HYBRID BIOMATERIALS COMPOSED OF CHITOSAN AND BLOOD IMPROVE CARTILAGE REPAIR IN ANIMAL MODELS

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Chitosan can be solubilised in near-neutral glycerol phosphate (GP) buffered solutions [1] and combined with freshly drawn whole blood from animals or people to form a chitosan-GP/blood hybrid biomaterial. These chitosan-GP/blood mixtures are viscous solutions that adhere to tissue surfaces such as cartilage and bone and solidify within the time frame of blood coagulation (~10 minutes) to form a chitosan-reinforced blood clot. This hybrid biomaterial has been tested in both large (sheep) and small (rabbit) animal models for its ability to stimulate cartilage repair when combined with surgical methods of bone marrow stimulation. In bone marrow stimulation, orthopaedic surgeons debride the cartilage lesion to subchondral bone and then pierce the subchondral bone with a pick (microfracture) or by drilling to induce bone bleeding and wound repair. These methods by themselves give rise to insufficient amounts of fibrocartilage rather than effectively producing hyaline cartilage repair. Our experiments in animal models [2,3,4] revealed that chitosan-GP/blood implanted in surgical defects carrying microfracture or microdrill holes produced more hyaline repair tissue in both sheep and rabbits. The improved cartilage repair was associated with greater host cell recruitment to the cartilage lesion, as well as higher levels of subchondral re-vascularisation, bone remodelling and bone repair. The chitosan-GP/blood hybrid biomaterial thus appears not only to stabilise the clot within the cartilage lesion but to also contribute to improved cartilage repair by augmenting natural mechanisms of wound repair in osteochondral locations. These promising results have led to the initiation of a randomized clinical trial for cartilage repair applying these biomaterials to repair cartilage lesions in the knee.

References

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