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Research Article

Nanofiber and stem cell to bone, cartilage and muscle tissue engineering

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Abstract: Tissue engineering technology and multi-disciplinary approach that involves the different sciences. Tissue engineering in the fields of biology, cell biochemistry, biomaterials, medical engineering, medical and pharmaceutical uses. The help of all of you can be a tissue engineering application is desired, until the tissue defect is repair or rebuild our own tissue to achieve optimal performance. To date, human artificial tissues such as skin, liver, bone, muscle, cartilage, tendons and blood vessels are made. One of the key challenges in the field of tissue engineering and synthesis of specific binding to cells and the development of methods for the production of natural and synthetic three-dimensional biodegradable polymer. In particular important issue in tissue engineering to create a good adhesion between cells and framework. Nano fiber produced through tissue engineering has been used as a framework.
Keywords: Tissue engineering, Nano fiber, bone, cartilage, muscle.

INTRODUCTION

The term was first coined by Dr. Fung, from California University, which suggested this name during the National Science Foundation Meeting, in 1987[1]. Alexei Karl with Lyndrbrg at the Institute of Studies in New York for the purpose of maintenance and replacement of new in vitro tests began in a living organism. After Carl and Lyndrbrg, a lot of work in this area until the skin was artificial, and was tested on a patient. The first official definition dates to 1988, though, when Skalak and Fox published it after the "Tissue engineering Meeting" held in Lake Tahoe, USA during that year [2].

Tissue engineering

In short, a porous material in tissue engineering scaffolds as extracellular matrix for cell growth or growth factors are produced and then placed on them. After growth of cells in the porous scaffold is transfer from the laboratory to the living organism. Scaffolding developed gradually into the blood vessels and cells feed. The soft tissues after the transfer, not necessarily new tissue scaffold must be destroyed to replace it, But for hard tissue can be used materials that are inevitable destruction. Over time, cells and by messages from the scaffold on which cells are stimulated, and eventually the tissue reconstruction5)

The main components of tissue engineering

- Polymer scaffold of biological materials (biomaterials) is suitable
- Cell
- Bioactive biologically active molecules such as growth factors that are effective signals for cell adhesion, cell differentiation and cell proliferation eventually be created.

Cellular sources

Sources of cells are divided into main categories: 1. animals. Cells that are obtained from animals (Xenograft) called. In this case we have the highest rejection because the cells that stimulate the immune system and the cells must constantly during use of immunosuppressive Immunosuppression be used. Another problem is that adopting an animal cell in the human body cannot be pleasant for most people. 2-Human Cells are taken from a person. This is better than before. But there is still the problem of transplant rejection and immune system stimulation 3-cell and genetic engineering. These cells have been created with the help of genetic engineering. It is the most widely used type. Using this method will create a specific function on a cell to tissue engineering process improve [3].

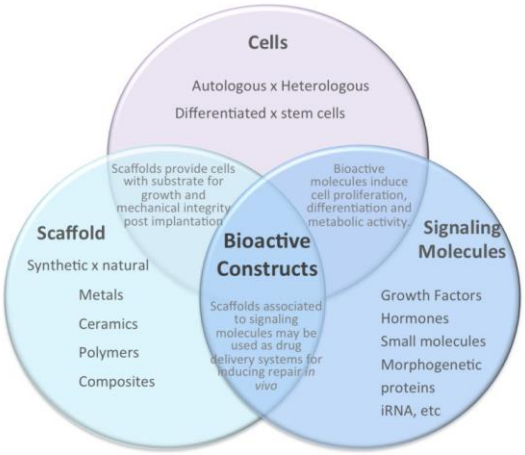

Fig-1: The main components of tissue engineering

Bone Tissue Engineering

The bones of the compounds are about 100 nm wide. If the surface of a prosthetic limb to natural bone reconnected it back to his body. For the production of artificial tissue in the bone are natural and the artificial surface. Osteoblasts are bone in connective tissue and bones, especially in the growing activity are significant. With the creation of nanosized particles in artificial joints and bones stimulates osteoblasts less likely due to the disposal of replaced. These particles are created by combining polymer materials; ceramic and metal was proved by scientists long ago [4].

