High performance polymer mesh as an alternative to traditional degradable mesh for alveolar bone repair

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Introduction

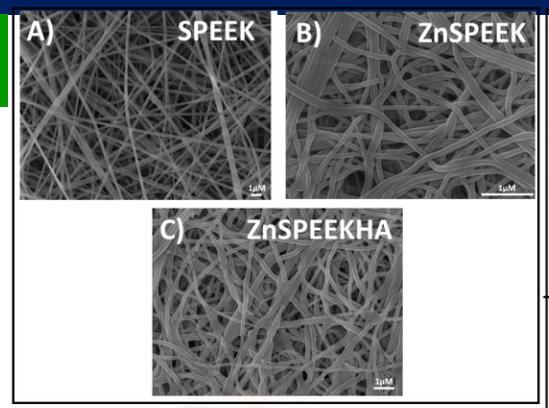
In oral implantology, alveolar bone after tooth loss, experience secondary absorption and atrophy. Currently, guided bone regeneration technique is used for alveolar bone repair. Based on the absorbability, commonly used barrier mesh can be classified into absorbable and nonabsorbable mesh. **Barrier mesh should provide cell selective isolation, should provide strength and space for stable bone regeneration space.** Absorbable membrane provides limited stiffness and initial spatial protection only. But nonabsorbable polymeric mesh made of zinc modified sulphonated polyetheretherketone provides good biocompatibility, stable spatial protection and they possess superior mechanical property, making the meshes an alternative to traditional degradable meshes for alveolar bone repair.

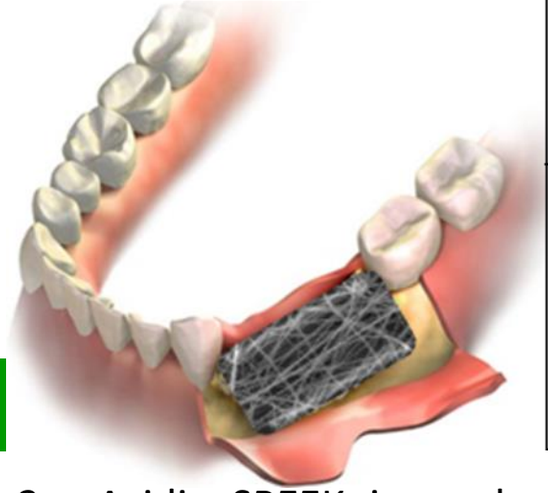
Methods

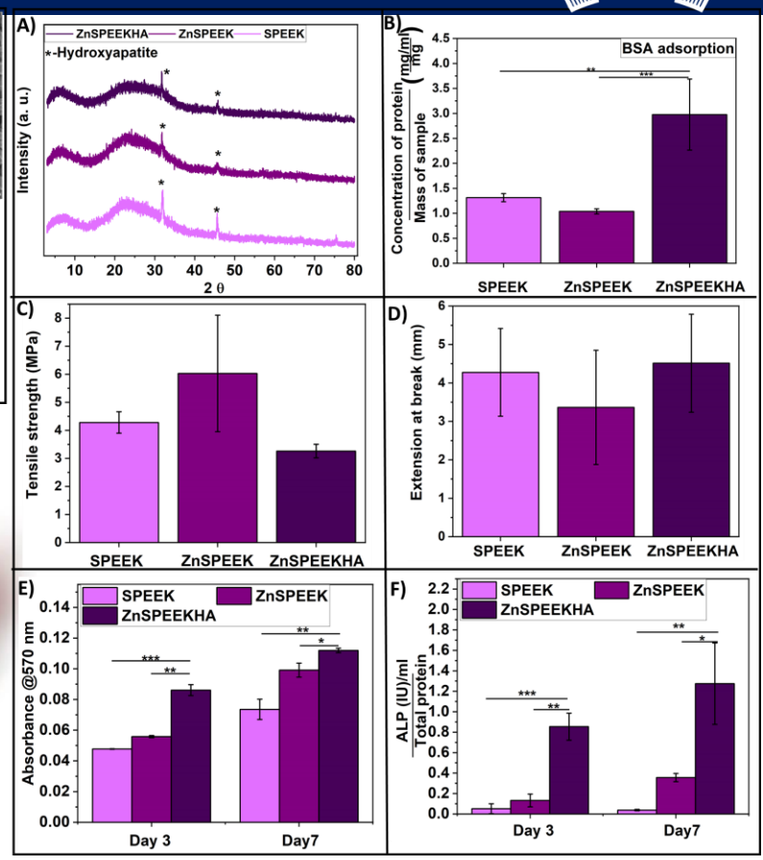
Polyetheretherketone (PEEK) was sulfonated using concentrated sulfuric acid to create sulfonated polyetheretherketone (SPEEK, degree of sulfonation 50%). SPEEK was electrospun using dimethylacetamide (DMAc) as solvent. To the SPEEK solution 10% hydroxyapatite is added and electrospun (SPEEKHA). The electrospun mats were modified by dipping them in 0.1 M zinc acetate solution and then air dried. Modified electrospun mats were named as ZnSPEEK and ZnSPEEKHA respectively. SPEEK, ZnSPEEK and ZnSPEEKHA were subjected to apatite formation studies, protein adsorption and in-vitro biocompatibility and alkaline phosphatase (ALP) quantification studies using SaOS-2.

Results and discussion

1. PEEK is dissolved in concentrated sulfuric acid and gets sulfonated into SPEEK.
2. SPEEK at 50% degree of sulfonation is electrospun into nanofibers.







3. Acidic SPEEK is made neutral by ion exchanging with zinc acetate
4. Zinc modification on the nanofiber mat did not affect the apatite forming ability, mechanical property but improved the cell viability of nanofiber mat.
5. Addition of hydroxyapatite into the zinc modified electrospun mat not only enhanced the protein adsorption ability but also the overall osteogenic potential (i.e. biocompatibility and marker of early osteogenic phenotype marker) of the scaffold.

Summary

1. Surface modification and hydroxyapatite addition into SPEEK enhanced osteogenic ability into scaffold.
2. Inherent mechanical property along with improved osteogenic ability will provide stable space for bone regeneration and will act as an alternative to degradable mesh.