Bioingegneria, biotecnologia e tecnologie per la salute
Bioengineering

DII research group
Chemical Bioengineering

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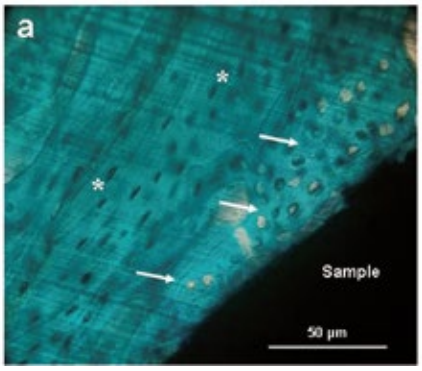
Main research topics:

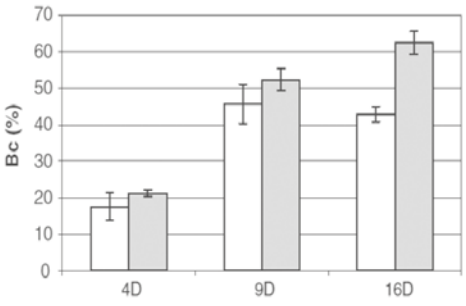
- Innovative biomaterials: synthesis of bioactive peptides and covalent functionalization of surfaces
- Synthesis of DNA mimetics for biosensors
- Matrixes of self-assembling peptides chemoselectively modified for regenerative medicine
- Biomechanical characterization of animal pericardium for prosthetic heart valves
- Functional assessment and classification of mechanical heart valve prostheses
- Analysis of skin perfusion by laser Doppler fluxy metry

Synthesis and exploitation of bioactive peptides for the production of endosseous devices

A wide range of biochemical signals promoting cell functions (adhesion, migration, proliferation, differentiation) and thereby improving osseointegration are currently investigated. Unfortunately, their application is often hampered by insolubility, instability, and the limited availability of large amounts of inexpensive, high-purity samples.
An attractive alternative is the use of short peptides carrying the minimum active sequence of the natural factors. Synthetic peptides mapped on fibronectin and vitronectin have been demonstrated to enhance cell adhesion to polystyrene, acellular bone matrix, glass, titanium oxide and electrospun polyester scaffolds; in particular, a nonapeptide sequence from the Human Vitronectin Precursor (HVP) operates via an osteoblast-specific adhesion mechanism. This mechanism involves interactions between cell membrane heparansulfate proteoglycan sand heparin binding sites on extracellular matrix proteins. After in vitro assays, the ability of the (351–359) HVP sequence to promote osteogenicactivity was assessed in vivo. The peptide was covalently bound to titanium implants, surgically inserted in the femurs of white New Zealand rabbits; then, it was measured how and how much its effects change with time across three bone regions surrounding implant surface.
The presence of the (351–359)HVP peptide improves the osteogenic activity immediately after implantation, thus accelerating bone ongrowth. This preliminary stimulus of the osteogenic activity might result in faster and better osteointegration. Advantages for clinical exploitation of the (351–359) HVP peptide are evident.



Goldner's trichrome stain evidences the formation of newly grown bone in direct contact with sample surface (original magnification), 16 days after surgery. Double asterisks indicate preexisting bone tissue; arrows, newly grown bone.



Bone-to-implant contact (Bc) is the ratio between the length of the bone profile in direct contact with the implant surface and the length of implant profile. It was measured 4, 9, and 16 days after surgery on the functionalized implant (grey bars) and on controls (white bars). It showed an increasing trend, significantly higher for the functionalized samples.