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A Knitted/Non-Woven Composite Polycaprolactone Scaffold for Tissue Engineering of the Aortic Valve

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The use of mechanical or animal derived valves were replaced by tissue engineered (TE) heart valves (HV) due to their disadvantages such as thrombogenicity and poor durability. A tissue engineered valve, ideally mimics the function of a native valve by responding to growth and physiological forces. It is also believed to have a longer life span, close to that of a native valve. Knitting is a versatile technology, which offers a large spectrum of products and solutions that are of interest in heart valve (HV) tissue engineering (TE). One of the main advantages of knitting is its ability to construct complex geometries and structures by precisely assembling the yarn by forming interlocked loops to desired positions. Furthermore, the yarns can be knitted precisely to reproduce the anisotropic structure of native heart valve. The advantages of this industry has convinced scientists to employ knitting to construct a HV scaffold. Inherently the knitting yields strong but open structures that individually, cannot be used due to their permeability to the fluids. Several studies to seal the pores with hydrogels have shown poor results. Therefore, a new composite material, which is a combination of knitted structure with non-woven structure of the same polymer, namely bioresorbable polycaprolactone (PCL) has been developed and described in this study. The knitted layer provides the desired mechanical stability while nano-fibers of non-woven PCL seals the construct, and makes it functional. Moreover, both types of employed fibers (micro and nano) facilitate the oriented growth of cells in a longitudinal direction, and, consequently, enable the deposition of extra-cellular matrixes (ECM) proteins in an oriented manner. This technique, therefore, has a potential to provide a functional composite PCL-based scaffold. An additional task of this report is to describe example of interaction between tissue and textile engineers. To enable that interaction the textile engineers had to gain a basic understanding of structural and mechanical aspects of the heart valve and, tissue engineers needed to acquire the knowledge of tools and capacities that are essential in knitting technology.

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