MORE BONE INGROWTH

FASTER FUSION FOR MEDICAL IMPLANTS

'Polyether ether ketone implants achieve increased bone fusion when coated with nano-sized hydroxyapatite: a histomorphometric study in rabbit bone', Johansson et al. (2016), International Journal of Nanomedicine, Vol 11, Pp 1435—1442.

Aim

Porous geometries are interesting in implantology due to their advantageous properties with respect to osseointegration. The presence of pores gives rise to an increased number of possible anchoring points for bone cells to attach and interact. Porous structures have also gained in interest for the material PEEK. Even though PEEK is biocompatible and displays excellent mechanical properties, the bioactivity is low which affects integration.

Presence of the nanometer-thin HA^{nano} Surface does not alter the surface topography or clog the pore when compared to an unmodified surface. Instead, HA^{nano} Surface follows the underlying structure thereby preserving the surface roughness and porosity.

Materials and Methods

To evaluate the bioactivity of a porous PEEK structure, vented PEEK implants were manufactured. Half of the implants were modified with HA^{nano} Surface. The implants were surgically inserted in the femur of 24 rabbits. Implants were removed and analyzed with histology after 3 and 12 weeks of healing,respectively.

Results

The bone areas inside and in close to vicinity to the pore were evaluated using histology after 3 and 12 weeks of healing (Figure 1). Presence of HA^{nano} Surface gave rise to 74% more bone inside and in close vicinity to the pore after 3 weeks, and 49% more bone after 12 weeks of healing, when compared to the unmodified surface (Figure 2). HA^{nano} Surface also improved Bone-to-Implant Contact (BIC) significantly by 21% and 32% after 3and 12 weeks, respectively.

The results clearly show the advantages of using HA^{nano} Surface for enhancing the osseointegration of complex implant designs.

Conclusion

Histology analysis of vented PEEK implants shows that more bone was formed inside and in close vicinity to the pore for HA^{nano} Surface modified implants compared to unmodified surfaces.

The increase in bone area and BIC for HA^{nano} Surface modified vented PEEK implants also clearly illustrates the osteoconductive properties of HA^{nano} Surface. This is of great interest for hydrophobic substrates and complex implant geometries, as it indicates that HA^{nano} Surface can improve the integration of such implants.

