**Introduction:** Slipped capital femoral epiphysis (SCFE) is now a well-known hip disorder in adolescents, characterized by the displacement of the capital femoral epiphysis from the metaphysis through the physis. Although a number of non-operative and operative treatment strategies have been described, in situ pinning has become the current standard in treating this disorder in North America. Regardless of the severity of the slip, many studies demonstrate in situ pinning to be the treatment of choice. To date, most studies have focused on the number of screws to optimize stability and the ideal location of the screw to minimize complications. The current standard for stable slips is to use a single cannulated screw placed in the center of the epiphysis, perpendicular to the physis. Fixation failure and slip progression however can occur despite this, suggesting that the current practice can be improved upon. There is an absence of studies addressing the type of screw to be used, its mode of placement, and the thread distribution to optimize stability in this setting. A recent study challenged the belief that compression across the physis maximized stability and found thread distribution across the physis to be important.1 Either too few threads in the epiphysis or in the metaphysis both lead to decreased stability. Maximum stability was noted by the authors with an even thread distribution across the physis. The purpose of this study was to compare the biomechanical stability of fully versus partially threaded single screw fixation for the treatment of slipped capital femoral epiphysis. We hypothesize that a greater number of threads in the metaphysis will provide greater incremental stability.

**Methods:** Twenty skeletally immature (10-12 month old) porcine femora were stripped of soft tissue and sectioned mid-diaphysis. Confirmation of an open physis using this model has been accomplished previously.1 A 30 degree angular wedge was resected from the femoral neck to create a simulated SCFE. Kirschner wires were placed through the epiphyseal fragment for stabilization prior to screw insertion. Femora were randomly assigned to either 7.3mm partially threaded or 7.3mm fully threaded stainless steel cannulated screws (Synthes, Inc., Paoli, PA). A guide wire was passed from the “center-center” position of the epiphyseal fragment and exited the anterior femoral neck. Each screw was then passed in a retrograde fashion over the guide wire. Image intensified fluoroscopy was used to ensure that only three threads crossed the physis and engaged the epiphysis. This thread number has been shown to maximize epiphyseal stability during similar biomechanical testing.1 The specimens, from the diaphysis to the lesser trochanter, were then fixed within two-part epoxy resin. A custom mold acetabulum applied loads in a posterior-inferior direction approximately 30 degrees from vertical on the lateral image. (Figure 1).

**Results:** There were no significant differences between partially threaded or fully threaded screws for forces at each sequential epiphyseal displacement. Forces at 2mm of displacement (partially = 356±134N; fully = 319±85N) approximated 80 pounds of force. Subsequent levels at 4mm (partially = 650±159N; fully = 662±209N), 6mm (partially = 980±237N; fully = 923±306N) and 8mm (partially = 1250±356N; fully = 1170±387N) generally showed an increase of required force of approximately 350N per increase in displacement. (Figure 2) The failure modes for each group demonstrated blow of the epiphyseal fragment through the femoral neck. There were no instances of femoral neck fracture or fracture of the epiphyseal fragment.

![Figure 1: Schematic of mechanical testing setup.](image1)

![Figure 2: Force data required for sequential epiphyseal fragment displacement.](image2)

**Discussion:** Despite minimizing the risk of avascular necrosis and condrolysis by using single screw fixation for SCFE, complications of fixation failure and slip progression have been recognized in this setting. A prevalence of 20% of slip progression after single screw in situ fixation was noted by Carney et al (2003) in their series. Maletis et al (1993) first reported windshield-wiper loosening in 3 of 18 patients, attributing this to the use of a titanium screw left more than 1.5 cm from the femoral cortex. Sanders et al (2002) demonstrated that the mechanism of slip progression was due to screw loosening in the metaphysis. The current study was undertaken to evaluate whether screws with greater thread length and thread distribution (fully threaded) in the metaphysis would further increase fixation stability. Our model was designed based on the findings of a previous study with three threads engaged in the epiphysis.1 The current study showed no significant biomechanical difference between fully versus partially threaded cannulated screws with respect to increasing displacements of the epiphyseal fragment, and hence more screw threads in the metaphysis may not improve stability. Data from the current study indicate that a fully threaded screw does not necessarily improve epiphyseal stability in an in-vitro simulation of slip progression. The use of a fully threaded stainless steel screw remains a reasonable option in the treatment of SCFE. It is possible that the in-vivo situation may result in improved stability with a fully threaded screw as bone is given time to heal around the threads. It is also possible that implant removal may be easier with a fully threaded screw due to thread purchase in the femoral neck. The issue of implant removal to assist the joint reconstruction surgeon requires further investigation.

**References:**