hydrolysis. The materials that have these properties must be included while designing any biodegradable hydrogel. At the same time one should consider while choosing monomer/polymer that the nature of degraded products should not be toxic. The preferred degraded products must show the properties of natural occurring products in the body such as lactic acid, colic acid, succinic acid and glucose. The main advantage of biodegradation is to release encapsulated drugs, growth factors and cells in a controlled manner from hydrogel, which helps the tissue regeneration. Based on nature of application one can tailor the degradation rate of the hydrogel by choosing appropriate polymers.

Hydrogel Applications

Cartilage

Cartilage is an important structural component of the body. It is a firm tissue but is softer and much more flexible than bone. Cartilage is made up of specialized cells called chondrocytes. These cells produce large amounts of ECM composed of collagen fibers, proteoglycan and elastin fibers. As cartilage does not have any blood vessels to supply nutrients to cells, they grow very slowly compare to other tissues. So it vital to design any biomaterial for cartilage repair should mimic ECM. Since hydrogels resemble aqueous rich environment of a cartilage tissue, they are considered suitable for cartilage tissue engineering.

Various hydrogels have been developed for cartilage repair. Natural polymers like alginate and fibrin hydrogels have been used to encapsulate cells for cartilage regeneration (Cao et al. 1998; Sims et al. 1998). Collagen gels, encapsulated with chondrocytes showed glycosaminoglycan content along with higher expression of Type II collagen and aggrecan (Taguchi et al. 2005). Chitosan based hydrogels were used to encapsulate chondrocytes. Chitosan-hydroxyapatite based hydrogel, formed by Schiff-base reaction encapsulated with bovine articular chondrocytes showed good cell attachment and proliferation as well as good mechanical stability (Hong et al. 2007). Park et al. developed hydrogel from methacrylated glycol chitosan (MeGC) and HA (Park et al. 2013). Injectable hydrogel was prepared from gelatin-hydroxy phenylpropionic acid (Gtn-HPA) conjugate, in which the HPA was enzymatically crosslinked using hydrogen peroxide and HRP. Chondrocytes encapsulated in Gtn-HPA hydrogels with medium stiffness (G' = 1000 Pa) showed higher levels of sGAG (Sulfated Glycosaminoglycan) production, higher collagen I & II gene expression, better ectopic cartilage formation and better integration with the surrounding cartilage *in vivo* (Wang et al. 2014). Photo-polymerized PEG based hydrogels encapsulated with chondrocytes (Elisseeff et al. 2000) and bone marrow-derived MSCs (Williams et al. 2003) were developed injected subcutaneously and photo-polymerized trans dermally in animal models. These gels showed good dynamic stiffness and equilibrium moduli, which increased with time. Histological studies showed tissue structure similar to the native neocartilage. Numerous other PEG based hydrogels were developed that showed good cartilage regeneration potential (Bryant et al. 2001; Fisher et al. 2004; Buxton et al. 2007).