

Biomips Immunomodulating Scaffolds for tissue engineering (BIAS)

In tissue engineering, scaffolds have the central role of guiding and promoting cell proliferation and tissue organization. When placed in the biological environment, scaffolds trigger the inflammatory response from the host tissue, whose intensity strongly depends on the characteristics of the material they are made of, and that is functional to stimulate the tissue remodeling process, thus guiding a successful regeneration

In contrast, when the scaffold-mediated immunogenic activation is too high, it can undermine the regeneration process, with negative outcomes on healing, such as scar formation or tissue damage. The direction of inflammation evolution is regulated by monocyte cells that, in response to external biochemical signals, can differentiate into two macrophages lineages, characterized by opposite behaviors: either pro-inflammatory and tissue aggressive, or anti-inflammatory and tissue regenerative.

The techniques adopted to control tissue inflammation are typically based on the use of anti-inflammatory drugs, administered either systemically, or locally released. Both the approaches suffer from problems like over- or underdosing and side effects that can lead to therapy failure.

With the BIAS project we propose a complete change in the paradigm of immuno-instructive scaffolds, aiming at locally modulating the inflammatory response in the regenerative route, without the use of drugs.

The strategy is based on the convergence of the world of tissue engineering and scaffold design, with that of molecularly imprinted polymers (MIPs), a discipline that aims at realizing synthetic molecular traps, based on the stereochemical affinity of site-specific cavities stamped in a polymeric network, through a template assisted synthesis. The joint collaboration between the leaders of two units involved in BIAS project, proposed the innovative concept of using polymer from natural origin to synthesize the nanotraps (bioMIPs). The conjugation of state-of-art scaffold fabrication with bioMIPs will have key-role in the project. The use of scaffolds with ability to suppress the pro-inflammatory chemo-signals produced by the inflamed tissue will instruct macrophages towards the regenerative direction.

The BIAS project puts together the scientific knowledge of UNITN unit in natural biomaterials synthesis, scaffold fabrication and functionalization, and in tissue engineering, with that of UNIVR unit, expert in the molecular imprinting of polymers. The research plan is addressing four main scientific targets, starting from (i) bioMIPs design and synthesis, (ii) scaffold fabrication, (iii) decoration of scaffolds with bioMIPs, until arriving to the final (iv) biological validation to assess the immuno-instructive potential.

Activities required:

experimental

- Validation of bioMIPs' expiration time in the biological environment.
- Selection of biomaterials for scaffolds fabrication
- Fabrication of the instructive and non-instructive scaffolds
- Biological validation of the instructive and non-instructive
- Biological comparison: non instructive vs instructive

dissemination/reporting

- Writing of monthly scientific advancements reports
- Participation to international congresses
- Writing scientific publication on high impact factor journals
- Preparation of promotional posts on social media
- Participation in social events (E.g. Night of the researchers)
- Contribution to final workshop organization