The Feasibility of Using Human Primary Chondrocytes Derived from Osteoarthritic Patients Overexpressed with *SOX9* Seeded on PLGA-Fibrin Hybrid Scaffolds for Cartilage Engineering

By Sukri, NM (Sukri, Norhamiza Mohamad) ; Sha'ban, M (Sha'ban, Munirah) ; Radzic, MAA (Radzic, Muhammad Aazamuddin Ahmad) ; Rahman, RA (Rahman, Rozlin Abdul) ; Zulkifly, AH (Zulkifly, Ahmad Hafiz)

Source MALAYSIAN JOURNAL OF FUNDAMENTAL AND APPLIED SCIENCES
Volume: 18 Issue: 3 Page: 304-323

Published MAY-JUN 2022

Indexed 2022-09-20

Document Type Article

Abstract This study aimed to find an optimal formulation to form 3D hyaline-like cartilage substitutes using the tissue engineering triads. The primary cells taken from osteoarthritic patients were overexpressed with transcriptional factor SRY (Sex Determining Region Y)-Box 9 (SOX9) using Lipofectamine 2000 (TM) through a non-viral transfection method. The transfected and non-transfected cells were seeded on poly(lactic-co-glycolic acid) (PLGA) based scaffolds with and without fibrin. The arrangement resulted in four experimental groups. The 3D 'cells-scaffolds'

tissue constructs were cultured for three weeks and implanted ectopically in nude mice for four weeks. The evaluations include macroscopic and microscopic study, gene expression analyses, and sulfated glycosaminoglycan (sGAG) assay, focusing on the cartilage properties. A biomechanical evaluation was performed only on post-implanted constructs. All in vitro, two- and four-week post-implanted constructs exhibited firm and smooth hyaline-like cartilage appearance. In vitro constructs showed sparse cells distribution with minimal cartilaginous tissue formation. However, a high density, lacunae-encapsulated chondrocytes embedded within the basophilic ground substances was observed in all post-implanted constructs. It is supported by positive-brownish precipitation immunolocalisation against collagen type II. Besides, molecular analysis showed that COL2A1 and other cartilaginous markers were also expressed. Increased sGAG content and compressive strain could be observed in vitro and in vivo. Although quantitatively, no significant statistical differences were found between the four groups, the qualitative results indicated that SOX9-overexpressed cells, PLGA, and fibrin combination guides hyaline-like cartilage formation better than other groups. Hence, the combination may be studied in a big animal model to develop its potential for future clinical application.

Keywords

Author Keywords: Articular cartilage; chondrocytes; osteoarthritis; SOX9; Overexpression; gene transfer; PLGA; fibrin; ectopic implantation model

Keywords Plus: MESENCHYMAL STEM-CELLS; ARTICULAR-CARTILAGE; GENE-TRANSFER; TISSUE; CHONDROGENESIS; EXPRESSION; GEL; MOSAICPLASTY; TRANSFECTION; LIMITATIONS

Addresses

[1] Int Islamic Univ Malaysia, Kulliyyah Allied Hlth Sci, Dept Biomed Sci, Jalan Sultan Haji Ahmad Shah, Kuantan 25200, Pahang, Malaysia

[2] Int Islamic Univ Malaysia, Kulliyyah Allied Hlth Sci, Phys Rehabil Sci, Jalan Sultan Haji Ahmad Shah, Kuantan 25200, Pahang, Malaysia

[3] Int Islamic Univ Malaysia, Kulliyyah Med, Dept Orthopaed Traumatol & Rehabil, Jalan Sultan Haji Ahmad Shah, Kuantan 25200, Pahang, Malaysia

Categories/ Classification

Research Areas: Science & Technology - Other Topics