Available online at ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Joint Bone Spine 75 (2008) 672–674

JOINT BONE SPINE

Research lectures

Adipose-derived mesenchymal stem cells and biomaterials for cartilage tissue engineering

Christophe Merceron [a], Claire Vinatier [a,c], Johann Clouet [a], Sylvia Colliec-Jouault [b], Pierre Weiss [a], Jérôme Guicheux [a,*]

[a] *Inserm, U 791, Université de Nantes, Laboratoire d'ingénierie des tissus ostéoarticulaires et dentaires, équipe ''physiopathologie des tissus squelettiques et ingénierie du cartilage'', 1 place Alexis Ricordeau, 44042 Nantes cedex 1, France*

[b] *IFREMER, Laboratoire de Biotechnologie et Molécules Marines, BP 21105 - Rue de l'Ile d'Yeu, 44311 Nantes cedex 3, France*

[c] *Graftys SARL, Eiffel Park-Bat D, 415 rue C.N. Ledoux, 13854 Aix en Provence cedex 3, France*

Accepted 16 July 2008
Available online 5 November 2008

Keywords: Adipose tissue; Stem cells; Biomaterials; Cartilage; Tissue engineering

1. Introduction

Joint cartilage is a specialized connective tissue that contains a single cell type, the chondrocyte, and a highly hydrated extracellular matrix composed chiefly of collagens and glycosaminoglycans. There are no blood vessels or nerves. The composition and histological architecture of joint cartilage ensures the transmission and distribution of mechanical loads through the joint. Joint cartilage can be altered by injuries, inflammatory disease (e.g., rheumatoid arthritis), or degenerative disease (osteoarthritis). Because there is no vascular supply, and because chondrocytes cannot divide, joint cartilage has limited capacity for self-healing, so that destructive lesions are irreversible. For many years, researchers have sought means of regenerating functional joint cartilage. Numerous approaches have been developed to promote cartilage repair, and interest in biomaterials and cell therapy is growing among clinicians [1]. An appropriate matrix can be used in combination with growth factors to create an optimal environment for cells selected for their cartilage-repair potential [2].

* Corresponding author. Tel.: +33 240 412 919; Fax: +33 240 083 712.
E-mail address: jerome.guicheux@nantes.inserm.fr (J. Guicheux).

2. Biomaterials for engineering cartilage

Tissue engineering (Fig. 1) involves seeding a biocompatible biomaterial with appropriate cells. The biomaterial can be loaded with signaling molecules that promote cell differentiation and maturation into the desired tissue. Two tissue-engineering approaches have been developed. One consists in generating functional tissue *in vitro* then implanting the construct into the joint. In the other approach, the construct is cultured briefly, implanted when still immature, and allowed to mature in vivo within its intended environment.

Many biomaterials have been tested *in vitro* and *in vivo* during preclinical and clinical studies. Biomaterials can be categorized based on their composition (proteins, polysaccharides, or artificial polymers), or on their form (massive solid, porous solid, foam, viscous fluid, or hydrogel) [3] (Table 1). The ideal biomaterial is biocompatible, that is, induces no inflammatory or immunological reactions that might compromise the host tissue. It should constitute a three-dimensional environment that promotes cell adhesion, division, and differentiation [4]. The biomaterial should be porous to permit migration of cells and diffusion of signaling molecules and nutrients. Growth factors can be loaded on the biomaterial for release after implantation. Other desired characteristics of biomaterials include adhesion to the host tissue, an appropriate degree of mechanical strength, and sufficient mechanical cohesion to prevent leakage or extrusion