Biocompatible Gold Nanorod-Embedded, Crosslinked Collagen Composites for Surgical Applications: Synthesis and Characterization

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Commercial sutures have shortcomings such as foreign particles harming the body and being unadaptable to surgery of sensitive tissue. A novel suture material that may eliminate these shortcomings is a synthetic biocompatible composite of gold nanorod-embedded, crosslinked collagen. Through a process known as laser tissue welding (LTW), incised tissue becomes welded together due to the ability of gold nanorods (GNRs) to absorb and convert light energy to heat, facilitating the bonding of tissue. The collagen mimics the extracellular matrix to provide biocompatibility. Surgeries could be safer and more efficient, benefiting both the patient and surgeon. Specifically, this study focused on the synthesis and characterization of GNR-embedded crosslinked collagen sutures. Collagen solutions were embedded with GNRs and crosslinked with either glycerol diglycidyl ether (GDE), butanediol diglycidyl ether (BDE), or poly (ethylene glycol) diglycidyl ether (PEGDE). The crosslinking of collagen was expected to improve the durability of sutures. Uncrosslinked collagen with embedded GNRs was used as a control. Sutures made from these composites were tested for their durability. The three crosslinkers improved the suture durability, with GDE-crosslinked collagen sutures being the most durable. The durability of the synthesized sutures was lower than polydioxanone (PDS) and polyglycolic acid (PGA) commercial sutures. Nevertheless, the biocompatibility and LTW capability could provide distinct advantages over commercial sutures particularly in surgeries of sensitive tissues. GNR-embedded, GDE-crosslinked collagen sutures appear to be the most promising candidate for future research owing to their higher durability.

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