Understanding Femoral Morphology for the Development of Osseointegrated Implants for Amputees

Jessica N. Bauer Kemper (Roy D. Bloebaum)
Bone and Joint Research Laboratory
Veteran Affairs Medical Center, Salt Lake City, Utah 84108

With the United States engaged in the war against terrorism and no date set on when soldiers will be brought home, the number of soldiers seriously injured during combat will likely increase. Although body armor reduces torso injuries, limbs are left vulnerable to injury, which often leads to amputation. Currently the only option for amputees is socket prostheses, which have several limitations including skin irritations, blisters, sores, and chafing. These limitations reduce the quality of life and the probability of maintaining an active lifestyle. The development and ultimate use of bone attached implants (osseointegrated implants) for amputees will likely reduce the limitations associated with socket prostheses and provide soldiers an increased quality of life. The success of this new technology will not only help amputee soldiers, but will eventually increase the quality of life and activity levels for all amputees worldwide.

To develop a successful osseointegrated implant for above-the-knee amputees, the variation of bone morphology along the femoral shaft needs to be understood. To understand this variation a pilot study on 13 pairs of cadaveric femurs from adult Caucasian males (N=8) and females (N=5) was conducted. Anterior-posterior and lateral radiographs were taken to obtain cortical bone and medullary canal diameters along the diaphysis. The data from the radiographs was analyzed using a paired t-test. The analysis showed significant differences between males and females in the anterior-posterior diameter of the medullary canal and the medial-lateral diameter of the diaphysis at 35%, 50%, & 65% biomechanical length. These results suggest the need for different implant sizes for males and females. Further studies will include a larger sample size of male and female cadaveric femurs and possible ethnicity and age differences will also be accounted for. This information will be used to design an implant that will fit and fill the medullary canal properly.