

# Term project literature essay

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This scaffold will represent the shape of the final tissue construction and later living cells will be added. The scaffold geometry should include porous structure where pores are large enough in diameter to allow cell ingrowths but also should be balanced and not causing decrease in strength. The mechanical properties of the porous scaffold are highly crucial in that sense.

In this literature review we will examine different approaches from different scientists. Tissue Engineering Scaffold geometry should represent the native tissue properly. For better presentation, the scaffold geometry should include porous structure where pores are a few hundred microns across and this size allows cell ingrowths. If the scaffold has a micro-porosity, the cells can insert fibrils so that they can attach firmly to the scaffold walls. Most of the approaches use fabricators to enhance reproduction of the cells. For example, a mixture of polycarbonate (PC) which is biodegradable and acts as a matrix materials used to manufacture a scaffold for producing a mixture of bone and cartilage and then implanted into a rabbit in one of the studies. Also, adding trim-calcium phosphate (TCP) improves the absorbability to enhance bone regeneration. But still it is difficult to maintain the integrity of the scaffold for a long time enough to form healthy and strong bone (Gibson, Rosen, & Stacker, 2010, p.

391). In William Buildings research also bone tissue has been chosen, since bone is a self-repairing tissue it provides a model for tissue engineering. Also it has a highly complex structural hierarchy and has the ability to adapt its structure. As its mechanical properties, it mostly depend on the level of porosity, from compact bone to spongy bone in dullard cavities. He claims that key feature for a porous scaffold is the interconnectivity which allows

cells to invade. To which we come to a conclusion that diameter of pores must be greater than 100 mm in diameter so that the cells can go through them.

Pore size is highly crucial both for ingress of cells, also to develop visualization. The maximum porosity possible would be the most suitable from a biological standpoint however increased pore diameter may cause decrease in strength So it should be balanced. After finishing the structure of the hydroxylation he had focused on making hydroxylation more vocative, for example to decrease the time for bone infilling of the scaffold. The benefit is for patient to resume load bearing as soon as possible, as a result to have a healthy psychological response.

However the cells do not have the strength to resist until the porosity of the scaffold is filled by cellular ingrowths. Producing psychometric hydroxylation, I. E.

With a calcium phosphate ratio of 1.7, produced a faster biological response than trillium phosphate or calcium oxide containing commercial hydrostatics's. (Bonfires, 2005) Heterogeneous porous Tissue Scaffolds Porous scaffold structures are used as a guiding sub-structure for tissue regeneration process. If scaffold structure enhances the cell growth by cell migration, proliferation, waste removal and such dynamic regulatory systems, the interaction between the cells and the scaffold can be considered as successful interaction. Pore size, porosity, bio-compatibility and fabrication technology are some examples of factors that affect the functionality of the scaffold design.

For example, nutrients and proteins are the basic needs of cells seeded on the scaffold, so fluid transport is very critical for cell survival. In traditional homogeneous scaffolds, the cells that are away from the boundary might have not access to the nutrients and oxygen because of limited nutrient flow. Therefore, the size, geometry, interconnectivity and surface chemistry are important parameters that affect the nature of necessary fluids' flow. Also, the size of the pores determines how much space the cells will have in later growth periods.

Since tissues do not have homogeneous properties, multi-scale porosity is needed for better presentation. In the studies, wide range of pore size of 50- $\mu\text{m}$  was found as acceptable but there is no agreement on the optimal pore size. Homogeneous scaffold structures may not represent the properties of the native tissues, so designing scaffolds with heterogeneous porosity may achieve the functionality of the native tissues. By heterogeneous porosity design, the channels that are feeding deepest regions of the scaffold by allowing (Placeholder 1 ) (Dry & Mooney, 2003)g proper nutrition flow and waste removal can be formed.

As for manufacturing process, the path planning is an important step to ensure that the designed layers can be made by continuous, interconnected and smooth material deposition path. The path plan should be designed in a way that the deviation between the design and the actual fabricated structure is minimized(Shod & Koch, 2013). Hydrogen as Scaffold Material  
The success which had been achieved is mostly as a result of finding an appropriate material to meet the critical physical, mass transport, and biological design variables inherent to each application. Hydrogen are an  
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appealing scaffold material because they are structurally similar to the extracellular matrix of many tissues and can often be processed under relatively mild conditions. Consequently, hydrogels have been utilized as scaffold materials for drug and growth factor delivery, engineering tissue replacements, and a variety of other applications. As hydrogels being used in scaffold designs, the mechanical property of the porous structure mostly stays the same but with little changes.

For example, scaffolds designed to encapsulate cells must be suitable for being gelled without damaging the cells to meet the physical requirements. Also shouldn't be toxic to the cells and the surrounding tissue which is considered for biological design. Since cell invasion is highly crucial, allowance to diffusion of nutrients is also important and must be considered which should be considered for mass transport.

So the variables in these three content, physical properties, biological design and mass transport are highly relevant to overall success. The hydrogels have many applications in medical scaffold design. They are applied as space filling agents, as delivery vehicles for bioactive molecules, and as three-dimensional structures that organize cells and present stimuli to direct the formation of a desired tissue. Space filling agents are and are used in a variety of applications, including bulking, adhesion prevention, and mostly as a biological "glue". Also, bioactive molecules are delivered from hydrogel scaffolds in a variety of applications including advancing of angiogenesis and prevention of secretory cells. Lastly they are applied to transplant cells and to engineer nearly every tissue in the body, such as cartilage, bone, and smooth muscle.