**Introduction:** The tibial tubercle osteotomy is a common method used in patellofemoral realignment procedures and is becoming increasingly popular for exposure in revision knee replacement. Use of bicortical screws or 18-gauge stainless steel cerclage wires with step-cut osteotomies are the most common techniques to fix the osteotomy [1,2,3]. Clinical studies [1,2,3] have shown good to excellent results but with concerns of tubercle displacement, and extensor mechanism failure. There is no existing biomechanical data to guide the rehabilitation of patients following tubercle osteotomy. Consequently this study examined the strength of fixation of tibial tubercle osteotomy when exposed to cyclic loads approximating loads applied during the rehabilitation period. Our hypothesis is that fixation strength will decrease after cyclic loading, leading to low failure loads.

**Materials and Methods:** Twenty frozen lower extremities were dissected at the knee with the patella and patellar tendon intact. The specimens were split into two equal groups of ten.

Specimens were prepared by skeletonizing the proximal half of the tibia with preservation of the patella and its attachment through its tendon to the tibial tubercle. The tibia was transected at the mid-diaphyseal region. A step-cut with an osteotome was made 5-7 millimeters in depth at the attachment of the tendon to the tibia. The osteotomy consisted of a fragment approximately 1.5 centimeters in depth at the tubercle and 11.5 cm in length from the step-cut to its distal exit. The first group had a step-cut osteotomy with fixation by two 4.5 bicortical screws placed approximately two and six centimeters distal to the level of the tubercle. The second group had a step-cut osteotomy with fixation by four 18-gauge stainless steel wires placed just below the tubercle then two, four, and six centimeters distal to the tubercle.

Testing was performed with a servo-hydraulic Instron 1321. Dynamic cyclic loading to 400 N at a rate of 125 mm/min was imparted to the specimens until either 1 cm of displacement or 500 cycles occurred. After this was completed a static load at 25 mm/min was placed on the specimen to determine the failure load of the osteotomy in Newton’s. Failure was defined as peak load or the load at 1 cm of displacement depending on which occurred first. A displacement (LVDT) transducer was used to determine tubercle fragment displacement.

Measurements of three variables were determined for each specimen to determine similarities or differences in the groups and to determine if it had an influence on the outcome. The first was a DEXA scan with a Hologic 4500A (Hologic Inc., Waltham MA) to account for bone mineral density. The second was surface area of the osteotomy measured via image analyses of osteotomy tracings. The last was depth of the step-cut measured with a ruler to the nearest millimeter.

**Results:** Dynamic cyclic loading of the two techniques (figure 1) demonstrates that there is minimal displacement of the osteotomy in both groups. This illustration also shows that there is essentially no difference between the fixation types (p>0.05). The failure load (figure 2) shows that screw fixation is significantly stronger (p<0.05) than wire fixation. The variables of surface area, step-cut depth, and bone mineral density of the two groups were essentially the same. Surface area of osteotomy in wire fixation group was 21.1 cm² vs. 20.8 cm² in the screw fixation group. Step-cut depth in the wire fixation group was 1.54 cm vs. 1.50 cm in the screw fixation group. Bone mineral density in the wire fixation group was 0.72 gms/cm² vs. 0.74 gms/cm² in the screw fixation group.

**Discussion:** Rehabilitation postoperatively after total knee revision is essential to an optimum outcome. The 400 N load applied to the fixation techniques represents an active straight leg raise; a knee extension against gravity is approximately 250 N. Tibial tubercle osteotomy fixation by current techniques appears to provide adequate stability for standard rehab protocols at loads equaling those of knee extension against gravity. Cerclage wire fixation, while significantly lower than screw fixation, appears to provide adequate stability under these rehab conditions. This study also provides data to support that cyclic loading does not compromise the overall fixation strength of both constructs. Failure loads obtained in this study were comparable to that found by Davis et al [4].

**References:**

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