

Hydrogels for Bone Regeneration

An Overview

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Introduction

Bone is a unique type of connective tissue, which is both strong and light. In order for its supportive and protective function, bone acts as a reservoir for inorganic ions; it plays an important role in the homeostasis of calcium in the body. The extracellular matrix (ECM) of this tissue comprises of a non-mineralized phase (osteoid), containing type I collagen and glycosaminoglycans (GAGs), and a mineralized phase, comprising calcium phosphate salts (Marks Jr. and Odgren 2002). During embryonic development, bone formation is achieved via direct or indirect ossification. Flat bones of the skull, e.g., the mandible, maxilla, and clavicles are formed via intramembranous ossification, during which mesenchymal stem cells (MSCs) differentiate directly into osteogenic cells function (Marks Jr. and Odgren 2002; Wozney 2002). In contrast, long bones and other load-bearing bones form via endochondral ossification, during which MSCs first differentiate into cartilage that is subsequently replaced by weak woven bone with randomly organised collagen fibres. Woven bone is gradually replaced by mature and rigid lamellar bone, consisting of highly organised concentric layers of inorganic and organic ECM (Marks Jr. and Odgren 2002).

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