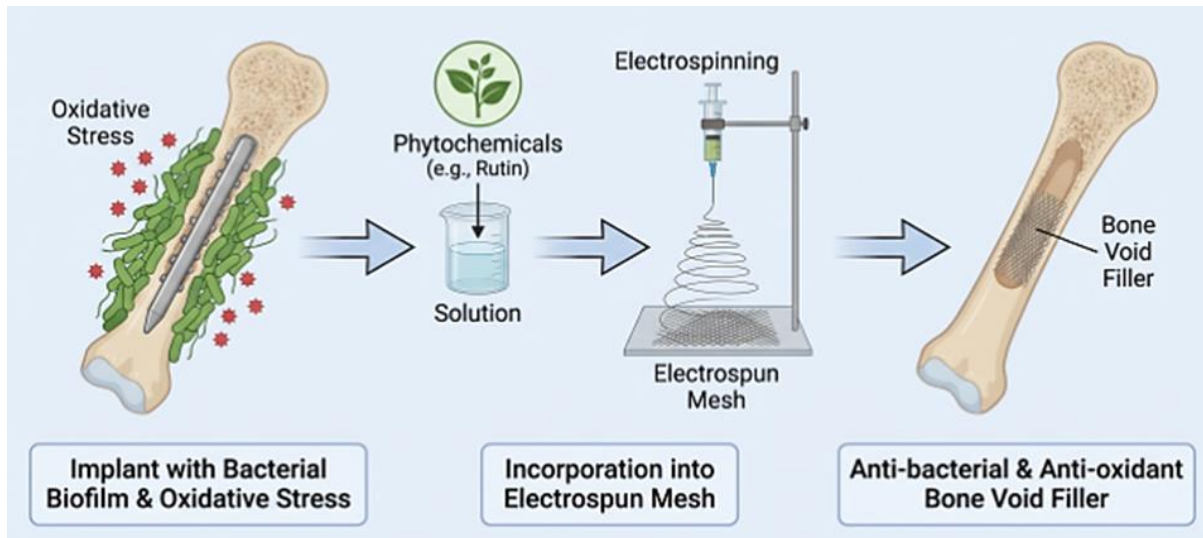


Phytochemical-Loaded Electrospun Meshes for Bone Repair

Project for a master student in biomedicine, start January 2027 or later in 2027



This 1-year project covers the fabrication of novel flexible bone void fillers, composed of the polymer poly lactic co glycolic acid (PLGA) and nanoparticles made of amorphous calcium phosphate (aCaP) with a phytochemical, thymol, that is known to have antibacterial and antioxidant properties. The fabrication method is emulsion electrospinning. The such produced fiber meshes will be analyzed by scanning electron microscopy (SEM), Fourier transformed infrared spectroscopy (FTIR) and water contact angles. Furthermore, bacterial adhesion will be tested. Additionally, the novel materials will be tested in the CAM assay with regards to tissue integration and angiogenic response. In vitro cell culture experiments with osteoblasts and adipose-derived stem cells will give insight into the cellular response towards these materials by their adherence behavior, proliferation and differential transcription. Also, the antioxidant capacity will be tested

Experimental steps

1. Emulsion electrospinning of bi-layered PLGA/PLGAaCaP thymol meshes with varying thymol concentrations to achieve at least a 10% release within 7 days (control pure PLGA meshes)
2. SEM analysis of fiber thickness and pore size of pure PLGA and of favorite thymol mesh
3. FTIR analysis
4. Water contact angle analysis: static and dynamic
5. Biofilm formation *Staphylococcus aureus* and *Staphylococcus epidermidis*
6. CAM assay: tissue integration, angiogenesis
7. In vitro cell cultures: human osteoblasts seeded on novel implant materials
8. In vitro cell cultures: human adipose-derived stem cells seeded on novel implant materials
For 7. and 8. Adherence (histology), Alamar Blue (proliferation), qPCR *ALP* gene expression, among others to be defined
9. Antioxidant capacity test with Trolox (TEAC test):

- a) Osteoblasts or human adipose-derived stem cells seeded on control PLGA or favorite bioactive thymol mesh will be cultivated without further oxidative stress.
- b) Osteoblasts or human adipose-derived stem cells seeded on control PLGA or favorite bioactive thymol mesh will be cultivated and ROS induction by 10 nM Dexamethasone (oxidative stress).

Supervision

Supervision of Master Thesis: Prof. Dr. Mutlu **Özcan** (Oral Biology)

Supervision by Plastic Surgery at USZ (PCH) members: Steps 1, 2, 3, 4, 6, 8, 9 above

Supervision by Department of Cranio-Maxillo-Facial and Oral Surgery at USZ (MKG) members: 5, 7

Literature

General

[Pro-angiogenic and antibacterial copper containing nanoparticles in PLGA/amorphous calcium phosphate bone nanocomposites - PubMed](#)

[Synergistic Effects of Insulin-like Growth Factor-1 and Platelet-Derived Growth Factor-BB in Tendon Healing - PubMed](#)

[Bioactive Biomaterials: Phenolic and Terpenic Compounds as Prospective Antibacterial and Antioxidant Additives for Electrospun Scaffolds](#)

Thymol specific literature

[Evaluation of the Antibacterial, Anti-Inflammatory, And Bone-Promoting Capacity of UiO-66 Loaded with Thymol or Carvacrol](#)

[Effect of thymol on Ca²⁺ homeostasis and viability in MG63 human osteosarcoma cells - PubMed](#)

[Thymol inhibits RANKL-induced osteoclastogenesis in RAW264.7 and BMM cells and LPS-induced bone loss in mice - PubMed](#)