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Agarose entrapped gold nanoparticles for the crosslinking of collagen: A comparison study

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As one of the most common proteins found in the human body, collagen is generally regarded as biocompatible and has well-defined properties that make it ideal for biomedical applications. However, for purified forms of collagen, the overall biomechanical and biodegradation properties are inadequate for many of these applications. Efforts to strengthen the matrix and control biodegradation have traditionally focused on increasing the number of crosslinks formed between collagen molecules using both physical and chemical techniques. In addition to these techniques, glycosaminoglycans such as chondroitin sulfate are often added to collagen matrices to improve the flexibility and handling characteristics of the material, as well as to positively influence cellular adhesion and proliferation. Many of these techniques have been researched extensively; however, there is a lack of significant research in the area of nanomaterials and their potential to crosslink collagen. The purpose of these experiments was to determine if agarose-entrapped gold nanoparticles (AuNPs) could be utilized to crosslink collagen. Several formulations were prepared using different volumetric ratios of AuNPs to collagen, as well as duplicate formulations which also contained chondroitin sulfate. All collagen gels were allowed to crosslink at 37 ºC overnight and then fixed in paraformaldehyde and critical point dried in preparation for scanning electron microscopy. The resulting micrographs exhibited collagen matrices with a variety of structures and porosities. The matrices ranged from structures with large pores and AuNPs scattered along the collagen fibers to nearly solid sheets with clusters of AuNPs. Overall, the results supported the hypothesis that agarose entrapped AuNPs could be utilized to crosslink collagen. Future studies will focus on thorough characterization of the matrices to determine the optimal ratio of AuNPs to collagen.