INTRODUCTION:
Supracondylar humerus fractures comprise 65% of fractures around the elbow joint in the pediatric population. Several studies have examined the biomechanical stability of smooth wire fixation constructs used to stabilize pediatric supracondylar humerus fractures. An analysis of varying pin size, number and lateral starting points has not previously been performed.

METHODS:
Twenty synthetic humeri were sectioned in the mid-olecranon fossa to simulate a supracondylar humerus fracture. Specimens were all anatomically reduced and pinned with a lateral-entry configuration. There were two main groups based on specific lateral-entry starting point (direct lateral versus capitellar) (Fig. 1). Within these groups pin size (1.6mm versus 2.0mm) and number of pins (2 versus 3) were varied and the specimens biomechanically tested (Fig. 2). After fracture stabilization, the humeral shafts were embedded in a 2-part epoxy resin (Bondo-Marhyde, Atlanta, GA) and secured with custom fixation rigs to a biaxial servohydraulic MTS858 test frame (MTS Co, Eden Prairie, MN). Each construct was tested in extension, varus, valgus, internal, and external rotation. For extension, varus, and valgus, constructs were tested by applying a translational force through the distal fragment at 0.5 mm/sec to a maximum of 4 mm of displacement. For internal and external rotation, constructs were tested at 0.5 degrees per second to an end point of 10 degrees. Data for displacement (millimeters), force (Newtons), rotation (degrees), and torque (Newtons millimeter) were sampled at 100 Hz during every test. Data for fragment stiffness (Newtons per millimeter or Newton millimeters per degree) were analyzed with a MANOVA and Bonferroni post hoc analysis (p < 0.05).

RESULTS:
Starting point: The capitellar starting point had a stiffer construct compared to the direct lateral construct in internal and external rotation (p= 0.031, 0.0001, 0.0001, respectively). There was no statistical difference noted in valgus or extension.

Number of Pins: With respect to the number of pins (two 1.6mm pins versus three 1.6mm pins), no differences were noted in any of the modes of stress in either the direct lateral or capitellar starting point groups. When comparing two 2.0mm pins versus three 1.6mm pins, the 2.0mm pin construct was stiffer in internal and external rotation utilizing either of the two starting point groups (p= 0.0001) (Fig. 5). There was no statistical difference noted in varus, valgus, or extension.

DISCUSSION:
The gold standard for displaced supracondylar humerus fractures is closed reduction with percutaneous pinning. Controversy remains around the exact pin configuration. The present study found the best torsional resistances in the capitellar starting group along with increased pin diameter. The capitellar starting point enables the surgeon to engage sufficient bone of the distal fragment and maximizes pin separation at the fracture site. In our anatomically reduced fracture model, the addition of a third pin provided no biomechanical advantage.

CLINICAL RELEVANCE:
Consider a capitellar starting point for the more distally placed pin in supracondylar humerus fractures, and if the patient’s size allows, a larger pin construct will provide improved stiffness with regards to rotational stresses.