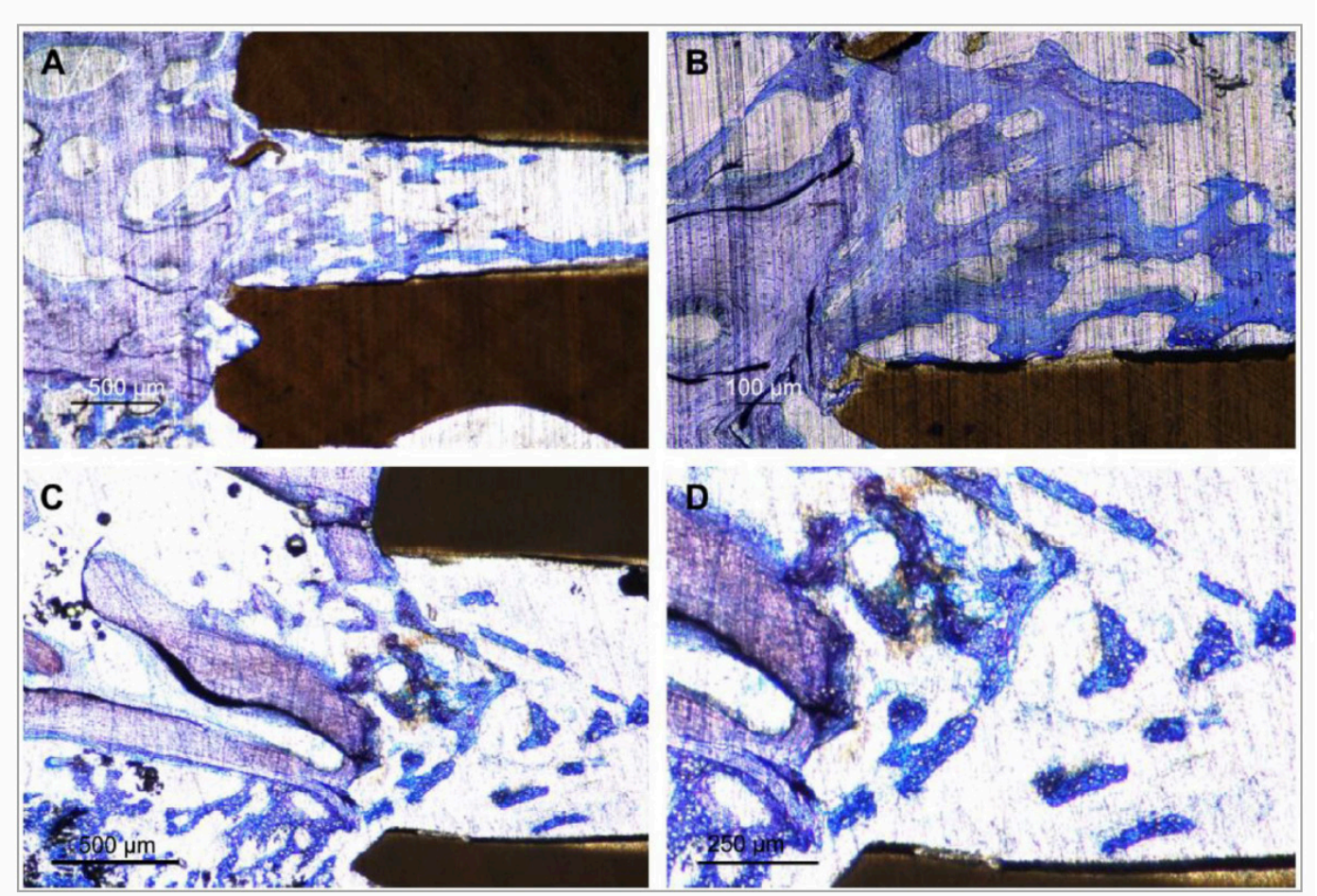

Figure 1. *The HA^{nano} Surface modified implant in lower magnification (A) shows bone growth through the entire hole. In the enlarged image (B), the line between the new bone and old bone can be tracked, and inside the hole, the bone approaches the implant surface with regular intervals through the hole. The unmodified PEEK implant (C) demonstrates significantly less bone area at the entrance and inside the perforated hole compared to that of HA^{nano} Surface modified PEEK. With the higher magnification, the bone structure was found to be in the center of the perforation without having contact to the implant surface (D).*

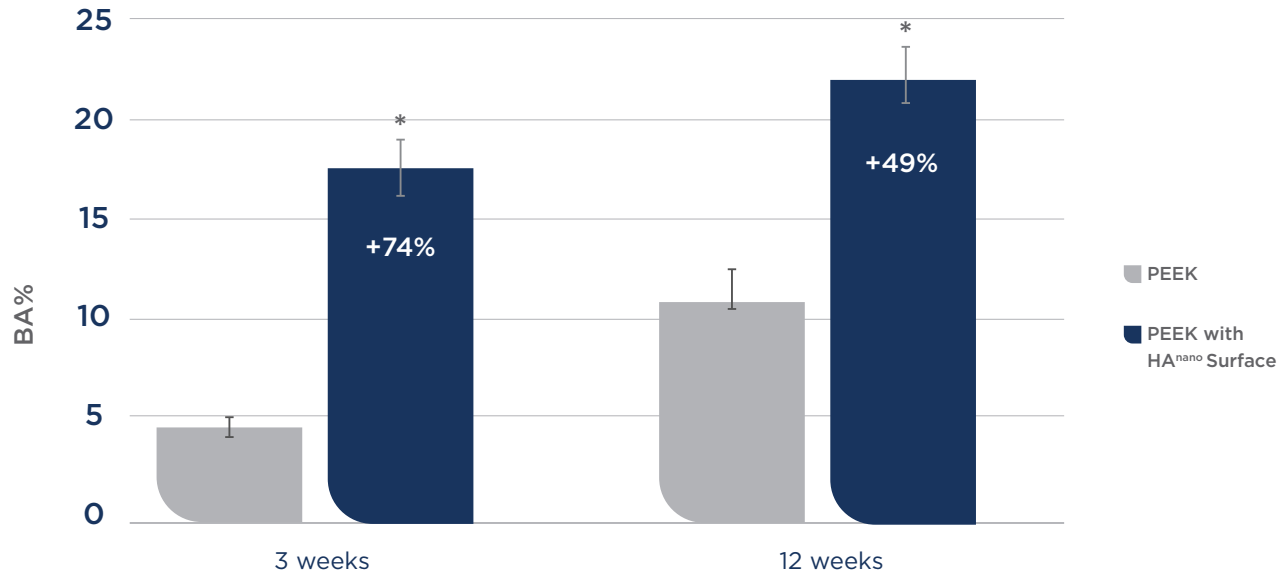

Figure 2. *Bone area for unmodified and HA^{nano} Surface modified PEEK implants using histology, after 3 weeks (significant, p = 0.000) and 12 weeks (significant, p = 0.001) of healing. Error bars represent standard error.*