INTRODUCTION
Loosening of the tibial component is a major cause of failure in both cemented and cementless total knee arthroplasty (TKA). Although cemented total knee replacements typically experience less micromotion, the cyclic compressional forces across the knee joint are still sufficient to cause migration and loosening, leading to the need for revisions. Thus, the need for improving initial fixation persists. The shear strength of the cement bone interface increases with depth of cement penetration. The ideal depth of penetration is 3-4 mm. However, achieving uniform penetration to this depth has presented a challenge with current implants. Walker et al. noted lower penetration around the sides of the tibial component due to side leakage, a factor which has also been noted by surgeons in our group. New designs in tibial components are needed to prevent any leakage of cement and also to maximize the preservation of the patient's tissues during implantation. In this study, a proven form of torsional testing methodology will be used to determine the shear stress/forces for a stemless rimmed cemented tibial component (SRCTC). We have designed a new tibial component that features a 3 mm cement retaining rim to provide rotational stability and support minimal invasive surgery procedures (Figure 1b). The purpose of this 3 mm rim is to create a well that prohibits the leakage of cement out the sides of the bone-implant interface and assures cement penetration into trabecular bone. The proposed improvement in cement penetration by the SRCTC promotes our ultimate goal of cemented minimal invasive surgery.

METHODS
Radiographic analyses were performed and pre-implant radiographs (AP and lateral) of six pairs of cadaveric tibia were taken in order to size tibial implants. All tibias exhibiting visible deformities or pathological legions were excluded. The tibias were stored in sealed plastic bags at 20°C until six hours before implantation. While still sealed in plastic, all tibias were placed in a 37°C water bath the morning of implantation. All tibial pairs were lavaged by an InterPulse System (Stryker Instruments, Kalamazoo, MI) using one liter of saline per tibia. Acetone was then C water bath the morning of implantation. Cycles were excluded. The tibias were sterilized by the InterPulse System (Stryker Instruments, Kalamazoo, MI) using one liter of saline per tibia. Acetone was then C water bath the morning of implantation. All data analysis was performed using Labview 7 Express (Austin, TX.)

RESULTS
During the implantation of the SRCTC, little or no bone cement escaped from the bone implant interface. The normal stemmed tibial components exhibited large amounts of cement extrusion during implantation for all tibias. Radiographically, an uneven distribution of bone cement was visualized in all tibias receiving the normal stemmed implant, showing higher concentrations near the stem of the implant and less near the perimeter. The tibias implanted with the SRCTC showed a more even and consistent distribution of bone cement at the bone implant interface. Figure 2 shows the ramping torque of one tibial pair and the corresponding point of failure for each tibia. Torque force failure rates for the tibias implanted with the Natural Knee II ranged from 229 kg cm to 1719 kg cm, while the failure rates for the tibias implanted with the SRCTC ranged from 303 kg cm to 1666 kg cm. Data analysis showed that the SRCTC withstood 5% higher torque rates overall, before failing at the bone-cement interface. Therefore, no significant differences were evident when comparing the torsional strength properties of the SRCTC and stemmed tibial components.

DISCUSSION
The even distribution of cement visualized on the radiographs taken from the tibias implanted with the SRCTC, can be attributed to the near total containment of all the applied bone cement by the 3 mm rim. The large amount of side leakage of bone cement recorded during the implantation of the stemmed tibial component, points to the inconsistent cement levels observed on clinical radiographs. Evenly distributed bone cement promoted by the SRCTC’s 3 mm rim, results in rotational stability on par with that of the stemmed Natural Knee II implant. Virtually eliminating bone cement extrusion during implantation could lead to lower host immunological responses and is less likely to migrate into the articulation. The SRCTC’s rotational stability mimics that of the Natural Knee II, but is 80% shorter (1.667 in.) in component profile accommodating minimally invasive surgical techniques. Smaller implants require less invasive incisions, thus potentially minimizing host tissue damage during implantation.

REFERENCES