

The Use of 3D-printing Technology in Rhinoplasty: Change Horizons, Change Principles, Change Future



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Letter to Editor

Rhinoplasty surgery include reshaping, rearranging and sometimes reconstructing –due to trauma, malignancies and etc.-variety of tissues such as skin, cartilage and bone to reach ultimate goal of cosmetic surgery which is to provide aesthetic along with function similar to normal organ. Advantages of techniques and also biomaterials help clinician for reach to this goal. In contrast, there are still limitations, which may resolve through new advanced technologies [1,2].

For the first time Langer and Vacanti introduced the definition of tissue engineering [3], this approach explain the basics of functional substitutes for tissue damaging and how to reconstruct and regenerate theses tissue based on principles of biology and medical engineering. This new field in contrast to the former biomaterial thoughts, presents incredible disciplines which diverse the goal of regeneration induction of traumatized or damaged tissue rather than substitution with inert parts [4]. The architecture of normal extracellular matrices can be simulated at the nano scale level with use of scaffolds. This provides the primary base for the regeneration of new tissue [5]. Originally a “top-down” approach was used as a tissue engineering method for scaffold generation. In this method, cells are seeded onto a biodegradable and biocompatible scaffold, and are predicted to migrate and fill the scaffold hence creating their own matrix.

Methodology

Through years, three-dimensional (3D) printing has been used to produce variety of products for different applications.

Three-dimensional (3D) printing is a manufacturing method in which objects are made by fusing or depositing materials such as plastic, metal, ceramics, powders, liquids, or even living cells in layers to produce a 3D object. This technology describes a process by which a product derived from a computer-aided design (CAD) is built in a layer-by-layer fashion. After 1986, this process began to gain momentum and received appreciation worldwide and held importance in different fields, including the medical field. 3D printing is becoming a subject of great interest in surgery in the last decade.

Three-dimensional printing provides ability to generate scaffolds precisely with higher flexibility which depends on the type of materials used to make such scaffolds. Three-dimensional printing uses an additive manufacturing process where a structure is fabricated using a layer-by-layer process. Materials deposited for the formation of the scaffold may be cross-linked or polymerized through heat, ultraviolet light, or binder solutions. 3D printed scaffolds can be prepared, optimized and enhanced for tissue engineering with aid of this technology [6].

The 3D printing generated scaffolds are structures with controlled pore size and interconnectivity which is a critical factor to provide the ability of scaffold to support cell growth and tissue formation. For 3D printing there is a need to Computer Assisted Design (CAD). Designed model printed and then it depends to each 3D printing system to “print” the desired scaffold structure. Various researches aimed to use these 3D printed scaffolds to reconstruct tissues for rhinoplasty. The main goal of almost all of these

researches is to reach clinically significant results to regenerate nasal bone for dorsal augmentation [7].

Due to bio-mechanical limitations and difficulties in diffusion properties of these scaffolds, the “top-down” technique faces several challenges. To resolve, “bottom-up” methods have been developed including cell-encapsulation with micro scale hydro gels, cell aggregation by self-assembly, generation of cell sheets, and direct printing of cells. Various methods such as micro fluidics, magnetic fields [8], acoustic fields [9], and surface tension [10] introduced to assemble these complex tissue units.

Researchers created a few methods of printing with the goal of finding a solution to the given problems for optimal tissue bio-fabrication. Thermal Inkjet bio-printing with bio-ink, and direct-write bio-printing both make use of modified inkjet printers but with varied application techniques. Organ printing with tissue spheroids is the recent achievement of researches which seems promising to fabricate tissues directly.

Discussion

Organ printing offers a pathway to generate a scalable and reproducible of tissue-engineered products in large amounts. On the other hand, another advantage of the method is to allow the precise 3D positioning of several cell types, simultaneously. This causes ability to create tissues with a high level of cell density. This may be promising to avoid complications of various types of grafts for dorsal augmentation and to reach the ultimate goal of cosmetic procedure. Financial difficulties are the major limitation to develop a natural-like, fully functioning fabricated human tissue [11].

Conclusion

This challenge must definitely be overcome if bio-fabrication technology is to allow the creation of a functional living human organ. In the meantime, effective and positive interaction of the

integrated and well-established fundamentals of biology along with engineering concepts is the key to realize the true potential of this exciting area.

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