Tissue Engineering

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Scientists and engineers working in the growing field of tissue engineering are striving to create biological substitutes for living tissue. Ultimately, they want to urge the body into growing its own replacement parts. Recent advances in molecular biology and polymer science have made this type of research a reality. Regenerating or engineering new tissues and organs may one day allow routine replacement of lost or failing or aging tissues and organs.

One such technique of internal cellular growth involves an extracellular matrix. Collagens are the most commonly occurring proteins in the human body and play a central role in the formation of this extracellular matrix. Collagens are triple-helical structural proteins. It is this triple-helical structure that gives the collagens the strength and stability that are central to their physiological role in the structure and support of the tissues in the body. This extracellular matrix made of collagen is shaped and seeded with living cells and combined with rapid growth elements. When the cells multiply, they fill up the scaffold and grow into three-dimensional tissue, and once implanted in the body, the cells recreate their intended tissue functions. Blood vessels attach themselves to the new tissue, the scaffold dissolves, and the newly grown tissue eventually blends in with its surroundings.

Biomaterials are substances used in the creation of a medical device or other implanted therapeutic product. Collagen is frequently used as a biomaterial due to its ability to persist in the body long enough to carry out its specific role without developing a foreign body response that could lead to the premature rejection or overall failure of the biomaterial.

Biocompatibility is the degree to which a device avoids the foreign body response. Because of its strength and stability as well as its general compatibility with living tissues, collagen is widely held to be an ideal biomaterial. Many devices made of less biocompatible materials are routinely coated with collagen in an effort to make them more biocompatible.

Much of the current research in the field involves growing cells in three-dimensional structures instead of in laboratory dishes. Cells grown in a flat Petri dish tend to behave as individual cells. But cell cultures grown in a three-dimensional structure behave as they would in a tissue or organ. Tissue engineers are testing different methods of growing tissue and organ cells in three-dimensional scaffolds that dissolve once the cells reach a certain mass. The hope is that these cell cultures will mature into fully functional tissues and organs.

Celdyne is committed to improve the biological science of culturing 3-dimensional human tissues. The HFB™ is a rotating dome-shaped cell culture vessel with a centrally located sampling port and an internal rotating viscous spinner attached to a rotating base. It simultaneously produces a low-shear fluid culture environment and a variable hydrodynamic focusing force that can control the movement, location, and removal of suspended cells and tissues from the bioreactor.

Tissue disease and organ failure leads to an estimated 8 million surgical procedures annually in the United States. Transplantation and tissue reconstruction are among the most expensive therapies, costing billions of dollars a year. The availability of mass produced tissues and organs would mean a substantial savings, being less expensive than donor organs, and would allow physicians to begin treatment before patients are critically ill.

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http://www.whitaker.org/95_annual_report/tissue95.html
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