TROCHANTERIC SLIDE OSTEOTOMY: EVALUATION OF FIXATION AND ROLE OF MUSCLE LOADS

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INTRODUCTION
Osteotomy of the greater trochanter (GT) offers the surgeon a wide exposure of the joint during revision hip arthroplasty. The technique was described as part of Charnley’s procedure. This ‘classic’ osteotomy has been improved by maintaining the attachment of the vastus lateralis to the GT: the ‘slide’ osteotomy. The slide osteotomy is inherently more stable since the vastus maintains the attachment of the vastus lateralis to the GT: the ‘slide’ part of Charnley’s procedure. This ‘classic’ osteotomy has been improved by previous biomechanical studies have been limited to the classic osteotomy. A biomechanical model of muscle loads for the trochanteric slide osteotomy was developed previously1, and demonstrated that the interfacial compression was dependent upon the activity of the vastus muscle. The purpose of this study was to examine the effect of interfacial compression and type of fixation (cable system and a suture technique) on the shear stiffness of the construct, in both superior and anterior directions.

MATERIALS AND METHODS
A trochanteric slide osteotomy was performed on seven fresh-frozen human cadaveric femurs. The GT of each femur was reattached sequentially with a suture technique and the Dall-Miles cable-grip system, the sequence being randomized. The cables were tightened with the manufacturer-supplied cable tensioners to 445N. For the suture technique, the GT was reattached with six interrupted loops, three posterior and three anterior, of number 5 Ethibond. The diaphysis was potted in dental stone, and a threaded rod was inserted transversely in the GT for applying shear loads. The femur was mounted in a biaxial test machine (Instron 8874, Instron Corp., Canton MA) in which compressive loads perpendicular to the osteotomy plane were applied with the rotary actuator and a shear force, either superior or anterior, was applied with the linear actuator through the threaded rod. This loading scenario was derived to represent various degrees of weakness of the vastus lateralis and subsequent shear loads during gait1. The compressive force was stepped from 100% of body weight down to 0N in decrements of 25% body weight. At each step, the shear force cycled from 0N to 75% of body weight at 0.25 Hz for five cycles. Motions of the GT relative to the femur were tracked with optoelectronic markers (Optotrak 3000, Northern Digital Inc, Waterloo, ON). Two motion parameters, cyclic amplitude and mean migration, were determined for the superior and anterior directions. A two-way repeated-measures ANOVA was performed to examine the effect of fixation type and compressive load on the motion of the GT fragment. Post-hoc SNK tests were performed to examine specific differences.

RESULTS
Overall, sutures allowed larger motion amplitudes than cables in the superior direction (p=0.05). However, there was no significant difference in the presence of compressive loads (p=0.69), see Figure 1. Decreasing the compressive load significantly increased motion amplitude for both the cable system and sutures (p=0.0005). Anterior motion amplitude showed similar results.

Similarly, the compressive load had a significant effect on migration of the GT (p=0.0003). The sutures allowed more migration (p=0.005), and were affected more by decreasing compressive loads (p=0.04), compared to the cable system. Mean superior displacement of the GT for each load step is shown in Figure 2. Anterior migration showed similar results.

DISCUSSION
Motions of the GT under high compressive loads were similar for both the cable system and sutures. This represents the ideal case for the slide osteotomy, in which the vastus lateralis is well preserved. Under decreasing compressive loads, the sutures allowed more cyclic motion and migration, while the cable system was relatively unaffected. Biomechanically, this represents reduced function in the vastus1, or at the extreme, the classic osteotomy. The sutures allowed more migration at all load steps compared to the cable-system, but this may not be as detrimental to union of the GT fragment as the cyclic motion amplitude since it is a one-time slip. Motions in the anterior direction showed similar magnitudes and trends, although the applied loads may have been excessive compared to physiologic loads.

The cable-grip system may be more than required to achieve union of the greater trochanter following a trochanteric slide osteotomy. The combined muscle forces in the slide osteotomy reduce the shear on the osteotomy plane and may allow the surgeon to reduce the amount of fixation, and use a technique that causes less soft-tissue irritation.

REFERENCES