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Transforming Growth Factor Beta (TGF- β): Natural Curing Agents for Repair

There are various techniques to enhance tissue regeneration via the application of growth factors to the site of regeneration to induce cells to proliferate, differentiate and regenerate. Generally, direct application of growth factors has little effect [1] because the growth factor diffuses out from the site of regeneration very quickly. This is a problem that can be solved by a controlled release of growth factor at the site of action over a long period of time by use of a bioabsorbable scaffold. Growth factors are protein based molecules in the body which are produced by cells and attach to the cell surface. Growth factors bind to membrane receptors, which in turn activate an intracellular signalling pathway. This will activate or inhibit a gene causing either an up regulation or down regulation of a gene product, which then alters the cells behaviour.

The Transforming Growth Factor Beta (TGF- β) super family include different proteins such as BMPs, nodals, activins, TGF- β and inhibins [2]. TGF- β is a cytokine produced by different cell types inside the body and exists in three isomers TGF- β 1, 2 and 3 [3]. These isomers can act as either paracrine or endocrine hormones and are structurally similar and encoded by three distinct genes in mammalian species [4]. All three isoforms have been found [5] to have overlapping functions *in vivo* with different biological activities *in vitro*. TGF- β 1 is more potent throughout adult development, whereas TGF- β 3 is more potent in tissues with mesenchymal origin. The three isoforms signal through the same kinase receptor with different binding abilities [6-8]. The TGF- β family of cytokines regulate cell functions such as migration, apoptosis, proliferation and differentiation [9]. It is important to know where the target cells are located as TGF- β can have different effects in different cell environments. For example, in skin cells when fibroblasts are grown in a monolayer in the presence of epidermal growth factor, TGF- β 1 causes a decrease in proliferation. In comparison, when these cells are grown in a semi-solid medium, TGF- β 1 induces growth [10]. TGF- β is also associated with the scarless healing of skin [1] and it plays a role in the repair of other tissues including cartilage and bone [11-13]. This cytokine influences number of other cell activities such as differentiating, stimulating mesenchymal stem cell (MSC) growth, acting as a chemotactic factor and also enhances ECM production, secretion and bone regeneration [14].

There is evidence that the TGF- β have significant effects on bone structure by regulating the replication and differentiation of chondrocytes, osteoblasts and osteoclasts [15]. Application of TGF- β promoted bone healing in skull defects and tibia1 fractures [16] and continuous infusion of TGF- β increased bone formation and fracture healing [17], suggesting TGF- β as a potential therapeutic agent for fracture repair. However, previous studies have shown [1,17] that there is limited research regarding the use of TGF- β isomers in bone cells in terms of fracture repair and healing compared to other cell types such as keratinocytes

Editorial

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Farshid Sefat*

Department of Chemistry, Chemical Biology and Biomedical Engineering, Stevens Institute of Technology, USA

*Corresponding author: Farshid Sefat, Tissue Engineering Group, Department of Chemistry, Chemical Biology and Biomedical Engineering, Stevens Institute of Technology, Hoboken, New Jersey, USA, Tel: 2017023337; E-mail: farshid.sefat@gmail.com

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[18-20], and also compared to other growth factors such as BMP [21], platelets-derived growth factor (PDGF), insulin-like growth factor (IGF) [22] and fibroblast growth factors (FGF) [23]. Therefore, there is a huge potential to carry out further research on the effect of different TGF- β isomers as a natural curing agent on bone repair and its related mechanism.

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