

# Stem Cell Based Tissue-Engineered Grafts for Articular Cartilage Defects- a Mini Review



Amit Kumar Singh and Krishna Pramanik\*

Center of Excellent in Tissue Engineering, Department of Biotechnology & Medical Engineering, National Institute of Technology, India

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\*Corresponding author: Krishna Pramanik, Center of Excellent in Tissue Engineering, Department of Biotechnology & Medical Engineering, National Institute of Technology, Rourkela, India, Tel: 91-0661-2462283(0); Email: mondalkp@gmail.com

## Mini Review

Millions of patient report hospital with joint and articular cartilage injuries that are usually occur in knee, wrist, and ankle joints. Among these, knee injury is the most critical and common one. People also suffer from knee arthritis which is caused by progressive cartilage tissue loss due to wear and tear [1]. Among the different joints affected by osteoarthritis, knee arthritis is the most critical that resists patients from doing everyday activities [2]. In osteoarthritis, the cartilage in the knee joint gradually wears away which further exposes the bony ends thereby affecting subchondral bone site of the knee and ultimately produces painful bone spurs [3]. Articular cartilage defects are difficult to heal due to their avascular nature and the repair process is only transient and imperfect, and tissue degeneration eventually occurs leading to the progressive deposition of subchondral bone [4,5]. Osteochondral lesion involving both articular cartilage surface and underlying subchondral bone, essentially forms fibrocartilage and loose its ability to protect subchondral bone degeneration [6]. All these events lead to severe pain, joint deformity, and retardation of joint mobility.

More than 51 million peoples had been reported to visit hospitals with some form of arthritis in USA only [7,8]. The currently used mosaicplasty, autologous chondrocytes transplantation and marrow stimulation techniques for the treatment of damaged cartilage and subchondral bone tissue often offer unsatisfactory outcome eventually lead to the continuing of pain [9,10]. The recently emerged tissue engineering technique has brought a new hope to the patients providing a suitable strategy for the regeneration and repairing of the damaged tissues through developing biologically functionalized scaffolds derived from biomaterials with appropriate properties mimicking body tissue [11-13]. However, it is quite obvious that TE, being new have numerous challenges starting with its development to actual application in human health care. The success of TE depends on various factors that often relate to patient's defect site, properties

of scaffold acts as a platform for cell career, cell types for neo tissue generation and level of interaction between scaffold and native body tissue [12,13]. The tissue-engineered scaffold developed from biodegradable and biocompatible polymers combined with bioactive ceramics are proven to be promising, however, the success of these techniques largely determined by the fabrication methods, cell source and signaling factors [14-17].

Though electrospinning has been evolved as the suitable fabrication technique [18] and being widely used so far, rapid prototyping technique, bioprinting in particular, is considered as the most appropriate which needs further development for its commercial availability with affordable cost [19]. Another important factor for the success of TE is to develop cartilage-bone interfaces that should be intact after implantation. Novel strategies suggest the fabrication of scaffolds with distinct layers of different biomaterials [20,21]. Stem cells, specifically mesenchymal stem cells possessing excellent chondrogenic and osteogenic differentiation capability are attractive cell source. Suitable cell signaling factors such as specific growth factors, mechanical and electrical stimulation and gas exchange are important to trigger and regulate cell differentiation and to improve mechanical property of the cartilage tissue after implantation [22].

The repair of osteochondral tissue defect involves much critical challenges as it is often associated with the risk of changes in cell phenotype and structural de-organization of the native tissue by the regeneration of neo-cartilage tissue [23-24]. It is, therefore, important to assure the ability of the scaffolds towards tissue integration through in vivo study using animal model with variation in defect thickness, angiogenesis, inflammatory effect and long-term stability to translate in-vitro data into clinically relevant approaches. To simulate in vitro tissue formation at optimal level, a suitable bioreactor system and its scale up are important. In this context, perfusion bioreactor is efficient that provides dynamic culture system resulting in the homogeneous cell distribution

throughout the scaffold and offers better nutrient exchange [25-27]. The preservation of the tissue engineered grafts on long-term perspective is important for commercialization of these products [28].

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