TITANIUM FOAM AS A BONE INGROWTH SURFACE IN ACETABULAR SHELLS: A CANINE STUDY

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ABSTRACT INTRODUCTION:
The ingrowth of bone as an interface for acetabular component fixation has been utilized for over a decade. New ingrowth surfaces that are closer to the porosity of the surrounding cancellous bone are now being utilized. Titanium three-dimensional ingrowth surface (Tritanium™, Ti) was investigated in this canine study as to the potential for ingrowth with and without a PeriApetite™ (PA) hydroxyapatite coating (Stryker, Mahwah, NJ).

METHODS:
24 mongrel canines underwent total hip arthroplasty with a macrotextured femoral component and a titanium foam porous surface acetabular shell. The acetabular shells were randomized to uncoated Ti foam or with a PA coating applied to the Ti surface. The cranial caudal acetabular shell. The acetabular shells were randomized to uncoated Ti macrotextured femoral component and a titanium foam porous surface acetabular shell. The acetabular shells were randomized to uncoated Ti foam or with a PA coating applied to the Ti surface. The cranial caudal approach was utilized for each operation (Figure 1). The study was approved by our institution’s animal review board prior to the start of the study. Each canine was treated with the same post-operative protocol with a pain management regimen and weight bearing as tolerated. 17 mongrel canines were included in this study after exclusion of 7 animals for dislocation, or implant and anatomy mismatch due to limited implant sizing. Radiographs were taken postoperatively and at 6 week intervals to assess for radiolucencies (Figure 2). Canines were sacrificed at 3 and 6 months. The surrounding bone was harvested to include the entire acetabulum which was removed of all tissue in a subperiosteal fashion and placed in a 10% formalin neutral solution. AP and lateral radiographs were taken of specimens to properly orient them anatomically for sectioning. The acetabular components were sectioned in the coronal plane near the middle of the ilium with a diamond saw and the sections ground to 250-350mm and polished. Quantitative measurements were conducted utilizing seven SEM image along the circumference of the cup along the ileum (Figure 3). Microradiography of each slide confirmed that the histologic section was aligned anatomically. Depth of bone ingrowth was calculated as a percentage of the length of the line from the top of the coating to the deepest point of bone towards the substrate to the whole thickness of the coating (Figure 4). Seven images along the circumference and in the plane of the ilium were analyzed with SEM at 20x magnification. Percent and depth of ingrowth were then calculated. Percentage of bone ingrowth was calculated as determining as area of interest (AOI) including bone and metal in the porous material region and then determining area of metal (M) and area of bone (B). Percent bone ingrowth then equaled (AOI)/(M-B) X 100.

RESULTS:
The depth of the bone ingrowth varied among specimens and the obtained images for each specimen. (Figure 4) A significant difference at 3 months resulted with Ti-PA having 94% bone depth and 26.5% bone ingrowth compared to 63.1% and 18% for Ti alone. At 3 months three out of six Ti-PA specimens had 100% bone depth compared to three out of four at 6 months (97% average). (Figure 5)

DISCUSSION:
The titanium foam surface proved to allow ingrowth of trabecular bone which was continuous with the surrounding acetabular bone. The depth of bone growth proved to be complete throughout the titanium foam to the solid portion of the acetabular shell. Tritanium performed well as an ingrowth surface in this study with a significant increase in percentage of bone ingrowth between 3 and 6 months. Average percent bone ingrowth increased from 28% at three months to 38% at six months while average depth of bone ingrowth into the titanium foam increased significantly from three to six months. These changes seem to be attributed to the greater depth of ingrowth for the PA-coated than uncoated at three months and the increase between three and six months for the uncoated titanium foam. The study results show that high porosity Tritanium surface with a PA coating creates a surface that ingrows at a faster rate. It should also be noted that with higher porosity Tritanium surfaces there is quantitatively more bone to interlock the shell than with beaded surfaces. The results show the titanium porous surface with PeriApatite coating to be a promising new type of fixation for implants in orthopaedic surgery.

REFERENCES: