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The impact of mechanical properties of biomaterials and scaffolds on inflammation and tissue organization

Lars M. Bjursten
Lund University, Sweden

The successful clinical outcome of the implantation of biomaterials and synthetic scaffolds is strongly dependent on their material properties, which holds especially true for approaches where the used material should trigger or assist the regeneration of missing tissue. Therefore, the design criteria of biomedical implants have become among the most discussed issues in biomaterials research.

Based on the mechanisms of interaction at the interface we have identified design parameters allowing the modification of the tissue response:

1. Mechanical stresses at the interfaceand surrounding tissuesmay be modified by
   a) changing the E-modulus of the material
   b) modifying the mesostructure of the implant surface
   c) making a slip or non-slip surface
2. Nitric oxide and oxygen radical generation at the interface
   a) catalytic breakdown of radicals
   b) generation of peroxy-compounds
3. Establishing tissue building cells at the interface
   a) presentation of ligands allowing binding of cells or extracellular matrix
   b) presentation of the proper inorganic chemistry for bone regeneration
4. Release of biologically active compounds

It appears that traditional in vitro cell studies only give limited guidance in how a specific material relates to the factors described above. However, a combination of selected and modified in vitro and implantation experiments may provide the required insight in how a biomaterial will interact with various tissues and the underlying mechanisms.

For an implanted actual device, the tissue response depends on additional factors related to the physical shape of the device as well as the state of the host tissue.

Lars_Magnus.Bjursten@med.lu.se