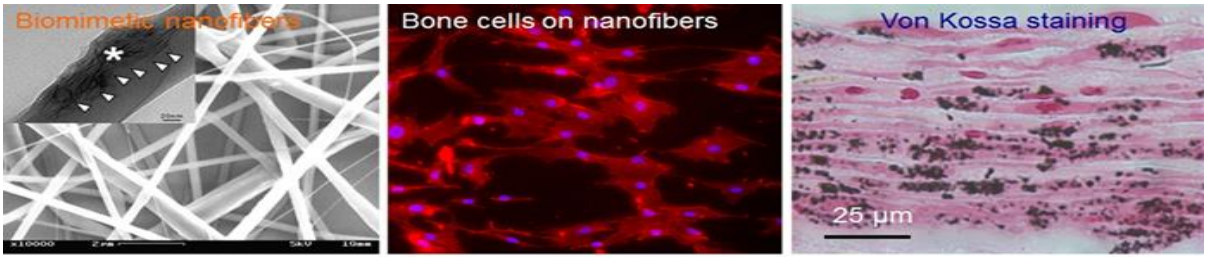

Fig-2:Left: electron microscopy image of biomimetic nanofibers containing hydroxyapatite (HAp) nanocrystals (arrow head and asterisk in inset). Middle: Fluorescent image of mouse bone cells cultured on nanofibres, in which cells were stained red with blue nuclei. Right: optical images of cultured cell/nanofiber constructs stained for mineralization.

Muscle Tissue Engineering

Natural materials like collagen and muscle tissue engineering scaffolds for tissue growth scaffold of nano fibers used. Satellite cell MyoD and M-cadherin and c-Met expressed in skeletal muscle and cause syndecan3. MSC mesenchymal stem cells can also be used in tissue engineering skeletal muscle. Telocyte tissue engineering skeletal muscle and heart muscle is used and c-kit expression and causing careline1. Insulin-like growth factor IGF-1 is used as the source of growth. Electrical stimulation of the nervous and muscular tissue engineering is still a challenge [5].

Cartilage Tissue Engineering

Cartilage tissues are compressed including tissue in the body that blood vessels. The proliferation of cartilage cells can be low. In this method, chondrocytes or mesenchymal stem cells MSC is of course chondrocytes can reproduce low and in cell culture consecutive phenotypic characteristics to lose and when samples from healthy tissue to damage the tissue there. Biologically active molecules for inducing stimulation of the chondrocytes in vitro MSC differentiation pathway of tumor growth factor TGF-β and examet has one is used [6].

Methods of nanofiber scaffold

The electrospinning process was first patented in the 1900s [7]. The principle of electro spinning is to use an electricfield to draw a polymer solution from an orifice to a collector, producing polymer fibers with diameters in the range of nanometers to micrometers [8]. A variety of synthetic and natural biomaterials, including poly (lactic-co-glycolic acid) (PLGA) poly (L-lactic acid) (PLLA), poly(caprolactone) (PCL), poly(ethylene oxide) (PEO), poly(vinylalcohol) (PVA), gelatin, collagen, silk protein and fibrinogen have been used to form nano- fibrous scaffolds for tissue engineering[9]. However, electro spinning typically is used to produce thin two-dimensional (2D) sheets. Also three-dimensional (3D) nano-fibrous scaffolds have been fabricated by layering these 2D sheets [10]. Initial attempts at combining electrospinning with 3D printing have yielded some success [11]. Molecular self-assembly is a useful approach for fabricating supra

molecular architectures [12]. Molecular self-assembly is mediated by non-covalent bonds such as hydrogen bonds, vander Waals interactions, electrostatic interactions, and hydrophobic interactions. Biomolecules, such as peptides and proteins, interact and self-organize to form well-defined architectures that are associated with functionality[13,14]. The fiber diameter created by molecular self-assembly usually is much smaller than those produced using electro spinning [15]. While molecular self-assembly is a fairly new technique it has limited ability to form macropores, which are important for cell accommodation and mass transport the mechanical properties of self - assembled scaffolds also have to be improved before they can be used in tissue engineering .A novel thermally induced phase separation (TIPS) technique was developed recently to fabricate nano-fibers to mimic natural collagen fibers [16]. The TIPS process for nanofiberformation typically includes five steps: polymer dissolution, phase separation and gelation, solvent extraction, freezing, and freeze-drying under vacuum .The fiber network formation depends on the solvent of the polymer solution and the gelation temperature .The fibers formed in this manner have diameters ranging from 50–500 nm, and have porosity in excess of 98% [17]. A distinct advantage of the TIPS technique is that it can be combined withother processing techniques (such as particulate leaching or 3D printing) to design complex3D structures with well-defined pore morphologies [18].

CONCLUSION

Nano-structure in tissue engineering is of increasing importance. By mimicking the ECM and including Nano-scale structural elements in tissue engineering scaffolds, cell response is affected at the cell-scaffold interface .Nano-fibrous scaffolds are a synthetic replica of the naturally occurring ECM which promotes cell distribution and have the potential to promote new tissue formation. Further work is underway to study the effect of these components on mechanical properties, biological effects and the mechanisms by which these properties are changed.

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