surface and point of fixation of wires and half-pins (table). We think that a better stiffness of new fixator than of others is due to a shorter distance between the bone surface and points of fixation of wires and half-pins. The proposed hybrid fixator corresponds to the contemporary requirements for external fixation: high stiffness, easy to apply, comfortable for the patient (being light and simple), low cost.

**References:**

**Table:**

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<th>Proximal wires</th>
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**Figure 1**

**Figure 2**