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Chitosan Scaffolds for Bone Tissue Engineering

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Abstract

Biomaterials research for bone grafting and replacement has increased over the last five decades. Biomedical implants should have the following criteria: biocompatibility, osteoconductivity, high porosity and biomechanical compatibility. For this purpose, autografts and allografts are widely used for bone grafting. The limitations and concerns of autografts and allografts have created great interest in the development of synthetic materials as bone graft substitutes. Composite materials consisting of biodegradable polymeric compounds and bioactive ceramics, such as chitosan and Hydroxyapatite, are considered as suitable materials for the construction of scaffolds. Studies on chitosan have been intensifying over the past 25 years as biomaterials for tissue engineering. Chitosan is one of the best biomaterials in tissue engineering because it offers a distinct set of advantageous biological and physico-chemical properties that qualify them for a variety of tissue regeneration. Scientists used Chitosan as a scaffold in various kinds of organ such as bone cartilage, skin, nerve liver, and blood vessel. The cell–material interaction study indicated that osteocytes seeded on the chitosan scaffold and cultured without osteogenic factors appeared to attach. Chitosan scaffold can be prepared in acidic, basic, or neutral solution.

Keywords: Chitosan; Scaffolds; Bone tissue engineering; Biomaterials

Mini Review

Biomaterials research for bone grafting and replacement has increased over the last five decades. Today significant development has been made in tissue transplantation and surgical rehabilitation to treat the loss of bone tissue. Making a biological material for load bearing should be combined with natural bone [1]. Biomedical implants should have the following criteria: biocompatibility, osteoconductivity, high porosity and biomechanical compatibility. For this purpose, autografts and allografts are widely used for bone grafting. The limitations and concerns of autografts and allografts have created great interest in the development of synthetic materials as bone graft substitutes [2]. Few compounds are classified as biodegradable, osteoconductive and bioactive. Chitosan and Hydroxyapatite are one of the best biologic materials in bone tissue engineering that are well-known for being well-balanced with the human body. Natural polymer materials have become important as scaffolds in tissue engineering of bone [3]. Composite materials consisting of biodegradable polymeric compounds and bioactive ceramics, such as chitosan and Hydroxyapatite, are considered as suitable materials for the construction of scaffolds. These composites provide biological, mechanical, physical, and predictable destructive properties [4].

The history of chitosan dates to the nineteenth century, when Rouget discussed the deacetylated Chitosan form in 1859. Studies on chitosan have been intensifying over the past 25 years as biomaterials for tissue engineering [5]. Chitin, the main source of chitosan and one of the most abundant organic matters, is after cellulose, the second most commonly produced substance produced annually by biosynthesis. This is an important component of the exoskeleton in animals, especially in the skin of crustacean, molluscs and insects. This is also the main fibrillar polymer in the cell wall of the fungi [6]. Chitosan is a linear polysaccharide composed of glucosamine and N-acetylglucosamine, which is linked to the β-linked glycosylated 1-4 glycosamine content as the degree of dyslacidation (DD). Depending on the source, and its preparation, its molecular weight may range from 300 to more than 1000 kD with DD from 30% to 95% [7]. In its crystalline form, Chitosan is commonly found in aqueous solutions with a pH of more than 7 insoluble, but in dilute acids (PHb6.0), free groups of proteins on glucosamine facilitate the solubility of the molecule. In general, Chitosan has three types of reactive groups, an amino group, as well as primary and secondary hydroxyl it is in positions (C (2), C (3) and C (6). These groups allow Chitosan to alter the copolymerization of the bond for specific applications that can produce useful scaffolds for tissue engineering programs [8]. The chemical nature of Chitosan, in turn, provides many opportunities for quantum and juniper modifications that allow for extensive mechanical and biological properties [9].

Solubilization by protonation of the -NH2 function occurs at the C-2 position of repeat D-glucosamine, thus polysaccharide is converted into a polyelectrolyte in an acidic environment. Chitosan is the only polyethylene cadmium, and therefore has a lot of uses that are unique in its properties (flocculants for protein recovery, etc. [10]. Solubility in aqueous solutions has many applications, such as gel, film or fiber. The first step in extracting chitosan is the purification of the sample: dissolved in acid and filtered with porous membranes (with pore diameter up to 0.45 mm). Set pH to ca. 7.5 By adding NaOH or NH4OH, the polymer can be clothed and insoluble in neutral pH. The polymer is then washed with water and dried [11].

