Tissue Engineering Approaches using Synthetic Polyester Materials for Tendon and Ligament Scaffolds

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Abstract

Tendon and ligament injuries affect a large number of people and cost the U.S. billions of dollars a year. Current treatment options include biological grafts and artificial prostheses, but issues such as donor site morbidity and poor long term results have lead researchers to investigate tissue engineering approaches to regenerate native tendon and ligament tissue *in vivo.* Tissue engineering has been described as the use of a 3D scaffold, made of a biomaterial, with pre-seeded cells and/or bioactive factors to promote tendon or ligament tissue regeneration, naturally in the body. The most frequently investigated synthetic materials for the 3D scaffolds are polyesters, including polyglycolic acid (PGA), polylactic acid (PLA) and polylactic-co-glycolic acid (PLGA). Many studies have attempted to characterize the performance of these materials with promising results. This family of polymers has shown great potential as materials for tissue engineering scaffolds with PLA and PLGA being the most popular materials due to the slow degradation rate and sufficient cellular responses to these two materials.

1. Introduction

Tendon and ligament injuries effect a large population, especially the young and active [1-3]. It is estimated that 32 million people are treated for traumatic and repetitive loading (chronic) injuries to tendons or ligaments, which costs the U.S. approximately $30 billion a year [4]. Tendon and ligaments do have a limited ability to heal naturally and many chronic injuries can be repaired from rest and rehabilitation of the damaged area [1,2]. The natural healing ability of these tissues, however, is not ideal for acute or traumatic injuries and the pre-damaged biomechanical properties of the tissue cannot be fully achieve from natural healing due to the formation of scar tissue around the site [2].

Different surgical repair techniques are currently being used and investigated to improve the healing of damaged tendons and ligaments. These techniques include biological grafts (allograft/autograft), artificial prostheses and tissue engineering approaches [1,2,5]. Biological grafts are known to cause donor site morbidity, are in limited supply, can cause disease transmission and involve the risk of rejection at implant site [1,2,5]. Artificial prostheses have shown great short-term results, however, long term studies highlight the lack of tissue integration, poor abrasion resistance and fatigue failure of these devices [1,2,5,6].

Therefore, in recent years, tissue engineering approaches have gained popularity in the field of tendon and ligament repairs. Tissue engineering is described as the use of a 3D scaffold, made of a biomaterial, with pre-seeded cells and/or bioactive factors to promote tendon or ligament tissue regeneration, naturally in the body [1,2,5-7]. The three main materials being researched for scaffolds are polyesters, polysaccharides and collagen. This review will