

Bone Cotton Wool – A New Implant Material for Bone Regeneration

Keywords

Bone regeneration, dentistry, amorphous tricalcium phosphate nanoparticles, PLGA nanocomposite, biomineralization, electrospinning

Patent status

Patent pending PCT

Background

Given the world's demographics shift towards an older population and today's lifestyles with more and more sportive activity, an inevitable rise of orthopedic injuries and diseases is expected.

Today, most of the surgical operations to repair fractures and bone defects are performed using autografts and allografts despite their limitations in terms of availability, donor-site morbidity, and potential negative immune responses. This has triggered research to find fully synthetic alternative bone substitute materials.

Ceramics such as hydroxyapatite and tricalcium phosphate, but also biodegradable polymers such as poly(lactico-glycolic) acid (PLGA) are more and more applied for bone repair and regeneration creating a growing market for such synthetic implants. However, currently used materials have their limitations, being brittleness, difficult shaping or constricted bioactivity.

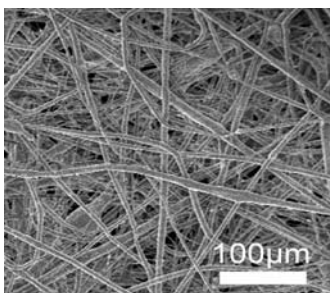


Fig. 1: Scanning electron microscopic image of Bone Cotton Wool (PLGA with 40wt% ATCP)

Invention

It has been shown that the combination of both a ceramic and a polymer within one material results in composites, which have the ductility of a polymer and the bioactivity of the calcium phosphate phase.

The invention of Bone Cotton Wool relates to the preparation of a new and advanced implant material consisting of a biodegradable polymer such as PLGA with up to 40 wt% of amorphous tricalcium phosphate (ATCP) nanoparticles incorporated into the polymer. These ATCP nanoparticles can be solely prepared by a dry, one step preparation method called flame spray synthesis (IP is covered by ETH Zurich, WO2005/087660).

The new composite is prepared by electrospinning, a technique which produces open structured, ultrafine fibers (Fig. 1). The resulting Bone Cotton Wool is very flexible and easy to shape due to its cotton wool-like appearance (Fig. 2). The high reactivity of the ATCP nanoparticles within the new implant material gave rise to most promising results on *in vitro* biomineralization.

Currently the new implant material is tested *in vivo* in an animal model.



Fig. 2: Appearance of Bone Cotton Wool; the new implant material is highly bioactive and easy to shape.

Field of Application

- Bone regeneration, especially in dental applications such as: Sinus lift, periodontal regeneration, socket preservation
- Other non-load bearing indications in orthopedic surgery

Main Advantages

- Improved bioactivity compared to current materials
- Apatite deposition after 48 hours
- Easy to apply: flexible, elastic, and compressible
- Bone Cotton Wool is removable if misplaced
- Fully synthetic material

References

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