Chitosan is one of the best biomaterials in tissue engineering because it offers a distinct set of advantageous biological and physico-chemical properties that qualify them for a variety of tissue regeneration [12]. Scientists used Chitosan as a scaffold in various kinds of organ such as bone cartilage, skin, nerve liver, and blood vessel. The cell–material interaction study indicated that osteocytes seeded on the chitosan scaffold and cultured without osteogenic factors appeared to attach [13]. Chitosan scaffold can be prepared in acidic, basic, or neutral solution. There are many challenges like improving Chitosan poor mechanical property as an artificial substitute, effective delivery strategy of growth factors to chitosan-based scaffold, demonstrating biocompatibility as well as sterility that must be addressed in various implant applications [14].

References

1. Eser Elcin A, Elcin YM, Pappas GD (1998) Neural tissue engineering: adrenal chroman cell attachment and viability on chitosan sca!olds. Neurol Res 20(7): 648-654.
2. Elcin YM, Dixit V, Lewin K, Gitnick G (1999) Xenotransplantation of fetal porcine hepatocytes in rats using a tissue engineering approach. Artif Organs 23(2): 146-152.
3. Damour O, Gueugniaud PY, Berthin-Maghit M, Rousselle P, Berthod F, et al. (1994) A dermal substrate made of collagen- GAG- chitosan for deep burn coverage: rst clinical uses. Clin Mater 15(4): 273-276.
4. Kratz G, Back M, Arnander C, Larm O (1998) Immobilized heparin accelerates the healing of human wounds in vivo. Scand J Plast Reconstr Surg Hand Surg 32(4): 381-385.
5. Nishimura K, Nishimura S, Nishi N, Saiki I, Tokura S, et al. (1984) Immunological activity of chitin and its derivatives. Vaccine 2(1): 93-99.
6. Hamano T, Teramoto A, Iizuka E, Abe K (1998) Ejects of polyelectrolyte complex (PEC) on human periodontal ligament broblast (HPLF) function. II. Enhancement of HPLF di!erentiation and aggregation on PEC by L-ascorbic acid and dexamethasone. J Biomed Mater Res 41(2): 270-277.
7. Madihally SV, Matthew HW (1999) Porous chitosan sca!olds for tissue engineering. Biomaterials 20(12): 1133-1142.
8. Lu JX, Prudhommeaux F, Meunier A, Sedel L, Guillemin G (1999) Effects of chitosan on rat knee cartilages. Biomaterials 20(20): 1937-1944.
9. Mattioli-Belmonte M, Gigante A, Muzzarelli RA, Politano R, De Benedittis A, et al. (1999) N,Ndicarboxymethyl chitosan as delivery agent for bone morphogenetic protein in the repair of articular cartilage. Med Biol Eng Comput 37(1): 130-134.
10. Sechriest VF, Miao YJ, Westerhausen-Larson A, Niyibizi C, Matthew HW, et al. (1998) GAG-augmented polysaccharide hydrogel for chondrocyte culture. Annual Meeting, Biomed Eng Society.
11. Sechriest VF, Miao YJ, Niyibizi C, Westerhausen-Larson A, Matthew HW, et al. (2000) K. GAG-augmented polysaccharide hydrogel: a novel biocompatible and biodegrable material to support chondrogenesis. J Biomed Mater Res 49: 534-541.
12. Suh J-K, Sechriest VF, Miao YJ, Shuler FD, Manson TT, et al. (1998) Glycosaminoglycan- augmented polysaccharide hydrogel: a potential carrier for chondrocyte transplantation. Second Bi-annual Meeting of Tissue Engineering Society, Orlando, Finland.
13. Shakibaei M, De Souza P, Merker HJ (1997) Integrin expression and collagen type II implicated in maintenance of chondrocyte shape in monolayer culture: an immunomorphological study. Cell Biol Int 21(2): 115-125.
14. Vacanti CA, Langer R, Schloo B, Vacanti JP (1991) Synthetic polymers seeded with chondrocytes provide a template for new cartilage formation. Plastic Reconstr Surg 88(5): 753-759.

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