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Editorial

# Synergy of Material, Structure and Cell

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## Editorial

The contemporary materials provide not only the load-bearing capacity for various engineering structures, but also may serve as a support and living environment for living systems, like cells. This type of material is often called biomaterial. Biomaterial is defined as a substance that has been engineered to take a form which, alone or as part of a complex system, is used to direct, by control of interactions with components of living systems, the course of any therapeutic or diagnostic procedure.

Recently regenerative tissue engineering has gained much attention recently as a novel alternative to bone transplantation and implantation. Although transplantation and implantation both seem to solve the problem, namely large-scale bone injury or decay, they both fall short upon further investigations. In order to avoid the limitations of transplantation and implantation, more effort is being put into developing artificial scaffolds that carry cells that can trigger the body's responses to grow new tissues. This approach carries with it many advantages over both alternatives mentioned above. Since the scaffold could be seeded with cells directly from the donor, there is no chance of rejection and since the cells regenerate the tissue that was originally there, the repairs should integrate into the body. Growing cells on a scaffold prior to implantation offers also the ability to deliver therapeutics directly to the site of the injury. This therapeutics may have many indications, from anti-rejection properties to the ability to stimulate cellular growth through biochemical signaling and nutrient delivery.

A good example is a recent work [1] describing the effect of the material interaction with mesenchymal stem cells (MSCs). The MSCs are adult stem cells that can differentiate into various cells depending on the culture conditions and the applied stimuli. Unfortunately, these cells contribute little to the therapeutic effects, i.e. to promote vascularization in the wound area. However, the paracrine products of mesenchymal stem cells may exhibit multifaceted functions useful for a particular task, as vascularization in the wound area. When proteins synthesized by one cell can diffuse over small distances to induce changes in neighboring cells, the event is called a paracrine interaction, and the diffusible proteins are called paracrine factors.

It was found that interaction with the specific scaffolds would guide the cell behavior. The main task of the scaffold is to provide a place for cells to attach and grow [2]. The scaffold materials were fabricated from polycaprolactone with different alignment parameters in order to study the effect of fibers on ability of MSCs to produce pro-angiogenic and anti-inflammatory paracrine factors. The result demonstrated that the fibrous topography of scaffolds is a key material property that modulates the paracrine function of cells. The results of this study shine light on a new aspect of material functions. By creating innovating scaffolds, one may promote tissue repair through guiding the paracrine signaling network.

Another example of use of conventional materials as a medium for grows and creation of the biological structures is the use of the scaffolds fabricated by using a gas foaming/particulate leaching method [3]. It was reported that the pore size of three-dimensional macroporous scaffolds can regulate cell differentiation under static or dynamic conditions [4]. Pore size also directly influences the shear stress experienced by cells when scaffolds are maintained under continuous perfusion, thus regulating osteogenic differentiation of MSCs [5]. Therefore, selecting the appropriate pore size for constructs cultured in perfusion bioreactors is vital for the bone tissue engineering applications. The results of this study demonstrate that's caffolds can augment osteogenic differentiation of MSCs under perfusion thus allow for robust bone formation. Optimization of scaffold pores distribution and connectivity allows achieving the desired level of bone formation.

Only two examples are shown here, but the message is clear-the synergy of conventional or man-made materials with the stem cells technology opens new perspectives and ways for improving the healing of wounds, creation of new bones and many other life saving procedures that are and will improve the quality of life.

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