Titanium trabecular 3D EBM® implants: A new promoting bone growth material

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Introduction:

Bone growth is an important entity in the process of fracture healing and bone fusion. Spinal fusion is the major procedure in order to obtain stability in degenerative or traumatic conditions. The ideal material should be osteoinductive and osteoconductive leading to rapid bone growth[1]. The aim of this study is to present the new porous trabecular titanium (PTT), 3D electron beam melting (EBM) designed, and the perspective of use in orthopedic and spine surgery.

Methodology:

Description of the basic research on porous trabecular titanium and the different derived product already used. The porous trabecular titanium 3D EBM is nowadays used in cervical and lumbar cages (MT Ortho, Aci Sant'Antonio, Sicily, Italy). This material is actually under investigation in the form of titanium microspheres as cement replacement. The safety, biomechanical proprieties, risks and benefits of each products are analyzed.

Titanium microspheres made by EBM® (Patent MT Ortho design)

Results:

In vitro studies have shown that porous trabecular titanium 3D EBM are osteoinductive and osteoconductive[1]. It was demonstrated in the cervical cages that the bone matrix could rapidly adhere and grow in the cage, leading to quick segmental stabilization. Preliminaries studies show a fusion rate in 83.3% of the patients and bony growth through the cage in 100% at 3 months. For the titanium microsphere, a preclinical study has shown good biomechanical stability. A first phase clinical study on 15 patients has confirmed the biomechanical stability and demonstrates less risk such as cement leak, temperature damage or pulmonary embolism.

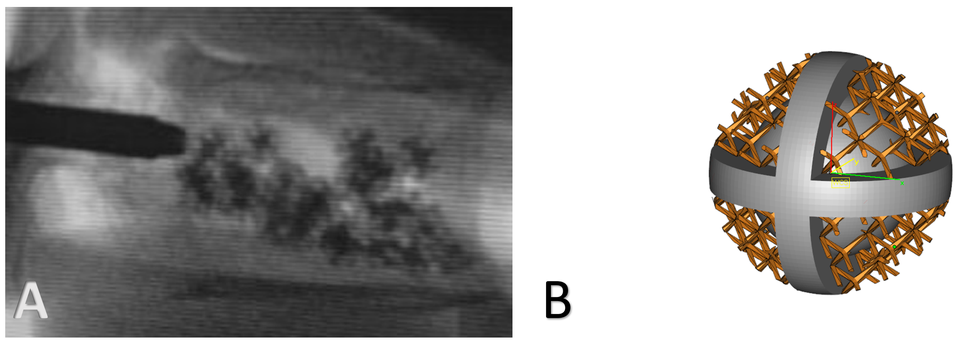
Discussion

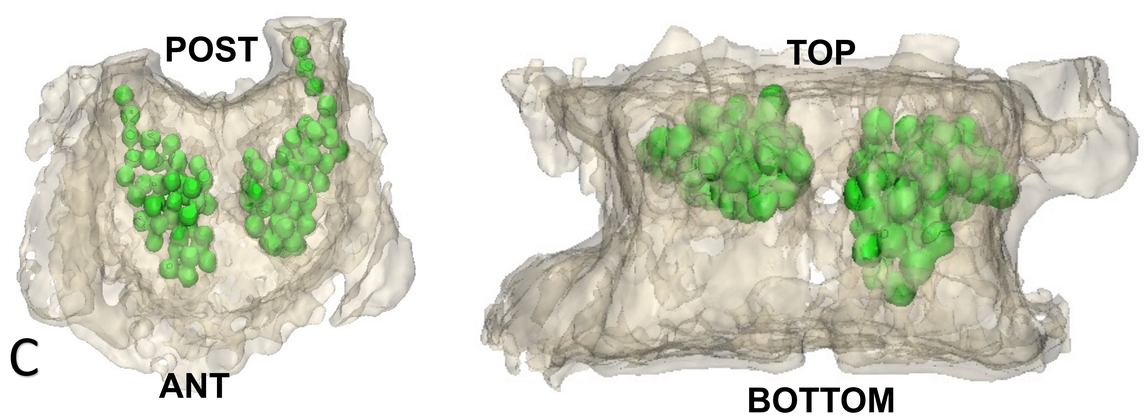
Porous trabecular titanium 3D electron beam melting is a promising material in bone growth stimulation. It can be used in a large variety of implants. In spine surgery, it allows rapid bone growth which is an imperative condition for fusion and segmental stability. The same material is also used in fractures as a cement replacement leading to greater stability and better bone healing with fewer complication risks[2]. The osteoinductive and osteoconductive properties of the PTT 3D EBM can be exploited in orthopedic surgery, such as in important bony defects, avascular necrosis of bone or traumatic bone loss.

Cage of porous trabecular titanium made by EBM® (Patent MT Ortho design)

Conclusion

Porous trabecular titanium can be widely and safely used as a bone growth stimulator. The potential of product development based on porous trabecular titanium is encouraging for further therapeutic use in pathology needing a rapid bone growth.





A. Fluoroscopic view during microspheres injection in a cadaver lab (with the courtesy of the Prof. A. Krüger)
B. Schematic representation of the titanium microsphere, designed as cement replacement
C. 3D Reconstruction with bone transparency: microspheres are represented in green

Literature :

1. Caliogna, L. *et al.*Osteogenic potential of human adipose derived stem cells (hASCs) seeded on titanium trabecular spinal cages. *Sci Rep,* 10, (2020)
2. Krüger A et *al. IOP Conf. Ser.: Mater. Sci. Eng*. 1038 (2021)