From Nano to Macro: The Beginning of a New Era of Nanomaterials in Spinal Surgery

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Introduction

Development of materials closely resembling natural bone would allow for tailor -made implants. Having the same structure and surface characteristics as natural bone, these composites could be seeded with appropriate growth factors or stem cells, and therefore provide a template for tissue regeneration, while slowly resorbing to finally leave no foreign substances in the body.

Methods

Numerous materials exhibiting substantial surface or total bulk porosity and performance to enable bone ingrowth have been investigated for use as bone scaffolds and bone-regeneration systems for tissue engineering and tissue repair.

This review focuses on the results achieved since the rising of nanotechnology in this forefront sector of biomedical research.

Results

Nanomaterials have been tested in bone grafting according to their biocompatibility, design flexibility, functional group availability, surface modifiability, light weight and ability to yield. Moreover they can be categorized into biodegradable and nonbiodegradable substractures.

- Nanophase alumina and titania have proven to simulate material characteristics (such as surface grain size) of physiological bone that enhance protein interactions (such as adsorption, bioactivity, etc) and subsequent osteoblast adhesion.

- Collagen-, gelatin-, poly-lactic acid-, poly-glycolic acid-based nanostructures have also shown reasonable mechanical properties along with the ability to degrade into non-toxic components with a controllable degradation rate in vivo.

- The versatility of these products has allowed the fabrication of implants with various porosities and mechanical properties that can mimic the complex architecture of bone-specific sites to optimize tissue regeneration.

- Further engineerization of these composites has reduced in vitro the risk of

Conclusions

Nanomaterials have attracted significant attention as alternative scaffold material for bone substitute.

This attention is due to their mechanical strength, porosity, biocompatibility and bioactivity, which allows cell adhesion, migration, growth, and proliferation, resulting in excellent integration with surrounding tissues. Nanomaterials are shaping the world of spine implants and are supposed to significantly affect our surgical strategies in the near future.

Most relevant references

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