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Commentary

Knee Meniscus Functional Repair based on Porous Poly

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COMMENTARY

The meniscus fibrocartilage plays a vital function in knee joint biomechanics in terms of load transfer, stress absorption, and general proprioception. The menisci predominantly transfer stresses between the femoral and tibial joint surfaces by creating circumferential (hoop) strains. Compressive load dissipation is also aided by the viscoelastic nature of meniscal fibrocartilage: energy is absorbed by compression of meniscal collagen fibres and ejection of joint fluid through the tissue's highly organised structure. Meniscal injuries are prevalent, and because suturing is sometimes impossible, partial or whole meniscectomy is used to treat them. One method to avoid these problems is to restore meniscal function with a biostable substitute that mimics the biomechanical properties of the meniscus. Allografts for total meniscal replacement are an alternative, however they have limitations in terms of clinical availability, size tenability, and cost. As a result, a synthetic implant with long-term durability, clinical processability, and configurable biomechanical properties that are close to the natural meniscus could be a viable choice. A hydrogel-based product can be used to imitate the high water content of native fibrocartilage. Furthermore, submillimeter-scale porosity and tunable viscoelasticity might be added to the hydrogel's bulk to imitate fluid exudation and pressurisation in natural tissue, as well as the meniscus' load dissipation capabilities.

Porosity would help the implant integrate with the surrounding tissue by facilitating cell migration and mechanical anchoring. According to the literature, we employed Poly (Vinyl Alcohol)(PVA) to make a meniscal implant. PVA is a biocompatible polymer with long-term stability that has been used in a range of biomedical applications, including as a meniscal implant. In a rabbit meniscectomy model, a PVA hydrogel meniscus prosthesis was demonstrated to improve histology scores in vivo. PVA hydrogels were used in sheep, however they failed terribly because to the hydrogels' inability to withstand the tensile hoop stresses that the meniscus is subjected to. As a result, others have sought particle- or fiber-reinforced hydrogels. However, such solutions may suffer from the usual drawbacks of composite materials, such as inhomogeneous mechanical and biological reactions and more complicated processing, especially when making a porous matrix, as in this case.

The purpose of this work was to design, develop, and evaluate a porous PVA hydrogel-based meniscal repair implant that may be used instead of allografts during surgery. PVA hydrogel is a promising material for biomedical applications because of its tissue-like mechanical behaviour and biocompatibility. It has the potential to replace rigid prosthetic components and operate as a synthetic meniscal cartilage-like structure.

The viscoelasticity of PVA hydrogels is comparable to that of native biological tissue. The porous structure is able to exudate the internal aqueous fluid phase with a defined period after a compressive action. -dependency as a function of stress-relaxation behaviour reveals that the porous structure can expel the internal aqueous fluid phase at a specified period. The porous structure's ability to exudate the interior aqueous fluid phase with porosity is confirmed by its -dependency as a function of its stress-relaxation behaviour (relative).

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