3rd International Conference on
BIOMATERIALS, CELLULAR AND TISSUE ENGINEERING
June 19-20, 2019 | Dublin, Ireland

Mater Sci Nanotechnol 2019, Volume 3

INTERLACED SCAFFOLDS FOR TISSUE ENGINEERED HEART VALVES (TEHVS)

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Tissue engineers have achieved limited success so far in designing an ideal scaffold for aortic valve; scaffolds lack in mechanical compatibility, appropriate degradation rate, and microstructural similarity. This paper, therefore, has demonstrated a carbodiimide-based sequential crosslinking technique to prepare aortic valve extracellular matrix mimicking (ECM) hybrid scaffolds from collagen type I and hyaluronic acid (HA), the building blocks of heart valve ECM, with tailorable crosslinking densities. Swelling studies revealed that crosslinking densities of parent networks increased with increasing the concentration of the crosslinking agents whereas crosslinking densities of hybrid scaffolds averaged from those of parent collagen and HA networks. Hybrid scaffolds also offered a wide range of pore size (66 – 126 µm) which fulfilled the criteria for valvular tissue regeneration. Scanning electron micrographs (SEM) and images of Alcian blue – Periodic acid Schiff (PAS) stained samples suggested that our crosslinking technique yielded an ECM mimicking microstructure with interlaced bands of collagen and HA in the hybrid scaffolds. The mutually reinforcing networks of collagen and HA also resulted in increased bending moduli up to 1660 kPa which spanned the range of natural aortic valves. Cardio sphere-derived cells (CDCs) from rat hearts showed that crosslinking density affected the available cell attachment sites on the surface of the scaffold. Increased bending moduli of CDCs seeded scaffolds up to two folds (2 – 6 kPa) as compared to the non-seeded scaffolds (1 kPa) suggested that an increase in crosslinking density of the scaffolds could not only increase the in-vitro bending modulus but also prevented its disintegration in the cell culture medium.