Relevance to Musculoskeletal Conditions: Prosthetic loosening is a major problem in reconstructive surgery. In this study corticocancellous bone graft is used to enhance bone bridging between host bone and prosthesis.

Introduction: The concept of composite fixation method with intramedullary cement fixation and extracortical bone ingrowth onto the porous prosthetic surface was initially introduced in order to enhance prosthetic fixation. Such bone ingrowth has been used in other implants with late loosening as a problem (1). Bone growth onto the porous surface is achieved only partially. Since modifications in design and surface materials have not yet eliminated the problem, closer attention has been focused on techniques of enhancing soft tissue and bone formation surrounding the implant. Bone grafting has been used to induce new bone formation (2), but it is also suggested that extracortical bone bridging and capsule formation could be achieved without application of bone graft. Larger callus size and accelerated tissue growth onto the prosthesis is assumed to ensure bone and organized fibrous tissue ingrowth into the prosthesis. When the bridging tissue is primarily osseous, the stresses within the stem and cement can be reduced significantly. Extracortical tissue formation may also prevent debris induced osteolysis by forming a tight capsule around the junction site (3). This experiment was designed to study whether a modified grafting method with combination of crushed cancellous bone and cortical autogenous strips is able to secure better new bone formation around the prosthesis. Cancellous bone is the primary inducer of new bone formation but viable onlay cortical bone strips are believed to enhance healing by contributing mechanical strength to the composite fixation site and acting as a scaffold for guided tissue regeneration.

Methods: Six mix-breeded dogs were used in the experiment. Each dog received a porous-coated prosthetic femoral diaphyseal replacement into the both femurs. The prosthetic implant developed for this study was a bistemmed segmental diaphyseal replacement (SDR) prosthesis made of titanium alloy (Ti-6Al-4V). The stems were cemented for initial fixation. In experimental side, onlay type cortico-cancellous bone autograft was used, while control side was ungrafted. Graft consisted of eight 2.5x0.5 cm cortical bone strips that were placed at bone-implant junction site (Fig. 1). Cancellous bone was placed under and in between cortical bone. The healing was followed 12 weeks. Radiographic, biomechanical, histological and histomorphometrical analyses were done in order to determine the bone ingrowth, extracortical bone bridging and soft tissue capsule formation. Intramedullary cement mantle was removed with specially designed jig before mechanical testing so that all torsional strength was due to the extracortical bone bridging on prosthesis. Gait analysis was performed to analyze functional recovery after operation.

Results: Dynamic weight bearing showed statistically significant decrease in ground force in non grafted limbs between preoperative values and 4 weeks post-operative values. By 7 weeks the values returned to normal on both sides.

Conclusions: The results showed that cortico-cancellous onlay bone graft could be used successfully to enhance bone bridge formation and bone ingrowth into the porous surface. Extracortical bone bridging was achieved with proper grafting technique. Bone strips are needed to guide and stimulate desirable tissue formation. Bone growth onto the prosthesis mechanically strengthens the interface and diminishes the tendency of implants to loosen by improving transfer of stress. Forming extracortical tissue may also effectively prevent debris induced osteolysis by forming a tight capsule around junction site.